Making a difference...together

Capital Regional District
Core Area
Liquid Waste Management Plan

Management of Inflow & Infiltration
Biennial Report

for 2007 and 2008

To Ministry of Environment

Prepared by:
Engineering Design Services
Environmental Services

June 2009

Capital Regional District
Core Area Liquid Waste Management Plan

Management of Inflow and Infiltration – Biennial Report

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EXECUTIVE SUMMARY
MANAGEMENT OF INFLOW AND INFILTRATION – BIENNIAL REPORT FOR 2007 AND 2008

In 2001, as part of Chapter 8 of its Core Area Liquid Waste Management Plan (LWMP), the Capital Regional District (CRD) embarked on an enhanced program to investigate, quantify and identify ways of reducing inflow and infiltration (I&I) in the region's sanitary sewer system. The goal of the program is to reduce inflow and infiltration to levels that minimize total conveyance, treatment and disposal system costs, coincident with reduction of I&I induced overflows to acceptable levels.

Good progress has been made in 2007 and 2008, with the following noteworthy accomplishments:

1. Overflows have been targeted through a variety of regional/municipal upgrades and initiatives including:

    - Pilot rehabilitation programs and municipal sewer upgrades.
    - Pump station upgrades.
    - Sewer inspection programs including video inspection, smoke, dye and joint testing.
    - Retaining consultants to advise and/or prepare municipal I&I management plans.
    - Commissioning of the Trent pump station and forcemain which were built to reduce overflows into Bowker Creek.

2. A Sanitary Sewer Overflow Management Plan for the Core Area was submitted to the Province in 2008. Among other things, the plan includes overflow action plan tables for the CRD and for each of the Core Area municipalities. Each table includes a list of overflow locations, documented overflows, notes on the receiving environments, and short and/or longterm action plans.

3. Results from the October 2006 to March 2008 flow monitoring period were documented in Flow Monitoring Analyses report. These results, along with the results from previous monitoring seasons, are used to establish preliminary I&I rates for catchments. The rates can be tracked over time to determine if I&I is getting better or worse. The rates are also used to help prioritize the spending of funds for I&I reduction.

4. Flow monitoring data was generated and analyzed, for the first time, from 40 permanent facilities, such as pump stations. Efforts are being made to increase the number of permanent facilities that provide data suitable for I&I analysis.

5. Sewer rehabilitation projects have been initiated or completed for a number of sewer catchments with the goals of reducing I&I and providing valuable cost-benefit information.

6. A discussion paper was prepared comparing the global costs of reducing I&I versus the benefit of reduced conveyance and sewage treatment costs.

7. Options for addressing private property I&I were researched and the information was consolidated. Plans are underway to review the options in a workshop setting with municipal engineers, in 2009.

This third "biennial" report fulfills the Minister's requirement to provide a report every two years that provides details of the measures taken in the preceding two years to reduce I&I. Considerable progress has been made in gathering, processing and analyzing a wealth of information to create the framework for the overall I&I program and to further develop I&I implementation plans.

1.0 INTRODUCTION AND OVERVIEW

1.1 Background

The Ministry of Environment (MOE), formerly the Ministry of Water, Land and Air Protection, approved the Capital Regional District's (CRD) Core Area Liquid Waste Management Plan (LWMP) on March 26, 2003. The LWMP outlines the plans of the CRD, and its municipal partners, for the management of liquid wastes from communities within the plan area for the next 25 years. The LWMP area is shown on Figure 1.1 and includes the municipalities of Colwood, Esquimalt, Langford, Oak Bay, Saanich, Victoria and View Royal. This area is serviced by two major regional trunk sewer systems, including twelve pumping stations that convey wastewater to the Clover Point and Macaulay Point pump stations; there the sewage is screened to remove solids, plastic and floatable materials larger than 6 mm, prior to discharge to deep sea outfalls.

Chapter 8 of the LWMP outlines goals, commitments and strategies for the management of inflow and infiltration (I&I). In simple terms, I&I occurs when rain and/or groundwater enters a sanitary sewer system instead of a storm sewer or drainage system. A certain amount of I&I is unavoidable, and is accounted for in routine sewer design. However, when I&I exceeds typical design allowances it robs capacity from actual wastewater flows, resulting in overflows and increased conveyance costs.

The CRD and municipalities began working together in the mid-1990's to assess technical issues surrounding I&I identification and to discuss various strategies to control or reduce I&I. In mid-2001, the CRD enhanced its I&I program to accelerate the identification of priority areas and projects. This included expanded flow monitoring, development of sewer models and further investigation of ways to reduce I&I.

This report provides a summary of the efforts and the progress completed over the last two years.

1.2 Regulatory Requirements

In addition to the Chapter 8 I&I commitments, the minister's approval letter outlined an additional requirement, as follows:

"The commitment to a four-year program to accelerate the identification of priority areas and projects is acknowledged and supported. In the absence of a specific schedule for the implementation plans, the CRD shall provide the manager with a report every two years that provides details of the measures taken in the preceding two years to reduce inflow and infiltration."

The first "biennial" report was submitted in April 2005, two years after the approval of the LWMP. This is the third biennial report to be submitted to the Ministry.

1.3 Goals and Commitments

The primary goal of the program is to reduce I&I to an optimum cost-benefit level. It is very expensive to size conveyance and wet weather facilities to accommodate vast amounts of I&I, but it can be equally or more expensive to rehabilitate or replace sewers to reduce I&I. Therefore, the optimal I&I level is the most cost-effective combination of I&I reduction and I&I accommodation.

Coincident with the goal of reducing I&I is the requirement to reduce overflows, as stipulated in the Municipal Sewage Regulation.

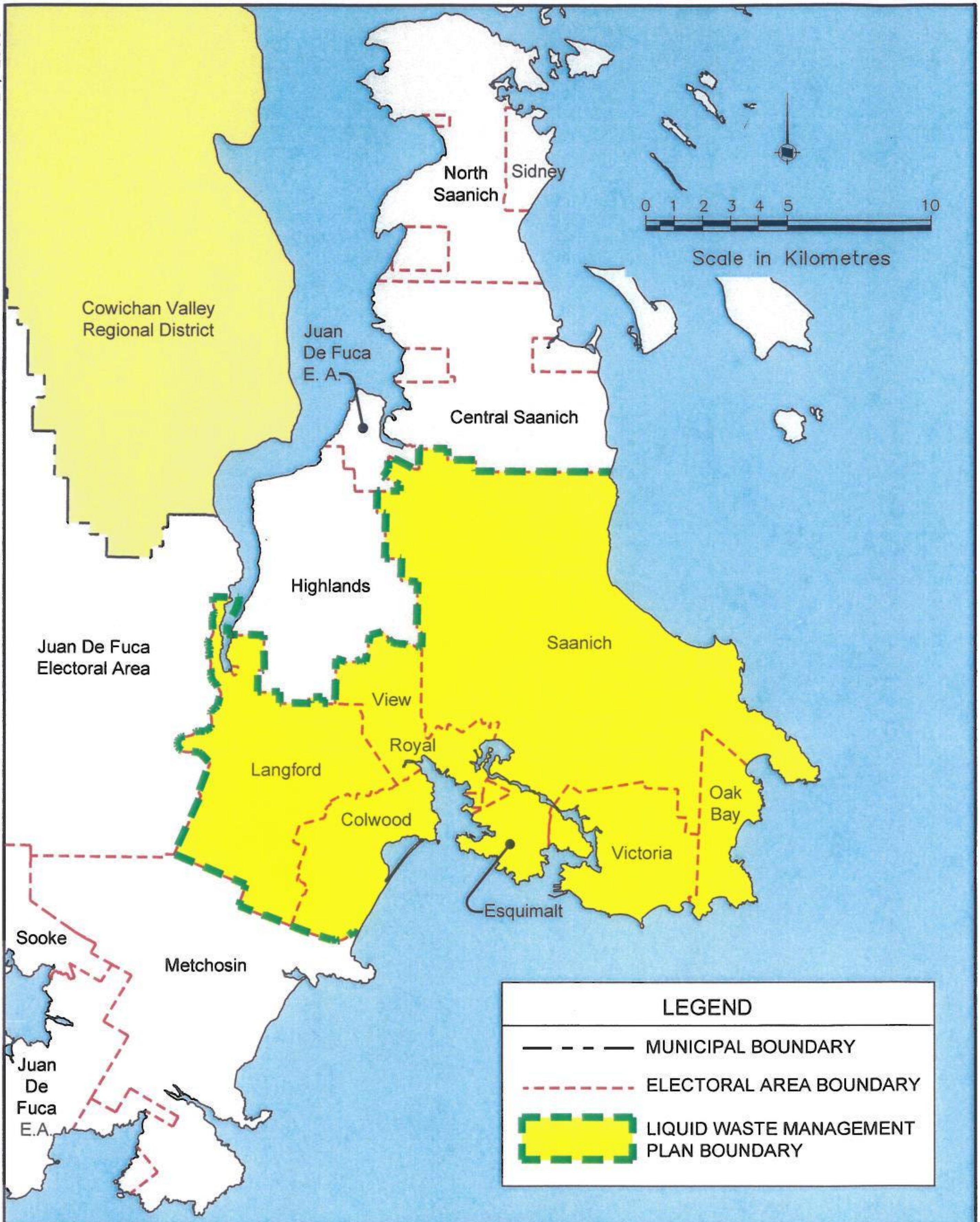
The joint commitments made by the CRD and participating municipalities to reach the goal, as noted in the LWMP, are as follows:

- "develop implementation plans for staged reduction of I&I over the 25-year life of the LWMP;
- recommend to future councils that they commit funds for I&I reduction that are economically justified by avoidance of future costs to treat and convey I&I; and
- to measure flows before and after carrying out work on sewers to reduce I&I, to document I&I expenditures and achievements, and to use this information to refine cost benefit curves".

1.4 Approach and Objectives

The overall approach of the program is to develop an integrated regional/municipal strategy to reduce I&I, which requires input and good communication with all participants. In mid 2001, at the onset of the CRD's enhanced I&I program, a project definition statement to establish the scope and objectives was prepared and agreed upon, and the frequency of subcommittee meetings established to monitor and coordinate the program. The general objectives and/or strategy of the program are listed in the Table 1.1.

DWG. No. 13S01401 DATE: JAN. 24, 2005



CRD CAPITAL REGIONAL DISTRICT

Environmental Services

CORE AREA
LIQUID WASTE MANAGEMENT PLAN
PLAN AREA

FIGURE 1.1

Table 1.1
Core Area I&I Program: General Objectives and/or Strategy and Status of Completion

Task Description	Status	Notes
Compile all available flow data for the Core Area, analyze it for I&I, and document the results.	Complete	The data collected between October 2008 and March 2009 will be analysed and reported in the summer of 2009.
Divide the Core Area into moderately sized catchments and quantify I&I rates for each catchment.	Complete	When available, permanent locations are used to collect flow data so that flows can be compared over time. Portable meters were used to quantify I&I rates in the remaining catchments.
Collect sewer flow data from portable meters and and permanent flow monitoring locations.	Ongoing	Data has been collected and analysed from all suitable CRD and municapal permanent flow monitoring locations. Data has been collected and analyzed from a number of portable flow meters. The CRD owns a number of flow meters which are available for loan to the Core Area municipalities.
Review current technologies available to reduce I&I.	Ongoing	Hosted a webcast pertaining to siting flow meters in I&I studies. Hosted webcasts that compared flow meter technologies. Hosted a webcast that described a peer reviewed method for collecting and analyzing information pertaining to the condition of sewer infrastructure. Reviewed journal articles. Ongoing interaction with product vendors and consultants and other experts.
Review mechanisms for addressing private property I&I.	Ongoing	An options report is being prepared. Hosted a webcasts containing case studies from three jurisdictions that are taking steps to deal with private property I&I. Routine discussions at subcommittee meetings. Interactions with consultants, various experts, and a meeting with the GVRD.
Build a complete sewer network, for the Core Area, in a geographic information system (GIS).	Complete	The Core Area GIS is updated each year with data provided by the municipalities.

Task Description	Status	Notes
Compile I&I information into the Core Area GIS.	Complete	Updated each year.
Use the GIS network for analysis, planning, tracking and presentation.	Complete	The Core Area GIS is routinely used for each of these items.
Map all Core Area sewer overflow locations.	Complete	Refer to the Core Area Sanitary Sewer Overflow Management Plan report.
Determine frequency and location of I&I related sewer overflows.	Complete	Refer to the Core Area Sanitary Sewer Overflow Management Plan report.
Undertake a cost-benefit analysis to determine the effectiveness of rehabilitation works.	Project specific / ongoing	Refer Phelps and DND Belmont memos. See cost benefit report for global analyses with respect to sewage treatment.
Rank sewer catchments using I&I related data and develop long-term I&I implementation plans.	In progress	I&I rates have been generated for the entire Core Area of the CRD and they can be used to rank catchments according to I&I. Some of these catchments will be further broken down in the future and others, when based on older rates, will be updated.

Many of the objectives can be worked on concurrently, while some must be completed in a phased sequence, which extends the overall duration of a detailed implementation plan. This is due to the vast amount of information and data that must be collected, reviewed, analyzed and processed into a format that is understandable by technical and non-technical audiences with the goal of getting the plans approved and funding committed.

1.5 I&I Subcommittee

The Core Area I&I subcommittee is made up of technical representatives appointed by the participating municipalities, the CRD and other agencies. The primary role of the subcommittee is to:

- provide technical support;
- resolve technical issues that affect more than one member of the CRD;
- develop data sharing and reporting standards;
- act as the forum for exchanging information;
- report and make recommendations to the regional Engineering Liaison committee (ELC) as required; and
- standardize procedures, as much as possible, used by municipalities (or their consultants) when performing I&I investigations and analysis.

See Appendix A for the current list of I&I subcommittee representatives and other contacts.

Generally, the subcommittee provides progress reports to the ELC about once each year. Members of the ELC include municipal engineers from the Core Area municipalities. An outline of the membership, procedure and role of the ELC is attached in Appendix B. The ELC then forwards technical advice and makes recommendations related to I&I plans, through staff, to the elected directors appointed to the CRD Core Area Liquid Waste Management committee (CALWMC).

1.6 Core Area Reports

The Core Area I&I program has prepared a number of I&I related reports. The following table summarizes the reports that have been prepared.

Table 1.2: Overview of Core Area I&I Reports

Report Topic	Year	Notes:
I&I Analyses Result Reports	2001 – 2004 2004 – 2005 2005 – 2006 2006 – 2008	• Reports I&I analyses results for data collected during the reporting period. • The RDI&I analyses method is the predominant analyses methodology. • When available, data collected from the same flow monitoring sites during previous years is included in the analyses.
Management of Inflow & Infiltration Biennial Report	2005 2007 2009	• Contains "Sewer Condition Reporting Standard Templates" which standardize data analyses, inventories and submissions of information. This template was produced by Kerr Wood Leidal Associates Ltd. and was recommended and approved at the February 10, 2004 ELC meeting. • Contains written summaries of regional and munipical I&I related accomplishments and upgrades • Provides an overview of I&I related activities in the Core Area.
Sanitary Sewer Overflow Management Plan	2008	• Contains "Sanitary Sewer Overflows and Action Plans" templates which standardize the submission of overflow locations, numbers of overflows, and plans for addressing each overflow location.

Report Topic	Year	Notes:
		• Provides an overview of overflow related activities in the Core Area.
I&I Management Plan Templates	In-progress, (to be completed in 2009)	• Provides a substantially written report that municipalities can use as a template for preparing long term I&I management plans, which are required by the Province.

2.0 INFRASTRUCTURE DATA MANAGEMENT

The CRD's sewer infrastructure management system consists of a GIS, the Sewer Condition Monitoring Database, which can exchange data with the GIS, and Sanitary Sewer System Infrastructure Management (SSSIM) reports.

2.1 Geographic Information System

GIS is a powerful tool that is used to store, analyze, and present spatial information. The CRD uses its Core Area GIS network to store sewer infrastructure information, to assist in managing sewer system operations and as a tool for I&I related work.

The Core Area GIS contains base map information and sewer infrastructure information. The base map information includes: municipal boundaries; lot boundaries; water bodies; orthophotos; roads; and land use information. The sewer infrastructure information includes: features (i.e., gravity mains, pump stations and valve chambers), attributes for each feature (i.e., diameter, shape, age, sewer flow directions), and map coordinates. An identification (ID) system uniquely identifies all sewer infrastructure in the GIS. An example GIS map, containing sewer information for Esquimalt, is located in Appendix C.

The use of GIS for sewer infrastructure management includes the following advantages:

- It provides a seamless inter-municipal network of piping that can be used to create a hydraulic model for system analysis.
- It provides a platform for managing operations and maintenance activities.
- It can create rehabilitation drawings based on easily extracted data.
- It can produce maps showing pipe and manholes prioritized for repair, enabling field workers to easily locate maintenance areas.
- It can be used to produce catchment maps for use in I&I analyses.
- It can provide locations for known overflows.
- It can be used to track multiple types of data or years of completed sewer work, so that staff can evaluate the collection system and prioritize future repairs and upgrades.

2.2 Sewer Condition Monitoring Database

The CRD created a custom sewer condition monitoring database that allows municipalities to proactively enter sewer inspection and maintenance information as the works are being completed. The information entered into the database can be exported to the GIS for analyses or exported as custom summary tables.

Figure 2.1 provides a couple of "screen shot" looks of the data entry program.

Figure 2.1 – Sample Screen Shots of Data Entry Program

The sewer condition database and the GIS use the same sewer infrastructure ID's and, thus, can be used together for powerful data analyses applications. For example, a GIS map noting manhole repair needs can help staff determine which part of the municipality should be handled first and help them evaluate which rehabilitation methods would be most effective (i.e., repair, replacement, sealing, or lining). The sewer condition database can then be used to log the rehabilitation works completed. The resulting data can be exported back to the GIS for analyses.

The Sewer Condition Monitoring Database is designed to auto-generate a number of different reports, including Sanitary Sewer System Infrastructure Management (SSSIM) reports, which traditionally are time consuming to prepare.

2.3 Sanitary Sewer System Infrastructure Management Reports

The Core Area municipalities use SSSIM reports to summarize their sewer infrastructure related activities. The reports are standardized templates that contain the following five categories:

1. Sewer Inventory
2. Sewer System Evaluation Program
3. Capital Improvement Works
4. Sanitary Sewer Overflows
5. Summary of Costs for the Reporting Period

The SSSIM reports provide a quick synopsis of the measures taken by each municipality to maintain their sewer systems and to reduce I&I. Each report is intended to capture two years-worth of information. Appendix D contains SSSIM reports for the Core Area municipalities for 2007 and 2008.

3.0 FLOW MONITORING

The collection of flow monitoring data is a fundamental component of the Core Area I&I program. Flow monitoring data is used to:

- establish flow rates for catchments;
- monitor potential overflow locations;
- calculate I&I rates for catchments;
- prioritize catchments for rehabilitation works;
- quantify the effectiveness of rehabilitation works using before and after I&I rates; and
- calibrate sewer models.

3.1 Flow Monitoring Devices

In the Core Area, flow monitoring data is collected from permanent flow monitoring stations and from portable meters.

Examples of permanent flow monitoring stations include permanent flumes and magmeters, which are used for cost allocation purposes, and pump station flow meters, which are used for operational purposes. Additionally, efforts are currently underway to establish continuous flow monitoring at municipal pump stations.

Permanent flow monitoring stations collect continuous sewer flow data. In many cases, the flow data can be used to track I&I rates in specific catchments over time, which can be used to quantify the effectiveness of I&I work. Due to various technical considerations, permanent flow monitoring stations need to be analyzed individually to determine if their data is appropriate for I&I analyses.

Portable flow meter devices, which are generally installed in manholes, collect continuous sewer flow data. They are easy to install and relocate. The use of portable flow meters allows catchments to be broken down into discrete, appropriately-sized catchment areas, which can be ranked from best-to-worst.

The Core Area I&I program has researched a number of flow monitoring technologies and has purchased flow monitoring equipment, which is available for loan for the Core Area municipalities. The meters include: 4 portable VA flow meters manufactured by ISCO, 18 portable VA flow meters manufactured by American Sigma, 6 pressure transducer level sensors, 4 wireless VA meter data transfer devices with antennas, and 8 pump station data recording devices from Telog Instruments.

3.2 Core Area Flow Monitoring in 2007 and 2008

From October 2006 to March 2008, flow monitoring was conducted in each of the Core Area municipalities. In total, 53 sewer flow monitoring locations were analysed for I&I. Fourty of these locations were monitored using permanent flow meters and the remaining 13 locations were monitored using portable flow meters.

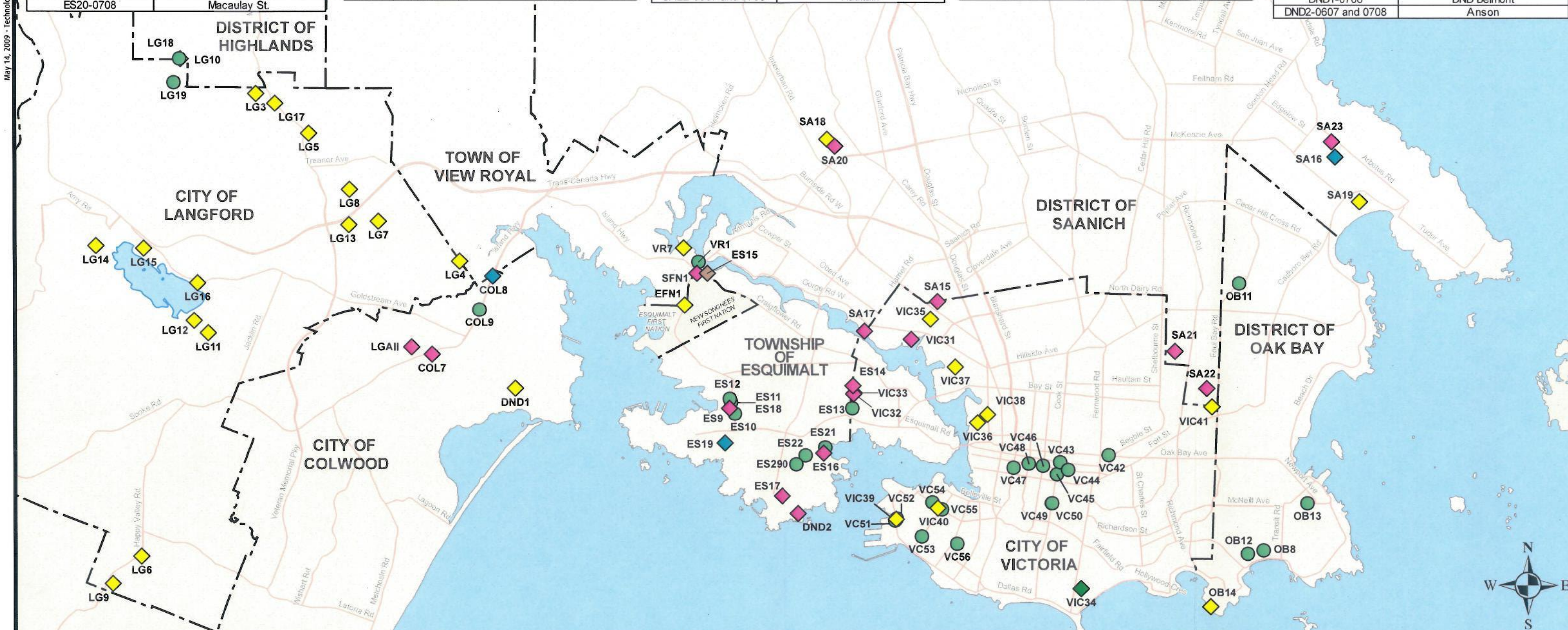
The permanent locations were selected based on availability and reliability of flow data. The locations included municipal and regional pump stations and CRD cost sharing locations.

The temporary flow monitoring sites were selected and monitored by the CRD, municipalities, or hired consultants.

Figure 3.1 shows the location of the portable flow metering sites selected during the 2007/2008 flow monitoring seasons.

2006-2008 Flow Monitoring Locations

SiteCode	Location
Colwood	
COL7-0607 and 0708	Aldeane
COL8-0708	Parson's Magmeter
COL9-0708	Wale at Sooke
Esquimalt	
ES9-0607 and 0708	Lang Cove PS (Esquimalt)
ES10-0607	655 Admirals
ES11-0607	685 Admirals
ES12-0607	690 Admirals
ES13-0607 and 0708	Wilson
ES14-0607 and 0708	Devonshire
ES15-0708	Esquimalt Panhandle
ES16-0607 and 0708	Head
ES17-0607 and 0708	Kinver Flume
ES18-0607 and 0708	Lang Cove PS (Dockyard)
ES19-0607 and 0708	Lyall Magmeter
ES20-0708	Macaulay St.
Esquimalt (con't)	
ES21-0708	507 Head
ES22-0708	952 Lyall
Langford	
LGAII-0708	Meaford
LG3-0607 and 0708	Bishops Gate
LG4-0607 and 0708	Country
LG5-0607 and 0708	Goldie
LG6-0607 and 0708	Happy Valley
LG7-0607 and 0708	Jeanine
LG8-0607 and 0708	Selwyn
LG9-0607 and 0708	Wild Ridge
LG10-0607 and 0708	Florence
LG11-0607 and 0708	Langford
LG12-0607 and 0708	Leigh
LG13-0607 and 0708	Strandlund
LG14-0607 and 0708	Westshore
LG15-0607 and 0708	Lake End
LG16-0607 and 0708	Goldstream
Langford (con't)	
LG17-0607 and 0708	Millstream
LG18-0708	Hannington
LG19-0708	Hedgestone
Oak Bay	
OB8-0708	Oliver St Near Beach
OB11-0607 and 0708	University Woods
OB12-0607 and 0708	Lafayette & Hampshire
OB13-0607 and 0708	Margate
OB14-0607 and 0708	Harling
Saanich	
SA15-0607 and 0708	Boundary
SA16-0607 and 0708	Haro
SA17-0607 and 0708	Harriet Flume
SA18-0607 and 0708	Marigold
SA19-0607 and 0708	Penrhyn Lift PS
SA20-0607 and 0708	Swan Lake
SA21-0607 and 0708	Townley
SA22-0607 and 0708	Haultain
Saanich (con't)	
SA23-0607 and 0708	Arbutus
Victoria	
VIC31-0607 and 0708	Cecelia
VIC32-0607 and 0708	Hereward
VIC33-0607 and 0708	Langford
VIC34-0607 and 0708	Olive Street
VIC35-0607 and 0708	Cecelia PS
VIC36-0607 and 0708	Chatham PS
VIC37-0607 and 0708	Garbally PS
VIC38-0607 and 0708	Government PS
VIC39-0607 and 0708	Niagara PS
VIC40-0607 and 0708	Superior PS
VIC41-0708	Trent PS
VIC42-0708	Begbie & Harrison
VIC43-0708	Johnson & Cook
VIC44-0708	Yates east of Cook
VIC45-0708	Cook & View
VIC46-0708	Yates & Vancouver
Victoria (con't)	
VIC47-0708	Blanshard & View
VIC48-0708	Quadra & Yates
VIC49-0708	McClure & Cook
VIC50-0708	McClure & Cook
VIC51-0708	Dallas & Niagara
VIC52-0708	St. Lawrence & Niagara
VIC53-0708	Niagara & Oswego
VIC54-0708	Superior east of Montreal
VIC55-0708	Superior & Oswego
VIC56-0708	Simco & Medana
View Royal	
VR1-0708	Shoreline
VR7-0607 and 0708	Craigflower
First Nations	
EFN1-0607 and 0708	Esqimalt Nation
SFN1-0607 and 0708	Songhees Nation
DND	
DND1-0708	DND Belmont
DND2-0607 and 0708	Anson



CRD Making a difference...together

Metres
0 500 1,000 1,500

Projection: UTM ZONE 10N NAD 83

Pump Station
Flume
Flodar
Magmeter
Strap-on Doppler
Temporary Meter
Major Roads
Municipal Boundaries

CORE AREA INFLOW AND INFILTRATION PROGRAM

FLOW MONITORING AREA

FIGURE 3.1
FLOW MONITORING SITE LOCATION MAP, 2006/2007 AND 2007/2008 REPORT DATA

3.3 Reporting of Flow Monitoring Results

The CRD analyses flow monitoring data using the Rainfall Dependent Inflow and Infiltration (RDI&I) Analyses method. This statistical method charts flow data collected during storm events, along with rainfall data, and extrapolates the likely flows from larger storm events. The accuracy of this method increases as both the number and size of storms increase.

During the 2007 and 2008 flow monitoring seasons (October 2006 – March 2008), seven storm events were greater than a six month storm events. The largest storm event recorded during these seasons was a 23 year storm event, as measured at the CRD's Craigflower pump station raingauge on November 6, 2006. When available, data collected at the same flow monitoring sites during previous years was also included in the I&I analyses.

The CRD presents its flow monitoring analyses results in stand-alone I&I analysis reports. The first report included data collected from 2001 to 2004. The second report included data collected from October 2004 to April 2005. The third report included data collected from October 2005 to April 2006. The most recent report includes data collected from October 2006 to March 2008. Data for the wet weather period of October 2008 to March 2009 will be analyzed in the summer of 2009.

The results documented in all of the Core Area I&I analysis reports provides a standard for tracking and reporting I&I rates in both catchments and municipalities as a whole over time. The reports also contain information and preliminary analysis that can be used to select appropriate investigation techniques and/or further determine sources of I&I. The reports are a key indicator for tracking the overall performance of the Core Area I&I program.

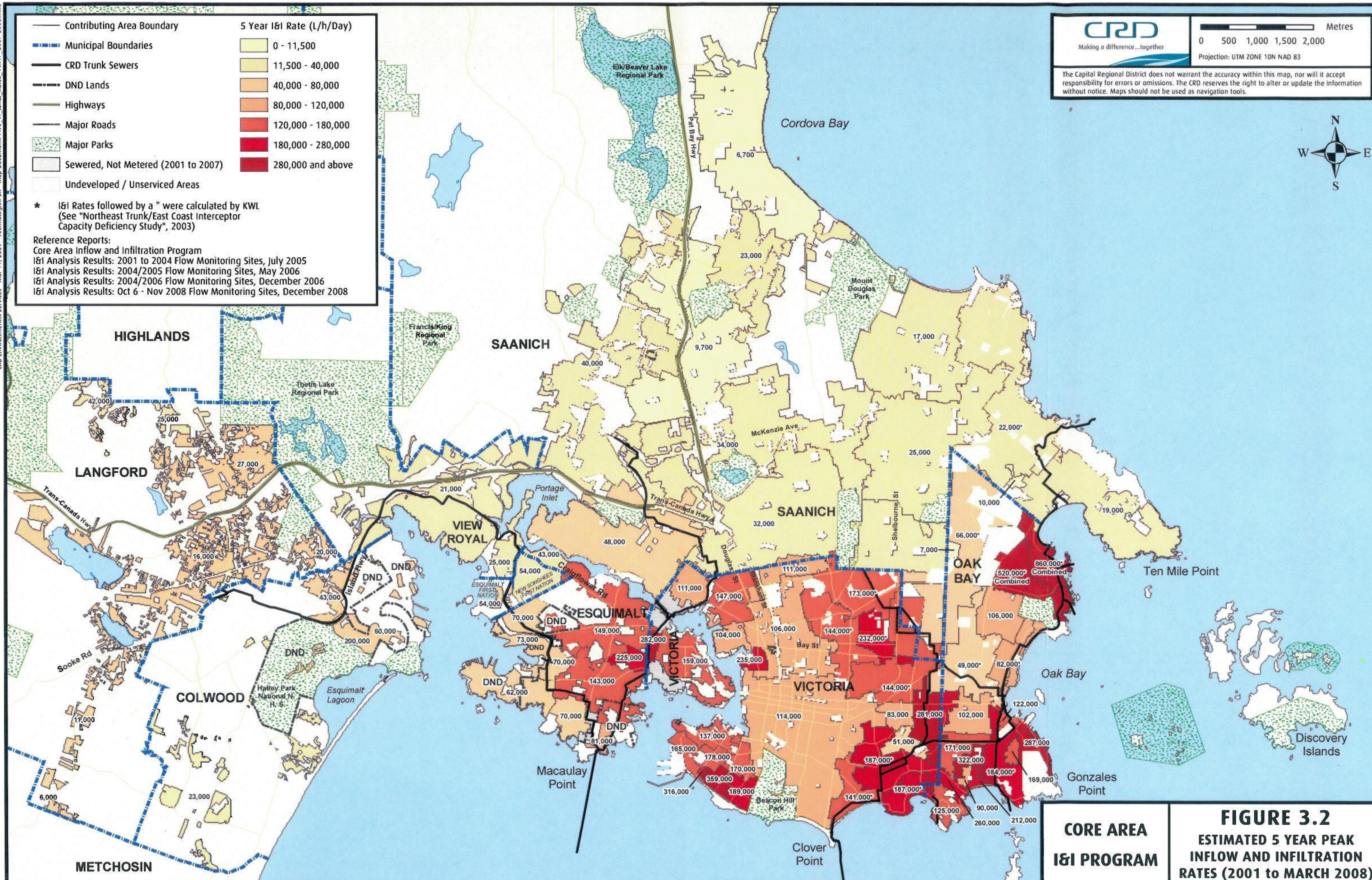
Figure 3.2 contains a map showing estimated 5-year peak I&I rates for the Core Area based on the data collected between 2001 and 2008. Table 3.1 summarizes the 24 hour peak 5-year storm I&I rates for each of the Core Area municipalities.

Table 3.1: Summary Core Area Municipal Peak 5-Year I&I Rates for 2008

Municipality	Average Age of Sewers (7)	Estimated 5-Year Peak I&I Rate (L/ha/day) (1,2)			
		1996 (3,4)	2004/05 (5)	2005/06 (6)	2006/08 (8)
Colwood (including DND) Excluding DND	20 9	not sewered	40-45,000 18-22,000	40-45,000 18-22,000	40-45,000 18-22,000
Esquimalt (including DND)	82	80-90,000	95-100,000	95-110,000	100-115,000 (9)
Langford	8	not sewered	15-20,000	17-22,000	17-22,000
Oak Bay Uplands	69 74	80-110,000 > 120,000	110-115,000 > 400,000	110-120,000 > 400,000	110-120,000 > 400,000
Saanich	33	18-22,000	18-22,000	18-22,000	18-22,000
Victoria	89	130-140,000	160-165,000	150-160,000	145-150,000
View Royal (incl. Reserves)	21	15-20,000	18-22,000	18-22,000	20-25,000

Notes related to Table 3.1:

1. I&I rates are determined at each flow meter location and then interpolated into a weighted average over each particular municipality.
2. A five-year storm event I&I flow rate is used since the Municipal Sewage Regulation stipulates that a sewer system must be able to convey flow under this condition without an overflow.
3. The 1996 I&I rates were calculated by Kerr Wood Leidal Associates Ltd. (reference reports – *Northwest Trunk Sewer Flow Analysis and Monitoring Station Review, January 1995* and *Northeast Trunk Sewer and East Coast Interceptor Flow Analysis and Monitoring Station Review, September 1996*).
4. The 1996 I&I rates for Esquimalt, Oak Bay and Victoria were estimated based on flow results from a few neighbouring catchments within Oak Bay and Victoria and likely underestimated.
5. The 2004/05 I&I rates were calculated by Kerr Wood Leidal Associates Ltd. and CRD Environmental Services (reference reports – *Northeast Trunk/East Coast Interceptor Upgrade Capacity Deficiency Study, May 2003*; *I&I Analysis Results: 2001 – 2004 Flow Monitoring Sites, July 2005* and *I&I Analysis Results: 2004/2005 Flow Monitoring Sites, May 2006*).
6. The 2005/06 I&I rates were calculated by CRD Environmental Services (reference reports – *I&I Analysis Results: 2004/2005 Flow Monitoring Sites, May 2006* and *I&I Analysis Results: 2005/2006 Flow Monitoring Sites, June 2007*).
7. The rate of I&I tends to increase in proportion to the age of the system. Older systems usually need more work than newer systems. The primary goal of the I&I program is to reduce I&I to an optimum cost-benefit level. It is expensive to size wastewater facilities to accommodate vast amounts of I&I, but it can be equally expensive to rehabilitate or replace sewers to reduce I&I. Therefore, the optimal I&I level is the most cost-effective combination of I&I reduction and I&I accommodation.
8. Changes in the I&I rates from 2005/06 to 2006/08 are more attributed to additional flow monitoring coverage and updating of municipal averages, rather than actual I&I escalation or reduction.
9. Esquimalt was in the process of doing substantial sewer rehabilitation work during the 2006/08 flow monitoring period. Esquimalt's 2006/08 I&I rate is based mainly on storm event data collected prior to the completion of this work. Flow data was only available for one post-rehabilitation storm event and the data indicates that I&I was reduced. Additional storm event flow data is being collected to calculate Esquimalt's post-rehabilitation I&I rate.



CORE AREA I&I PROGRAM

FIGURE 3.2
ESTIMATED 5 YEAR PEAK INFLOW AND INFILTRATION RATES (2001 to MARCH 2008)

3.4 Flow Monitoring Hydrographs and the Municipal Sewer Regulation

The provincial Municipal Sewage Regulation states that I&I shall not exceed the amount which causes the "average wet weather flow" (AWWF) to "average dry weather flow (ADWF) ratio to exceed 2.0 for storm events having less than a 5-year return period. Compliance with the regulation can be determined using the hydrographs located in the I&I analysis reports. The process for doing this is illustrated in Figure 3.3 and explained in the paragraph that follows Figure 3.3.

The hydrographs in the I&I analysis reports can also be analysed, in a cursory way, to better understand I&I in the catchments and to help select appropriate investigation techniques for further study. For example, a rapid increase in flow may indicate inflow or rapid infiltration. This would indicate potential storm sewer cross connections and/or leaky sewer pipes that allow groundwater to rapidly enter the pipe during storm events. Conversely, a slower flow increase and length of time for flow subsidence after a rain event would likely indicate infiltration rather than inflow.

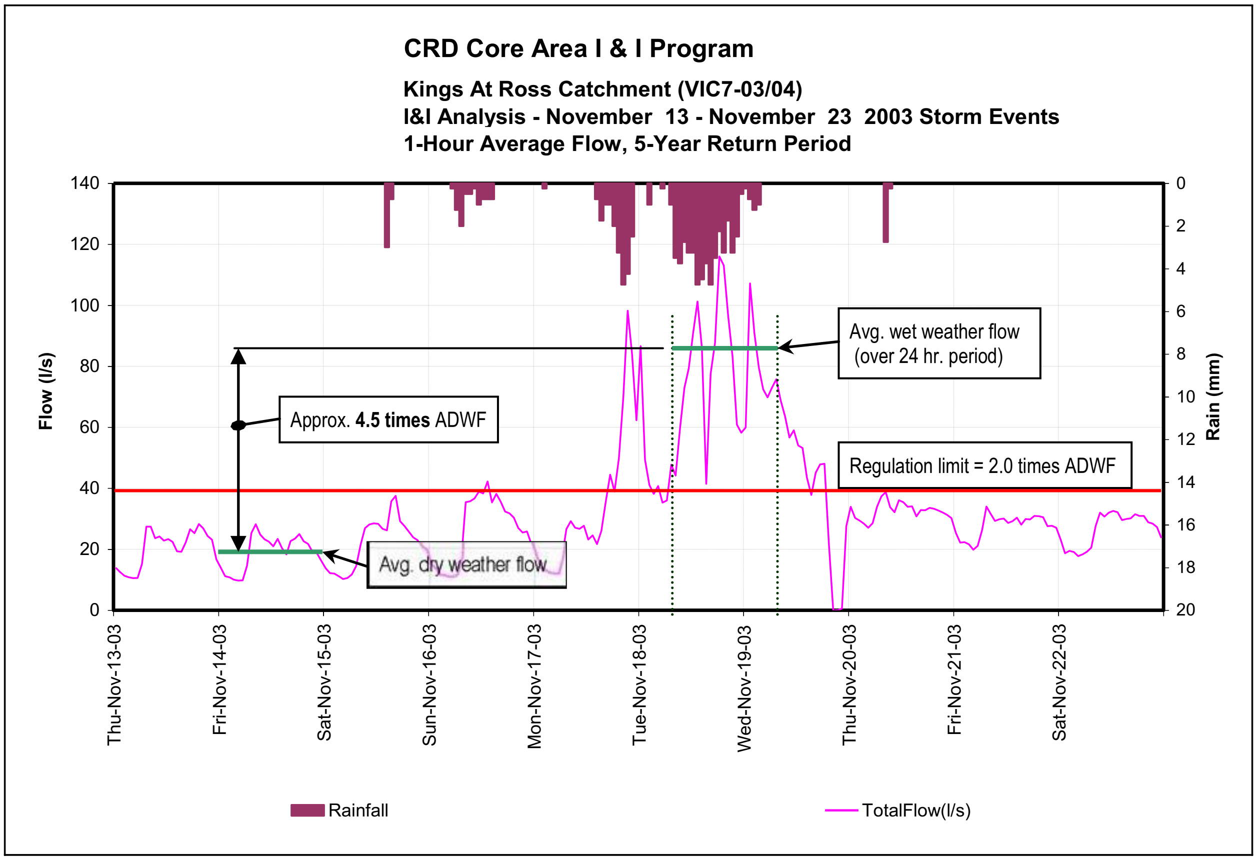


Figure 3.3 – Kings at Ross Flow Hydrograph

The storm event hydrograph chart at the Kings and Ross site, shown in Figure 3.3, indicates that the maximum average wet weather flow is about 4.5 times greater than the average dry weather flow. That ratio exceeds the acceptable rate of 2.0 times ADWF as stipulated in the Municipal Sewage Regulation. Note how the flow quickly responds to rainfall intensity changes and after the storm event subsides. The peak daily flow of about 38 l/s is still higher than the peak flow of

28 l/s that was recorded prior to the storm. This flow pattern suggests inflow or fast infiltration are significant sources in this particular catchment, with ongoing infiltration occurring after the rain storm has subsided.

4.0 SUMMARY OF I&I ACCOMPLISHMENTS FOR 2007 AND 2008

The CRD and the Core Area municipalities completed a number of activities and upgrades to address I&I and sewer overflows in 2007 and 2008. Examples of these initiatives are located in the sections below.

4.1 CRD

Over the past two years, the CRD Board approved a number of sewer infrastructure upgrades. The upgrades are designed to help the CRD meet its LWMP goals of providing long-term sewerage service for the Core Area and working towards compliance with sewer overflow regulations. A list of the Board approved upgrades is documented in Table 16.1A of the LWMP. The work carried out in 2007 and 2008 included:

- The construction and commissioning of the Trent pump station and forcemain. Both of these items are part of a $15.9 million project to upgrade the northeast trunk-Bowker (NET-B) system. Since the pump station was commissioned in November of 2008, there have been no overflows into Bowker Creek and/or onto the Oak Bay shoreline.
- Upgraded sanitary manhole openings on the Northwest Trunk Northern (48 in total) complete with larger frame, covers and, where required, new ladder rungs.
- Gravel debris removal and CCTV inspections of the Northwest Trunk Northern sewer system (4416 m of pipe). The removed gravel will improve the hydraulic capacity of the pipe, reduce the potential for overflows and decrease odours. The CCTV inspections will provide pipe condition information which will be used to plan for repairs.
- An emergency generator was installed at the Macaualay Point pump station to ensure that all critical equipment will remain in operation during power outages.

4.2 Colwood

Colwood's sewers are mainly constructed of PVC sewer pipe, which is known for its leak resistant joints and overall long-term durability. As a result, Colwood focuses its I&I efforts on sewer maintenance and on inspections of both new sewers and connections to new sewers. The work carried out in 2007 and 2008 included:

- video inspection of all new sewers;
- visual inspection of all manholes, once per year;
- flushing of all sewers, twice per year;
- continuation of a process to acquire sewer flow data from Colwood's pump stations using SCADA data;
- the updating of Colwood's GIS with sewer infrastructure information pertaining to new and rehabilitated sewers; and
- flow monitoring of five catchments during both the 2006/2007 and the 2007/2008 wet weather seasons.

4.3 Esquimalt

In 2007 and 2008, Esquimalt continued the $6.75 million capital sewer upgrading program which is now 90% complete. The work carried out in the last two years includes:

- Relining of 12,246 m of sanitary sewers
- The complete reconstruction of 68 sanitary sewer manholes. These manholes were previously combination structures serving both the sanitary and storm sewers.
- All eleven sewer pumping stations are now connected to the CRD SCADA system, which allows for better data collection and analyses.
- New control systems at all pumping stations, new electrical kiosk at nine pumping stations, and mechanical upgrades and repairs at four pumping stations, which will make the stations more efficient and reliable.

4.4 Langford

<u>I&I Works Completed for 2007 & 2008</u>

Langford sewers are constructed of PVC sewer pipe, which is known for its leak resistance. As part of the annual maintenance program in 2007/2008 approximately 12 km of existing and 11 km new mainline sewers were CCTV inspected. During that time over 130 existing and all new sewer manholes were inspected for condition and any I&I issues noted and repaired under the manhole grouting program.

Ongoing I&I investigation - As a continuing part of the annual maintenance program Langford and our maintenance contractor constantly monitors the sewer system visually for potential inflow and infiltration locations.

Westshore Environmental Services (WSES) monitors pump station flows, via SCADA, on a daily basis thereby identifying any variations in flow that may warrant investigation of potential I&I.

Langford and WSES adopted a new standard to add concrete boxes and cast iron lids at all newly installed Inspection Chambers to reduce potential damage and degradation due to weather which may lead to future I&I.

<u>Sewer Construction – Capital Works for 2007</u>

Five pump stations were constructed or upgraded

- 2110 Millstream Road PS construction completed (2007)
- 2530 Florence Lake Road PS construction completed (2007)
- 2795 Lake End Road PS construction completed (2007)
- 2950 Westshore Parkway PS construction completed (2007)
- 2445 Selwyn Road Generator Upgrade completed (2007)

Approximately 10.5 km of sewer construction completed

- Leigh Road low pressure sewer (LPS) extension south of Dunford (700m)
- Goldstream Meadows sewer extension (1700m)
- Florence Lake sewer extension (2329m)
- Walfred, Lodmell, Isabell & Weaver sewer extension (1600m)
- Millstream Road sewer extension (615m)
- Setchfield, Camli, Shaw, Treanor, Ashley, Fleetwood & Prospector providing strata connections to the municipal sewer system (2653m)

- Lake End / King Fisher sewer extension (600m)
- Atkins Avenue, Selwyn Road & Granderson Road sewer extensions (366m)

Inflow and Infiltration Program

- Rehabilitated 60 inspection chambers, rehabilitated 2 sewer manholes (Atkins) and 56 sewer manholes were inspected
- 6.4 km of sewer main flushed and CCTV inspected

Sewer Construction – Capital Works for 2008

Approximately 1.5 km of sewer construction completed

- Westwind Drive low pressure sewer (LPS) extension (450m)
- Powers Lane sewer extension (80m)
- Sooke Lake Road connector sewer extension (650m)
- Hazelwood Road sewer extension (330m)
- Windship Place Strata connection to municipal sewer
- Whisperwind Place Strata connection to municipal sewer
- Treanor Road / Ashley Place Strata connection to municipal sewer

Inflow and Infiltration Program

- 76 sewer manholes inspected
- Rehabilitated 38 sewer inspection chambers
- 6.0 km of sewer main flushed and CCTV inspected

Pump Station Upgrade and Maintenance

- Completed annual maintenance and servicing of all pumping equipment
- Completed annual maintenance and servicing of all electrical control equipment
- Completed annual load testing and servicing of all standby generators

4.5 Oak Bay

Oak Bay's sanitary sewer mains are predominately vitreous clay pipe. Based on past sewer video inspections, the sewer mains generally appear to be well constructed and structurally sound. This has resulted in a relatively small amount of deteriorated pipe to be replaced each year. In 2007 and 2008, Oak Bay's sewer program included the replacement of deteriorated pipe, CCTV of sewers and the flow monitoring of two catchment areas.

Oak Bay recently made a change to its sewer bylaw that provides it with the ability to enforce the disconnection of storm water connections from its sewer system. Once disconnected, the storm water sources must be connected to Oak Bay's storm sewer system or an engineered storm water detention system.

Oak Bay has targeted the Windsor area for a multi-year pilot rehabilitation study. In 2005, weirs were installed at two small catchments within the Windsor area. Flow monitoring data from the weirs is being collected year round to enable I&I analysis in these two areas. In one of the monitored catchments, Oak Bay will undertake a four-phase rehabilitation program, over four years, consisting of manhole lid sealing, manhole barrel sealing, mainline sewer relining or replacement. The other monitored catchment will be used for comparison only. Upon the conclusion of each pilot study phase, the flow monitoring results will be assessed to deduce the cost effectiveness of each type of treatment.

Phase 1 of the 4 phase rehabilitation program was completed in 2008 with manhole lid sealing. A memo documenting the results of the phase 1 work is located in Appendix E.

During phase 1, Oak Bay discovered, through dye testing, a number of direct storm drain connections and deteriorated storm mains within the two test areas. A number of these cross-connections were investigated and addressed. Oak Bay is currently working to correct the remaining cross connections.

Phase 2 of the rehabilitation project will start in the summer of 2009.

In 2007 and 2008 Oak Bay continued to work with consultants to refine options for complying with the Provincial Municipal Sewage Regulations and the CRD's LWMP for Oak Bay's combined sewers in the Humber and Rutland catchments Oak Bay is continuing to work with consultants to devise a suitable method of separation.

In addition to the above initiatives, Oak Bay also undertook the following items:

- ongoing maintenance program of flushing and cleaning sewer lines
- video inspection of existing sewer and storm mains through contract work or Oak Bay's push and crawler camera (allows public works to do spot repairs on broken pipe and assists the engineering department on sewer replacement priorities)
- flow monitoring of three catchment areas (in addition to the two pilot project catchments)
- smoke testing & dye testing in the pilot project catchments
- replaced 142 service laterals
- any homes undergoing building additions or repairs to perimeter drains must separate storm from the sanitary sewer line if city dye testing crews determine a combined system exists for the house.
- required the upgrade of old service laterals to PVC when a house is demolished and a new building is constructed.

4.6 Saanich

The District of Saanich continues to focus on replacing sewer infrastructure that is at, or near, the end of its service life.

The Dysart Sewage Lift Station and force main upgrade project was completed in 2008. Stand-by generator power was added to the station, removing one emergency overflow to the receiving Colquitz Creek. A total of 1.3 km of asbestos cement sewer gravity and force main was replaced from the project, as well as 43 service connections. Upgrades to the drainage system were also done within the project area.

The replacement of 2 km asbestos cement sewer and over 200 service connections were part of the 2007 and 2008 Capital program. The No-corrode Service Connection Replacement program remained ongoing targeting 80 connections per year.

The Vantreight Sewage Lift station is currently being upgraded by replacing aging mechanical and electrical equipment with new more efficient equipment. The removal of the station's emergency overflow system and the addition of stand-by generator power is included in the project. It is expected that the construction will be complete near the end of the summer, 2009.

Saanich is also currently undertaking the design for the upgrade of 6 small pumping stations in the Portage Inlet area by replacing electrical and mechanical components as well as providing either mobile or stand-by power to allow for the elimination of existing emergency overflows.

4.7 Victoria

For 2007-08, the City of Victoria focused on the planning and investigation stages of the Inflow & Infiltration Program. During this time, several data collection and investigative field programs were implemented to assist in determining the potential scope of I&I within the Clover catchment. These included:

- The smoke testing of over 19,000m of sanitary sewer mains within 5 sub-catchment areas.
- The installation & monitoring of 15 temporary flowmeters in the gravity sewer mains, 9 overflow flow indicators and 7 sanitary sewer lift station SCADA-integrated flowmeters to monitor both dry and wet weather flows.
- Monitoring of rain gauge data to assist in determining sub-catchment specific I&I responses to various storm events.
- Hired a consultant to develop a City-wide Flowmeter and Overflow Action Plan.
- Performed CCTV inspections on over 46,500 meters of sanitary sewer mains using WRc rating standards.

During the 2007-08 calendar years, sanitary sewer rehabilitation was performed on over 700m of main. Of that total, 92% was done using various trenchless rehabilitation methods.

<u>James Bay Inflow & Infiltration Pilot Project</u>

In 2007-08, the City, with the aid of a consultant, began an I&I reduction pilot project within the James Bay sanitary sewer sub-catchment of the Clover Point catchment. The pilot is currently in the planning stages, with rehabilitation works to begin the summer of 2009.

The City of Victoria's James Bay Inflow & Infiltration Pilot Project will study differing approaches to sanitary sewer I&I reduction and rehabilitation using a variety of Trenchless Technologies (such as lining, grouting, pipe bursting, epoxy wall coating and PVC liners), in four sub-catchments of similar size, age and infrastructure assets in the neighbourhood of James Bay.

The project, funded in the amount of $3,000,000.00 through the Innovations Fund Grant from the Canada-British Columbia-UBCM Agreement on the Transfer of Federal Gas Tax Revenues (GTA), will include a detailed pre- and post-rehabilitation study of the sub-catchments over a two year period with the aim of developing a systematic model for identifying the best reduction and rehabilitation strategy for I&I in the sanitary sewers of Victoria. The results will also allow the City to establish an overall cost/benefit analysis "blueprint" for future I&I reduction in other sub-catchments throughout the City of Victoria and the Capital Region.

The City of Victoria has set the proposed completion date for the James Bay Inflow & Infiltration Pilot Project for September 2010. A memo describing the project is located in Appendix E.

4.8 View Royal

In 2008, View Royal hired the consulting firm Kerr Wood Leidal (KWL) to generate flow data for a number of View Royal pump stations, using pump station SCADA data. KWL will generate flow data for the remaining pump stations in 2009. The data will be analyzed for I&I to determine areas of concern. Smoke testing will be conducted in one or more of these areas of concern as a first step towards I&I remediation.

View Royal is continuing with its ongoing lift station upgrade program. This includes adding generators to each upgraded lift station. View Royal is currently upgrading one lift station per year.

View Royal is looking at implementing the CRD's SCADA system and to monitor View Royal's pump stations. This would enable the tracking of flow rates, pump rates, pump hours, etc.

4.9 Esquimalt and Songhees First Nations

The Esquimalt and Songhees First Nations both contain private sewers that discharge in the CRD sewer system.

Flows from the Songhees nation have been flow monitored, for sewer cost sharing purposes, since the early 2000's. In 2008, the CRD analysed this flow data for I&I.

In October of 2007, a temporary sewer flow meter was installed to record flows from the Esquimalt Nation. The flow data indicated that the almost all the flow from the Esquimalt Nation property comes from the Nation's pump station. In September of 2008, a permanent flow meter was installed at the Nation's pump station. Data from this meter is relayed to a central server and it can be viewed through a website. The data will be analyzed for I&I in the future.

There are plans to test the sewers at the Esquimalt Nation in 2009. The testing will include smoke testing, video inspections, an assessment of the manholes, and an assessment of the pump station. Upon completion of the testing, a summary report will be prepared which will include recommendations.

5.0 PUBLIC EDUCATION

The CRD has an I&I section on its website and has an I&I brochure. Both of these items were created to educate the public on issues regarding I&I. The brochure and select pages from the website are located in Appendix F. Additional public education initiatives are being planned for the future.

6.0 GLOBAL COST BENEFIT ANALYSIS OF REDUCING I&I

The CRD is currently planning for sewage treatment in the Core Area. In January of 2009, the CRD's Core Area Liquid Waste Management Committee (CALWMC) requested a discussion paper comparing the global costs of reducing I&I versus the benefit of reduced conveyance and sewage treatment costs. A copy of the discussion paper is located in Appendix G. The preliminary conclusions of the discussion paper are as follows:

1. Inflow and infiltration is unavoidable and must be accounted for in routine sewer and treatment plant design. It has been shown through previous studies that I&I typically increases with time as the sewer system ages and decays.

2. Due to the average age of the existing Core Area infrastructure, inflow and infiltration is quite high (in the order of 4-10 times the average dry weather flow).

3. The current Core Area wastewater treatment strategy provides:

   - secondary treatment for all flows up to 2 times average dry weather flow (ADWF);
   - primary treatment for flows between 2 times and 4 times ADWF (with blended effluent); and
   - 6 mm screening for flows that exceed 4 times ADWF.

   As a result of this strategy, it is unlikely that reduced I&I flows will result in making the new treatment plants smaller or less expensive. This is due to the fact that the actual flows (as measured at the Clover and Macaulay Point pump stations) are 95-99% of the time below 2xADWF. The only real potential cost saving would be to reduce the flow down to a maximum of 2xADWF so that the wet weather, primary treatment facilities would not be required.

4. There are other motivations/requirements that justify investing in I&I rehabilitation such as the following:

   - **Environmental/Social** – Receiving environments are adversely affected by sewer overflows and basement back-ups can result in damaged personal belongings, extensive decontamination measures and compensation claims. Overflow requirements dictate that I&I must be reduced, over the long-term, to meet the Core Area LWMP commitments and the Municipal Sewage Regulation.

   - **Hydraulic** – Reduction in peak flows will free pipe capacity for future growth and may extend the design life of conveyance and treatment facilities.

   - **Safety** – Sewer overflows pose a public health risk, and deteriorated sewers can lead to pipe collapses and serious damage to adjacent infrastructure and sinkholes in road above.

   - **Asset Management** – Old infrastructure that is decaying needs to be rehabilitated anyways. Annual investment into the maintenance of infrastructure assets will ensure that the system is sustainable and prevent I&I from escalating out of control.

5. I&I programs are effective when implemented in a holistic manner. That is to determine which areas have chronic overflow locations, critical sewers, aged sewers, high I&I rates, and can be planned concurrently with other infrastructure upgrades (i.e.; roads, storm sewers, water mains, etc.). When those areas are identified and prioritized for I&I rehabilitation, it results in multiple benefits and works towards the long-term goal of I&I reduction.

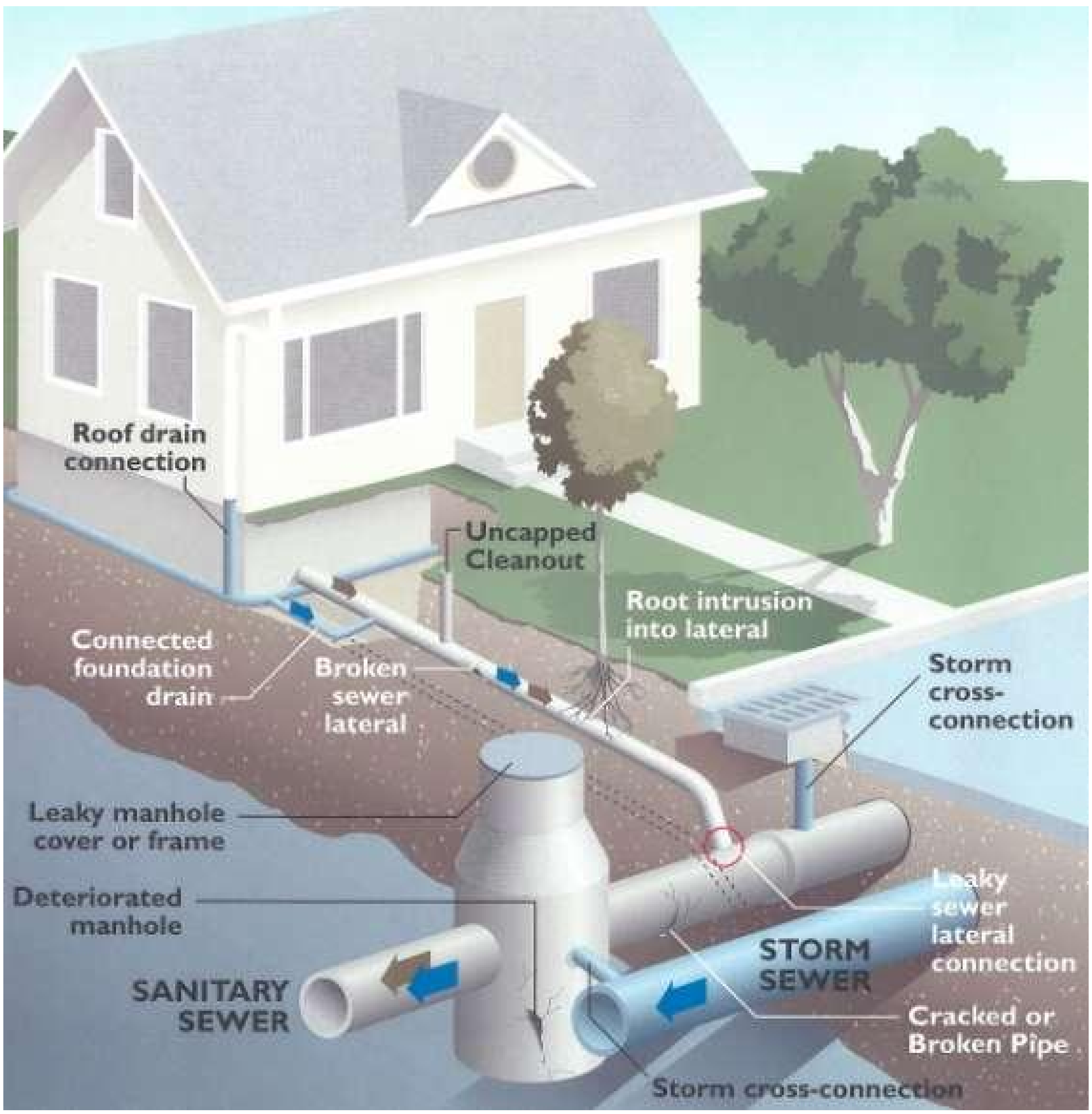
7.0 PRIVATE PROPERTY I&I

7.1 Overview

Private property sewers generally refer to sewer service laterals, which connect building plumbing to the municipality's sanitary sewer system. In some cases (i.e., strata developments), the private property sewers may also include collection pipes, pump stations, and/or treatment plants (i.e., Dockside Green).

Potential sources of I&I from private property include: broken sewer laterals; root intrusions into laterals, uncapped sewer cleanouts, and cross connections from roof drains and/or foundation drains. Sump pump cross-connections are an additional source of I&I. Figure 7.1 illustrates potential sources of I&I on private property and public property.

Figure 7.1: Sources of I&I from both Private and Public Property



In the Core Area of the CRD (except for Oak Bay), property owners own and are responsible for maintaining the sewer service laterals on their properties to the property line. The municipality owns and is responsible for maintaining the public sewer mains and the part of the sewer service laterals located between the property line and the sewer mains. In Oak Bay, property owners own and are responsible for maintaining the sewer service laterals from their houses to the sewer mains. The municipality of Oak Bay owns and is responsible for maintaing the public sewer mains. Figures 7.2 and 7.3 illustrate sewer maintenance responsiblilities in the Core Area. It should be noted, however, that in practice, sewer laterals are generally not maintained unless there is a blockage or a collapse.

Figure 7.2: Sewer Maintenance Responsibilities in the Core Area of the CRD (except for Oak Bay)

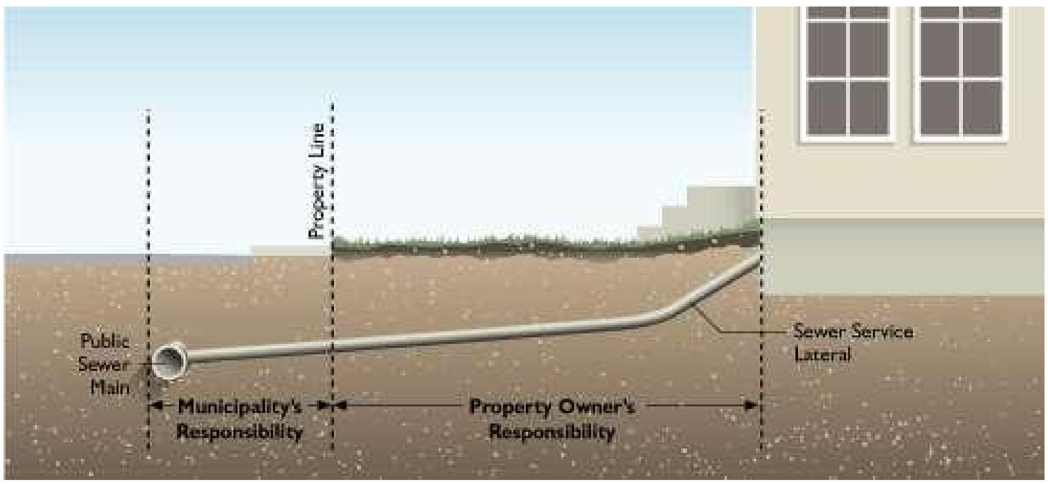
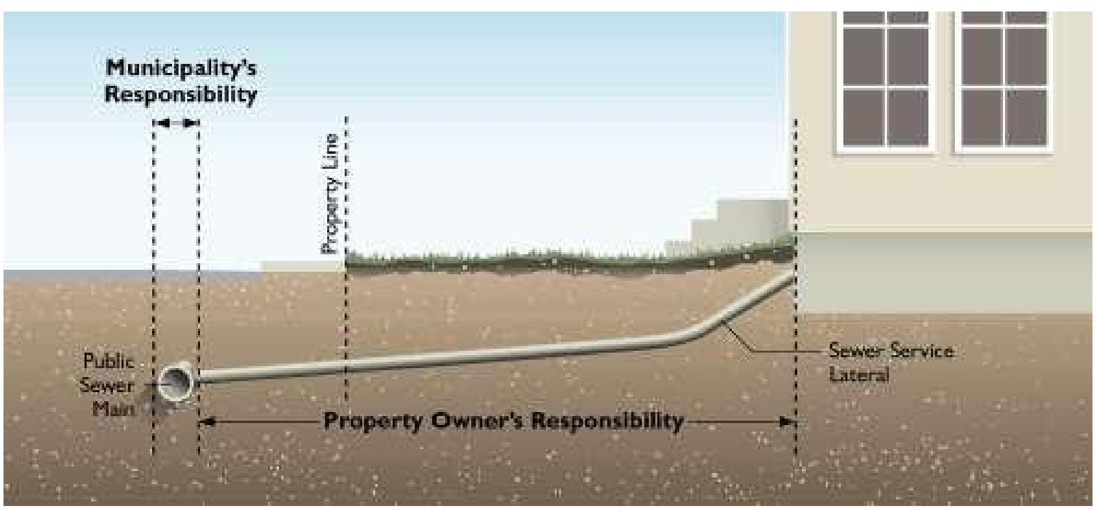


Figure 7.3: Sewer Maintenance Responsibilities in Oak Bay



Private property I&I is a significant source of the I&I in the sewer system. It is estimated that anywhere from 30 - 70% I&I comes from private property sources. This estimate is determined from a large number of sewer rehabilitation studies from Canada and the USA. In the studies, flows were measured in catchments before and after rehabilitation work. The reduction in I&I was atttributed to the rehabilitation works completed. The generalized results of these studies are summarized in the following table.

Table 7.1: General I&I Reductions Resulting from Sewer Rehabilitation Works

Portion of the Sewer System Rehabilitated	Percent Reduction in I&I
public sewers	10 to 50 %
private sewers	30 to 70%

Property property owners generally do not take action to deal with potential I&I on their properties because:

- they are generally not aware that I&I is an issue;
- their properties are generally not affected by the problems associated with I&I;
- they assume that their property has no cross-connections;
- they don’t test their laterals for leaks;
- they are not regulated to do so; and
- they have a disincentive to test for private property I&I because, if needed, the repair costs are high (generally between $2000 and $5000) and the repair work may result in no noticeable benefits to the property owner.

Municipalities generally do not take action to deal with private property I&I because:

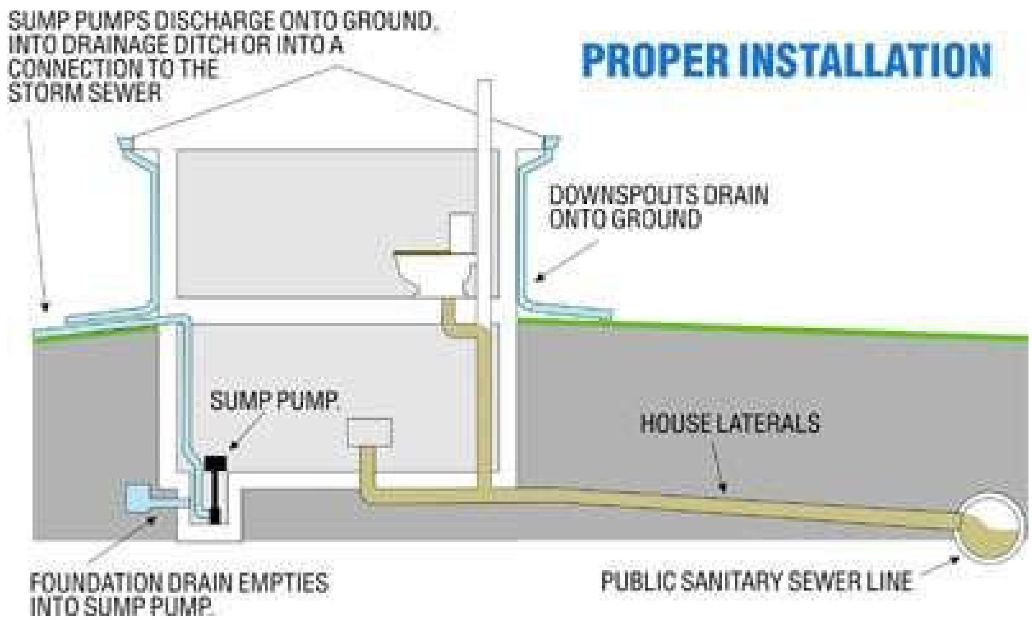
- technically, private property sewers are not owned by the municipality and the municipality does not have the authority to enter onto private property;
- testing for private property I&I (i.e., smoke testing for inflow, video inspection for infiltration) can be expensive and time consuming;
- working on private property could create liability issues for the municipality; and
- Politically, it is difficult to appear fair when dealing with private property I&I. The reason for this is that private property I&I investigations, when conducted, are generally done in small portions of the municipality. If repairs are needed, property owners in these areas are singled out for the repairs. If the municipality pays for the repairs, then property owners in the rest of the municipality feel that their tax dollars are being spent to improve someone else’s property. However, if property owners are forced to pay for the repairs, then they might complain about the fairness of being singled out for the expensive repairs when many other private properties in the municipality may have equal or worse I&I. Additionally, private property owners may not have budgeted and/or simply do not have the money required to pay for the I&I repairs.

7.2 Sump Pump Cross-Connections

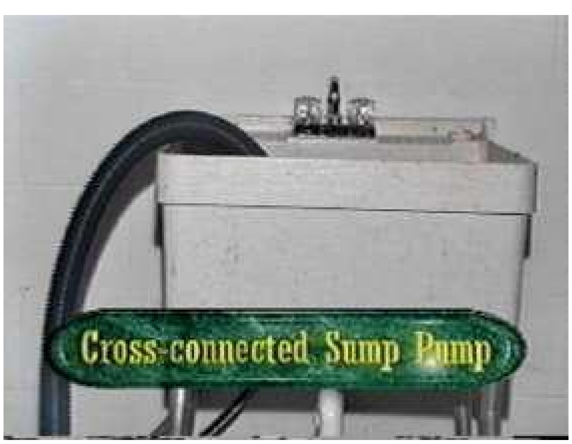
In some buildings, foundation drains and/or basements may be below the level of the the storm sewer system. Therefore, to protect their basements from being flooded, these buildings are usually installed with sump pumps to pump the groundwater from the foundation drains up to an elevation where it can be discharged into the properties storm water system.

Sump pumps should be installed to discharge into the building's stormwater drainage system. However, in some cases, sump pumps are cross-connected and discharge into the sanitary sewer system, usually because it is easier to connect the sump pump to internal plumbing (i.e., laundry sinks or sewer cleanouts) rather than coring through the building's foundation wall and connecting to the storm drain. Cross-connections do not meet the BC plumbing code and have the potential to add significant I&I to the sewer system, especially during storm events.

Figure 7.4: Correctly Connected Sump Pump



Figures 7.5 and 7.6: Examples of Sump Pump Cross Connections



7.3 Current Situation in the Core Area

Currently, there is no compliance program in the CRD to deal with private property I&I.

Oak Bay and Esquimalt are the only Core Area municipalities that have bylaws that relate to private property I&I. Both bylaws require that sewer laterals be assessed and, if needed, fixed if a property has a major renovation (i.e., greater than $100,000). However, property owners may circumvent this requirement, for example, by splitting the renovation over multiple years. In addition, this type of bylaw only relates to a small number of properties.

7.4 Approaches for Addressing Private Property I&I

The following table summarizes a number of potential approached for addressing private property I&I. The approaches may be used on their own or combined with other approaches. The table is based on information taken from the report entitled "Private Sewer Lateral Programs: A Study of Approached and Legal Authority for Metro Vancouver Municipalities". This report prepared for Metro Vancouver, in 2008, by the Sheltair Group.

Table 7.2: Options for Addressing Private Property I&I

Option	Opportunity	Challenges
Rebates Description: Property owners who voluntarily repair faulty laterals would be offered a rebate upon successful completion of the work.	• Legal mechanism already exists for this option. • Many municipalities already have experience using rebate based programs.	• The rebate would need to be substantially large enough to convince residents to fix their laterals.
Deferred Payment / Lien *(may be combined with no interest loans through the municipality)* Description: Property owners would be offered a deferred payment plan to repair their faulty sewer laterals. A lien would be placed on the property to ensure repayment. A no interest loan, through the municipality may be offered as incentive for the work.	• Legal mechanism already exists for this option. • The property owner has the option to pay for the repairs over a long period of time so they are not faced with an immediate financial "hit". The lien on the property would ensure that the municipality is paid back if the property is sold.	• Potential for high capital cost to the municipality (unless options are explored for municipalities to "buy-down" interest from private lenders) • May not be viewed as an incentive. The property owner is essentially paying for the repairs and receiving long term financing to do it.
Municipal tax exemption Description: The Community Charter allows municipalities to implement a partial or full municipal tax exemption for up to 10 years to achieve environmental, economic or social objectives. The exemption could be offered to home owners to deal with faulty sewer laterals. The exemption could be targetted at	• Legal mechanism already exists for this option.	• Municipality loses tax revenue. • Has not been used for sewer infrastructure before. • Requires a bylaw to implement. • Requires considerable planning. The property owner must apply for the exemption well in advance of the rehabiliation work in

Option	Opportunity	Challenges
specific sewer catchments or could be offered broadly to property owners throughout the municipality.		order meet municipal accounting department deadlines, etc.
Bylaw: Fines for non-compliance *(paid at time of enfraction)* Description: A bylaw would be written requiring that private property sewer connections be maintained in good condition to prevent I&I from entering the public sewer system. Infractions of the bylaw would result in immediate fines.	• Fines are regularly used by municipalities for various non-compliance situations.	• Difficult for low or fixed income homeowners. • If properties to be inspected are chosen based on criteria (i.e., age, material, catchment I&I, etc.) then there will need to be substantial public education to explain why specific homes are selected for inspection. • If properties to be inspected are chosen randomly, then the process wouldn't be efficient as many properties in catchments with low I&I would be inspected.
Bylaw: Fines for non-compliance *(paid at time of sale of home)* Description: A bylaw would be written requiring that private property sewer connections be maintained in good condition to prevent I&I into the public system. Infractions of the bylaw would result in a lien on the property which would be payed at the time the property was sold.	• Property owners would need to pay the fines prior to selling their properties in order to remove the liens. • Wise purchasers would verify that there are no outstanding municipal charges, rates or assessments associated with the property, and that the property complies with all local bylaws.	• If properties to be inspected are chosen based on criteria (i.e., age, material, catchment I&I, etc.) then there will need to be substantial public education to explain why specific homes are selected for inspection. • If properties to be inspected are chosen randomly, then the process wouldn't be efficient as many properties in catchments with low I&I would be inspected.

Option	Opportunity	Challenges
Bylaw: Building permits *(requiring compliant sewer laterals prior to granting building permits)* <u>Description</u>: A bylaw would be written that allows the municipality to withhold building permits until a property's sewer lateral is in compliance with the bylaw. The municipality would define the criteria that trigger the bylaw to come into effect. Examples include: • addition of 2+ plumbing fixtures; • renovations over $100,000; • addition of over 400 sq ft to a building on the property.	• Targets aging sewer laterals (based on the assumption that major renovations are generally done on older buildings.) • Only impacts property owners who have money available for renovations.	• Property owners can find ways to circumvent bylaw. For example, they can split the renovation over multiple years to avoid the trigger. • Only accesses a small portion of aging homes.
Bylaw: Terminate water or sewer service <u>Description</u>: Municipal sewer or utility bylaw(s) would be updated to give municipalities the power to discontinue sewer service from private properties that aren't in compliance with the bylaw. If property owners are found out of compliance, they would be given reasonable time to rectify the problem. They may also be given an opportunity to address council prior to disconnection.	• Strong incentive for compliance. • US municipalities that have implemented this find high levels of compliance.	• Politically sensitive. • Very harsh consequences for non-compliance. • Requires comprehensive evaluation program to identify non-compliance. • Difficult for low or fixed income homeowners.
Bylaw: Charge Individual Property owners for work to bring into compliance (through property taxes) <u>Description</u>: A bylaw would be written that allows the municipality to assess private property laterals, if needed repair the laterals, and charge the property owner for the repairs through property taxes.	• Effective at getting work done. • Work is done to City standards. • Municipalities currently use similar mechanisms for other types of work involving private property.	• Requires comprehensive evaluation program to identify non-compliance. • Difficult for low or fixed income homeowners

Option	Opportunity	Challenges
Amendment of the Provincial Land Title Act Description: The Act governs the transfer of properties between owners and includes provisions for adding terms and conditions to the sale. For this option, the Act would be ammended to provide an enforcable mechanism by which municipalities could attach conditions to the sale of properties (i.e., proof of successful sewer lateral inspection / rehabilitation)	• Trigger occurs at the most affordable time for the seller/buyer • Application is equitable • Establishes a recurring process that will maintain private sewer laterals in good condition over the long-term • Transforms the market so that the condition of private sewer laterals becomes a component of house sales (along with age of furnace, condition of roof, etc.) • Program has a broad application which may lead to broader results for reducing wastewater treatment and conveyance costs for the long-term.	• Needs amendment to provincial regulations (*Land Title Act*) which takes a significant length of time.
Provincial regulation: BC Building Code amendment Description: The Code would be updated to include a section on sewer lateral condition. The powers of the code may be triggered by: sale of home, age of home, and/or other defined criteria.	• Depends on the trigger used. • Likely similar to the benefits from the Amendment to the Provincial Land Title Act option.	• Needs modification of provincial regulations (BC Building Code) which takes a significant length of time
Adding a sewer lateral repair fee to all property taxes	• Would minimize impact on individual property owners with defective laterals. • No need to "force" homeowners into compliance.	• Increased property taxes. • Some residents may question the fairness in using public funds to fix private property sewers.

7.5 Path Forward

The CRD and Core Area municipalities will be working together in an effort to address issues of private property I&I. It is likely that the process will require additional research, workshops, political buy-in, and public outreach.

The next steps for addressing private property I&I are as follows:

1. Retain a consultant to provide a detailed investigation of CRD specific options.
2. Hold workshops for municipal engineers to go over the options.
3. Develop options for addressing private property I&I in the CRD.

4. Work towards finding consensus, at the municipal engineer level, on private property I&I options.
5. Prepare a staff report for the Core Area Liquid Waste Management Committee (CALWMC).
6. Receive direction from the CRD Board.

8.0 SANITARY SEWER OVERFLOWS

8.1 Overview

Sanitary sewer overflows (SSOs) are releases of raw sewage into storm drains and/or local waterways. Although the overflows are heavily diluted by rainwater, they still contain some sanitary sewage and, thus are a concern to public health and the environment.

The majority of overflows are caused from excessive I&I. That is, during periods of moderate to heavy rain, so much rainwater finds its way into the sanitary sewer that it exceeds the system's capacity, resulting in overflows. A reduction in I&I may decrease the number of sewer overflows. If, however, I&I is allowed to increase, the sewer capaity will be exceeded more often resulting in additional overflows. For this reason, I&I reduction and control programs are valuable for preventing overflows now and into the future.

Most overflows in the Core Area occur at specific locations designed to overflow when sewer capacity is exceeded, generally due to I&I. Examples of these locations include:

- engineered relief points in manholes and sewer pipes;
- engineered relief points in pump stations wetwells; and
- combined manholes, which can act as relief points if flows from the sanitary sewer spill into the storm sewer.

In addition, overflows may also occur as a result of sewer blockage (from debris, grease, roots), pipe failure and pump station failures.

The CRD and Core Area municipalities have identified each of their overflow locations, refereneced these locations against the adjacent "receiving environment sensitivities, and have records of each of their overflows. This information is used to help prioritize public works related to overflows. For example, pump station failures and blocked pipes must be addressed immediately since they have instant and significant impacts, usually into highly sensitive environments. Overflows that occur during storm events that are less than a 5-year return period must also be addressed in accordance with the Municipal Sewage Regulation (MSR). This usually requires I&I to be reduced and/or the collection capacity to be increased. Power outages are beyond the control of the sewer utility but can be mitigated by providing back-up power to the pump stations, and overflows that occur during storm events greater than 5-year return periods have less priority due to the relative infrequency of those events. Combined sewer overflows, of course, should be corrected by separating the stormwater from the sanitary sewer.

Table 22 summarizes the known potential overflow points in the CRD by category. A map of the Core Area showing these overflow points is located in Figure 8.1. It must be emphasized that, even though there are a large number of known potential overflow locations, the majority of them are never used or infrequently used (such as the combined manholes or emergency pump station overflows).

Table 8.1: Number of Known Potential Overflow Points in the Core Area

Jurisdiction	Pump Stations	Relief Points	Combined Manholes	Total
CRD	14	8	0	22
Colwood	0	0	0	0
Esquimalt	11	0	114	125
Langford	0	0	0	0
Oak Bay	6	0	Uplands is a combined collection system	6 plus Uplands
Saanich	30	0	0	30
Victoria	7	16	98	121
View Royal	12	0	0	12
Total	80	24	212	316

The CRD continuously monitors most of the regional overflow points with overflow sensors and investigates all overflows that occur. In addition, all of the CRD overflows are either screened, in compliance with the municipal sewage regulation, or construction is underway to bring them into compliance. The CRD will continue to monitor its overflow points and implement further improvements to minimize overflow frequency and/or impact.

Most Core Area municipal pump stations have overflow monitors for detecting overflows. However, few municipal relief points or combined manholes are currently monitored for potential overflows.

8.2 Regulatory Requirements

The Municipal Sewage Regulation (MSR) contains a number of requirements regarding sanitary sewer overflows. The regulation:

- only allows sewer overflows for storm events with return periods greater than five years;
- requires that all sewer overflows be reported; and
- requires that existing overflows be identified and addressed as part of a Liquid Waste Management Plan and that measures be taken to eliminate the overflows.

The CRD's Core Area Liquid Waste Management Plan contains a number of additional commitments regarding overflows, including:

- Creating overflow action plans for the Core Area by early 2008. The plans are to include a short-term schedule and estimate of cost for the elimination of sanitary sewer overflows during storm events having less than a 5-year return period.

- Review the need for screening at overflow points and incorporate the screens when necessary.

8.3 Core Area Sanitary Sewer Overflow Management Plan

In June of 2008, the CRD submitted a Sanitary Sewer Overflow Management plan to the Ministry of Environment. The plan documents the known overflow locations in the Core Area of the CRD and includes both municipal and regional sewer infrastructure. Amongst other things, the plan includes:

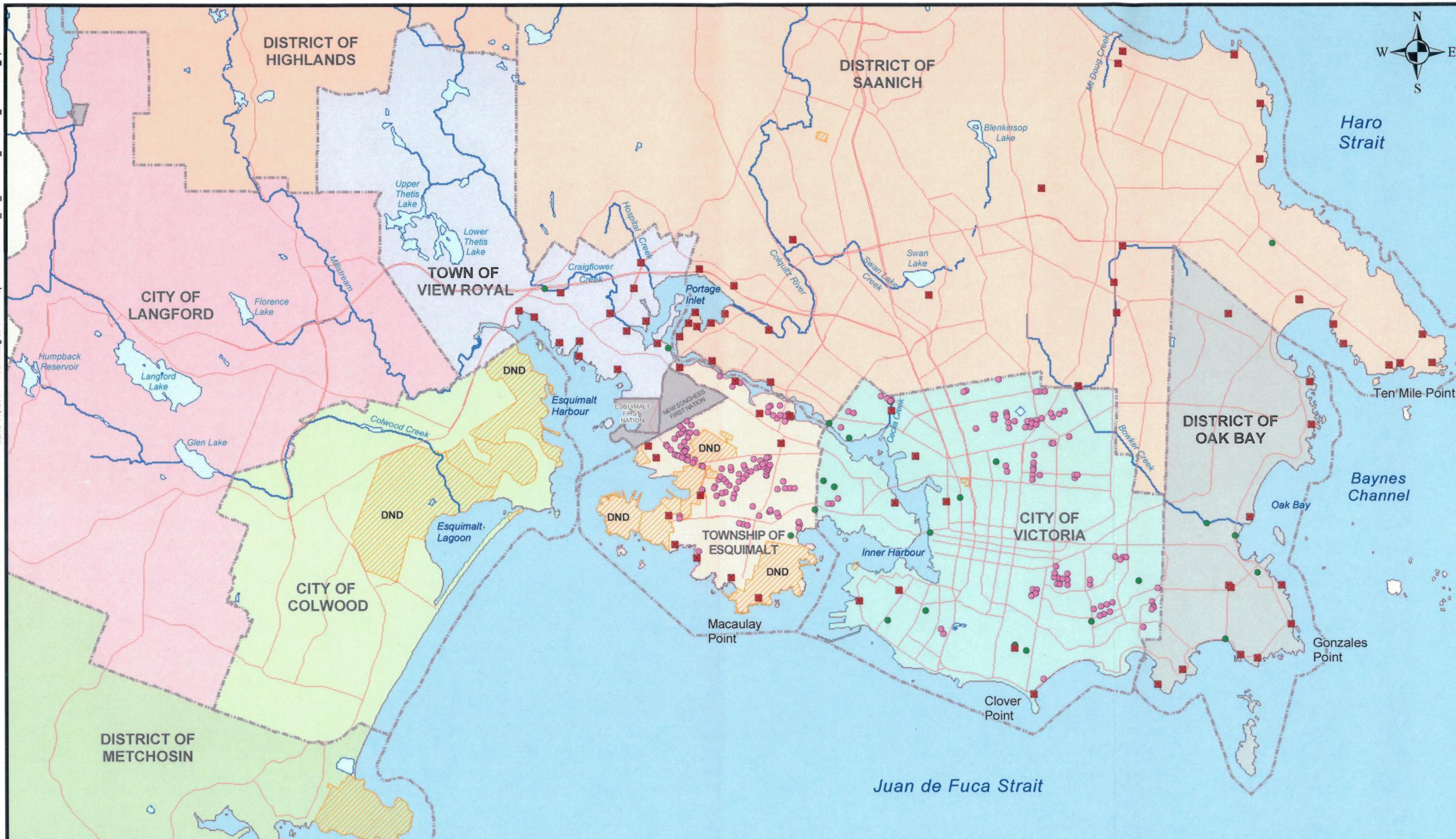
- Standardized “Sanitary Sewer Overflows and Action Plans” tables, which include a list of each of the CRD and Core Area municipalities known overflow locations. Each overflow location has a list of dates of overflows since 2000, a location description, a receiving environment sensititivity rating, short term action items with projected costs, and long term action items with projected costs. Copies of the “Sanitary Sewer Overflows and Action Plans” tables, taken from the 2008 Sanitary Sewer Overflow Management plan, are located in Appendix H.

- Written submissions from the CRD and Core Area municipalities describing planned work related to sewer overflows. Table 8.2 list the top two overflow priorities for the each jurisdiction in the Core Area.

Table 8.2: Top Two Overflow Priorities for Each Core Area Jurisdiction

Jurisdiction	Priority 1 *	Priority 2 *
CRD	Complete and commission Trent pump station, which will eliminate overflows to Bowker Creek at the Monterey Overflow.	Install backup generator at Macaulay Point pump station, which will keep the pumps and screens running during power outages.
Colwood	Upgrade supervisory control and data acquisition (SCADA) at all pump stations to collect flow data.	Continue with regular inspection and maintenance of its system, which is only about 13 years old.
Esquimalt	Complete the $6.75 million rehabilitation upgrades to their sewers.	Continue to separate and eliminate all combined manholes.
Langford	Continue with infrastructure upgrades as identified in Langford’s Sewer Master Plan.	Continue with regular inspection and maintenance of their system, which is only about 10 years old.
Oak Bay	Commence with the Uplands combined sewer separation program.	Continue with the South Oak Bay I&I rehabilitation pilot project.
Saanich	Complete upgrades to the Vantreight and Portage Inlet pump stations, which will eliminate overflows.	Continue to rebuild all pump stations, add standby power and remove overflows where possible.
Victoria	Commence with James Bay rehabilitation / I&I reduction project.	Complete hydraulic model to confirm if combined manholes and relief overflows can be removed.
View Royal	Upgrade pump stations where required to provide standby power and collect better data.	Continue with regular inspection and maintenance of their system, which is only 20 years old.

* Note: *The frequency of overflows will continue to be tracked to measure the success of the work completed.*



Making a difference...together

- Pump Station Overflow Points
- Sanitary MH/Chamber Overflow Points
- Combined Waste Water Manhole
- Municipal and First Nation Reserve Boundaries
- Major Roads
- Streams
- First Nations Reserves
- Department of National Defence Land

0 250 500 1,000 1,500 2,000 Meters

Projection: Universal Transverse Mercator Zone 10 North - North American Datum 1983

Figure 8.1

Summary of Core Area Known Potential Overflow Points

9.0 CONCLUSIONS

The Ministry of Environment (MOE), formerly the Ministry of Water, Land and Air Protection (MWLAP), reviewed and approved the Core Area Liquid Waste Management Plan (LWMP) in 2003. The plan commits to I&I reduction within the Core Area over a 25-year period. In addition, the Ministry's approval letter also requires the elimination of sewage overflows up to a 5-year return period, and a report to be submitted every two years providing details of measures taken in the preceding two years to reduce I&I. This is the third biennial report submitted to fulfill that requirement.

In 2007 and 2008, the Core Area I&I program made good progress in the areas of sewer rehabilitation, sewer inspection, and pilot projects. The sewer rehabilitation works undertaken during this period included the replacement of deteriorating sewer pipe and manholes, sewer relining, the construction of relief sewers, and upgrades of pump stations. The sewer inspection works included continuous flow monitoring, closed circuit television sewer inspections, dye testing, joint testing, smoke testing, and visual sewer inspections. The sewer rehabilitation pilot projects that were completed or initiated have and/or should reduce I&I and overflows and provide valuable cost-benefit information.

It is likely that I&I rates have been reduced in the areas where rehabilitation works have taken place, however, in some cases, pre-rehabilitation I&I data is not available for comparison.

Flow monitoring data was collected and analyzed from 49 locations. Many of the locations are permanent facilities that were analyzed for the first time. These parmanent facilities included CRD pump stations, weirs, and flumes and as well as some City of Langford and City of Victoria pump stations. Attempts were also made to increase the number of permanent locations that provide flow data suitable for I&I analyses.

An analysis of the flow data from the 49 locations is documented in a stand alone I&I analyis report. The data in this report, along with data from previous reports, can be used to track I&I over time, to see if it is getting better or worse, and to help prioritize sewer rehabilitation projects. Based on the data analysed, there is a wide range of I&I responses, between catchments, for different storm events.

Flow monitoring data can be analyzed to determine if the catchments monitored are within the Municipal Sewer Regulation 2.0 times ADWF limit. A number of the locations monitored were above this limit. This is not surprising as it is well known that there are some high I&I areas. In addition, when portable flow meters are used, they are often deployed in areas where I&I is known to be high.

Consultants were retained by some of the municipalities to advise and/or prepare municipal I&I management plans.

Technical I&I related webcasts were viewed by members of the Core Area I&I subcommittee. Webcasts topics included private property I&I case studies, I&I study setup, flow meters technologies, and sewer infrastructure management.

A discussion paper was prepared comparing the global costs of reducing I&I versus the benefit of reduced conveyance and sewage treatment costs.

Options for addressing private property I&I were researched and the information was consolidated. Plans are underway to review the options in a workshop setting with municipal engineers, in 2009, with the goal of bringing the favored options forward to the Board and eventually the politicians.

Educational materials have been created by the CRD to help educate the public on I&I. These materials include a website and a brochure.

A Sanitary Sewer Overflow Management Plan for the Core Area was submitted to the Province in 2008. Among other things, the plan includes overflow action plan tables for the CRD and for each of the Core Area municipalities. Each table includes a list of overflow locations, documented overflows, notes on the receiving environments, and short and/or longterm action plans.

It can take some years to develop a trend that shows if I&I rates are decreasing. Regardless of the rates, the primary goal of the program is to reduce I&I to an optimum cost benefit level that meets the I&I and overflow requirements of the Municipal Sewage Regulation. As noted in the regulation, that could mean that the optimal I&I level is the most cost-effective combination of I&I reduction and I&I accommodation.

10.0 RECOMMENDATIONS

The following recommendations are noted as items to be implemented over the next two years:

- Continue to collect and analyze available pump station SCADA flow data, including data from previous years, if available.
- Collect and analyze available permanent flow monitoring stations, including data from previous years, if available.
- Develop additional public education initiatives with an emphasis on private property I&I. This may include an I&I display that can be set up at public events.
- Build upon the I&I analysis report to include and track I&I rates at all permanent flow meter sites to see if they are getting better or worse over time.
- Continue to use the GIS network database to analyze I&I rates, catchments and sources, and prepare work plans.
- Continue with regional infrastructure upgrades to reduce overflows into sensitive waters.
- Follow up with the CRD and Core Area municipalities regarding their commitments in their overflow action plans.
- Review options for addressing private property I&I with municipal engineers in a workshop setting. Narrow down the options and make recommendations to the Board and, eventually, to the local municipal councils.
- Obtain cost-benefit information, in particular from the pilot rehabilitation programs, to generate regional-specific cost curves.
- Continue with the flow monitoring program to determine baseline I&I rates for all areas.
- Build on the momentum established by the I&I subcommittee to discuss strategy, share information and develop plans.
- Create a long term sewer management plan template that can be offered to the municipalities to help them prepare their long term sewer management plans

These steps will assist in reducing municipal and regional I&I and sewer overflows.

REFERENCES

1. *Core Area Liquid Waste Management Plan*, Capital Regional District, Environmental Services Department, July 2000

2. *GVRD Sewer Condition Reporting Template Standard*, Kerr Wood Leidal/Earthtech, November 2002

3. *Sanitary Sewer Infrastructure Decay Study*, Kerr Wood Leidal Associates Ltd., September 2003

4. *Identification of I&I Reduction and Sewer Rehabilitation Strategies*, Kerr Wood Leidal Associates Ltd., March 2004

5. *City of Victoria Inflow and Infiltration Management Plan,* UMA Engineering Ltd., April 2004

6. *Core Area I&I Analysis Results: 2001-2004 Flow Monitoring Sites*, Capital Regional District, Environmental Services Department, Interim Report February 2005

APPENDIX A

I&I SUBCOMMITTEE REPRESENTATIVES AND OTHER CONTACTS

CAPITAL REGIONAL DISTRICT

CORE AREA – INFLOW AND INFILTRATION SUBCOMMITTEE
REPRESENTATIVES AND OTHER CONTACTS
2009

MUNICIPALITY/NAME	PHONE/FAX	E-MAIL
City of Colwood 3300 Wishart Road Victoria BC V9C 1R1 • Helen Lockhart, PEng Engineer • Michael Baxter, PEng City Engineer	Tel: 250-478-5999 Fax: 250-478-7516	hlockhart@colwood.ca mbaxter@colwood.ca
Township of Esquimalt 1229 Esquimalt Road Victoria BC V9A 3P1 • Gilbert Coté Director of Engineering and Public Works	Tel: 250-414-7108 Fax: 250-414-7160	gcote@esquimalt.ca
City of Langford 2^{nd} floor, 877 Goldstream Avenue Victoria BC V9B 2X8 • Jon Manson City Engineer • Michelle Mahovlich Engineer	Tel: 250-474-0068 Fax: 250-391-3434 Tel: 250-474-0068	jmanson@cityoflangford.ca mmahovlich@cityoflangford.ca
District of Oak Bay 2167 Oak Bay Avenue Victoria BC V8R 1G2 • Dave Marshall Director of Engineering Services • Grace Espedido	Tel: 250-598-3311 Fax: 250-598-9108 Tel: 250-598-3311	dmarshall@oakbaybc.org gespedido@oakbaybc.org
District of Saanich 770 Vernon Avenue Victoria BC V8X 2W7 • Dwayne Halldorson, PEng Manager of Underground Services • Sean Elliott Sewer Infrastructure Technologist	Tel: 250-475-5574 Fax: 250-475-5450 Tel: 250-475-1775	Dwayne.Halldorson@saanich.ca Sean.Elliott@saanich.ca

MUNICIPALITY/NAME	PHONE/FAX	E-MAIL
City of Victoria #1 Centennial Square Victoria BC V8W 1P6 • Steve Fifield Supervisor, Water & Environment • Derk Wevers Pollution Abatement Officer (I&I)	Tel: 250-361-0308 Fax: 250-361-0311 Tel: 250-361-0552 Fax: 250-361-0311	sfifield@victoria.ca dwevers@victoria.ca
Town of View Royal 45 View Royal Avenue Victoria BC V9B 1A6 • Emmet McCusker, Superintendent Engineering and Transportation • Darryl Woodley Engineering Technologist	Tel: 250-479-6800 Fax: 250-727-9551 Tel: 250-479-6800	emccusker@town.viewroyal.bc.ca dwoodley@town.viewroyal.bc.ca
OTHER CONTACTS:		
Department of National Defense Base Construction Engineering Office CFB Esquimalt PO Box 17000 Stn Forces Victoria BC V9A 7N2 • Dan Bonneau Facility Support Manager	Tel: 250-363-2757 Fax: 250-363-5784	bonneau.dc@forces.ca
Royal Roads University 2005 Sooke Road Victoria BC V9B 5Y2 • Bob Hughes	Tel: 250-391-2686 Cel: 250-812-0011	
CRD STAFF RESOURCES:		
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Jim McAloon Engineering Technician CRD Environmental Services 625 Fisgard Street Victoria BC V8W 1R7	Tel: 250-360-3309 Fax: 250-360-3270	jmcaloon@crd.bc.ca
Shane Ruljancich GIS Technologist CRD Environmental Services 625 Fisgard Street Victoria BC V8W 1R7	Tel: 250-360-3006 Fax: 250-360-3270	sruljancich@crd.bc.ca

APPENDIX B

ENGINEERING LIAISON COMMITTEE MEMBERSHIP, PROCEDURE AND ROLE

CAPITAL REGIONAL DISTRICT
ENGINEERING LIAISON COMMITTEE (ELC)
MEMBERSHIP, PROCEDURE AND ROLE

MEMBERS:

- All municipal engineers or their designate
- Appointees from municipalities without municipal engineers
- General Manager, CRD Environmental Services, or his designate
- General Manager, CRD Water, or his designate
- Other members by consensus of the ELC

MEETINGS:

Generally, every second Tuesday of the month (except July, August and December) – 12:00 noon to 2:00 p.m. – lunch included

PROCEDURE:

- Meetings chaired by General Manager, CRD Environmental Services
- Decisions by consensus
- Agendas set by General Manager, CRD Environmental Services, with input from General Manager, CRD Water and municipal engineers (10 days notice for inclusion of agenda item), typically in the following form:
    - Approval of Agenda
    - Approval of Minutes
    - Presentations
    - Water Issues
    - Wastewater / Solid Waste Issues
    - Correspondence
    - Reports for Information
    - Liquid Waste Management Plans
- Agendas, minutes and action lists prepared and circulated by CRD Environmental Services staff

ROLE:

The ELC:

A. is a forum:

1. for the exchange of information on Water and Environmental Services activities
2. for the municipalities to provide input into Water and Environmental Services activities
3. to resolve partnership issues
4. for discussion of strategies for water and wastewater management that affect more than one municipality
5. to exchange advice on mutual issues

B. makes recommendations to the Environment committee on technical matters related to the liquid waste and solid waste services operated by the CRD on behalf of the municipalities

C. acts as a technical review committee for projects and initiatives referred to it by the Environment committee; e.g., onsite management

D. as a sub-group comprising those representatives from the seven core and peninsula municipalities, acts as the technical review committee for liquid waste management plans

E. receives presentations on technical / engineering issues or topics of mutual interest

Approved by ELC 10 Dec 1991
Revised by ELC 12 Sep 2000
Revised by ELC 09 September 2003

APPENDIX C

EXAMPLE GIS MAP
CONTAINING SEWER INFRASTRUCTURE INFORMATION
FOR ESQUIMALT

APPENDIX D

MUNICIPAL SANITARY SEWER SYSTEM INFRASTRUCTURE MANAGEMENT REPORTS

CRD
SANITARY SEWER INFRASTRUCTURE MANAGEMENT REPORT

Capital Regional District								
SANITARY SEWER SYSTEM INFRASTRUCTURE MANAGEMENT REPORT								
Date:	8	April	2009					
REPORTING PERIOD:		From:	01-Jan-	2007	To:	31-Dec-	2008	

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
1.0 SEWER INVENTORY				
1.1 Sanitary gravity sewers	m	57,084		57,084
1.2 Sanitary force mains	m	14280		14,280
1.3 Sanitary service laterals	ea.	0		0
1.4 Combined sewers	m	0		0
1.5 Combined service laterals	ea.	0		0
1.6 No. of manholes/cleanouts	ea.	327		327
2.0 SEWER SYSTEM EVALUATION PROGRAM				
2.1 Smoke Testing				
2.1.1 Sanitary sewers smoke tested	m	0		0
2.1.2 % of entire municipality sewers smoke tested	%	0		0%
2.1.3 No. of sewer deficiencies detected	ea.	0		0
2.1.4 Sanitary service laterals smoke tested	ea.	0		0
2.1.5 % of entire municipality laterals smoke tested	%	0		0%
2.1.6 No. of lateral deficiencies detected by smoke test	ea.	0		0
2.2 Dye Testing				
2.2.1 Sanitary sewers dye tested	m	0		0
2.2.2 % of entire municipality sewers dye tested	%	0		0%
2.2.3 No. of sewer deficiencies detected	ea.	0		0
2.2.4 Sanitary service laterals dye tested	ea.	0		0
2.2.5 % of entire municipality laterals dye tested	%	0		0%
2.2.6 No. of lateral deficiencies detected by dye test	ea.	0		0
2.3 CCTV Inspection of Sewers				
2.3.1 Sanitary sewers CCTV tested	m	3500	4413	7,913
2.3.2 % of entire municipality sewers CCTV tested	%	6%	8%	14%
2.3.3 STRUCTURAL CONDITION				
2.3.3.1 Sewers with a WRc structural rating of 1	m		not yet rated	
2.3.3.2 Sewers with a WRc structural rating of 2	m		not yet rated	
2.3.3.3 Sewers with a WRc structural rating of 3	m		not yet rated	
2.3.3.4 Sewers with a WRc structural rating of 4	m		not yet rated	
2.3.3.5 Sewers with a WRc structural rating of 5	m		not yet rated	
2.4 Air Testing of Sewer Joints				
2.4.1 No. of sewer joints air-tested	ea.	0		0
2.4.2 % of failed sewer joints	%	0		0%
2.5 CCTV Inspection of Service Laterals				
2.5.1 No. of service laterals CCTV inspected	ea.	0		0
2.5.2 % of entire municipality laterals CCTV inspected	%	0		0%
2.5.3 STRUCTURAL CONDITION				
2.5.3.1 Service laterals with a WRc structural rating of 1	ea.	0		0

Description	Unit	Reported to end of this Biennial Report Existing (Prior to this reporting period)	New (During to this reporting period)	Total
2.5.3.2 Service laterals with a WRc structural rating of 2	ea.	0		0
2.5.3.3 Service laterals with a WRc structural rating of 3	ea.	0		0
2.5.3.4 Service laterals with a WRc structural rating of 4	ea.	0		0
2.5.3.5 Service laterals with a WRc structural rating of 5	ea.	0		0
2.6 Visual Inspection of Manholes / Cleanouts				
2.6.1 No. of manholes/cleanouts inspected	ea.		48	48
2.6.2 % of entire municipality manholes/cleanouts inspected	%		15%	15%
2.6.3 No. of structurally defective manholes/cleanouts	ea.			0
2.6.4 No. of leaky manholes/cleanouts	ea.			0
3.0 CAPITAL IMPROVEMENT WORKS				
3.1 Sewer System Rehabilitation				
3.1.1 SEWERS				
3.1.1.1 Length of gravity sewers needing rehabilitation	m			0
3.1.1.2 Length of sewers lined using all lining techniques	m			0
3.1.1.3 Length of sewers grouted using all grouting techniques	m	435		435
3.1.1.4 Length of sewers point repaired	m			0
3.1.1.5 Length of sewers replaced through open cut trench	m			0
3.1.1.6 Length of sewers replaced thru pipe bursting	m			0
3.1.1.7 Length of sewers replaced through sleeve	m			0
3.1.1.8 Length of sewers replaced thru 'other' methods	m			0
3.1.1.9 **Total length of sewers rehabilitated**	**m**	**435**	**0**	**435**
3.1.2 SERVICE LATERALS				
3.1.2.1 No. of services needing rehabilitation	ea.			0
3.1.2.2 No. of service laterals lined using all lining techniques	ea.			0
3.1.2.3 No. of services grouted using all grouting techniques	ea.			0
3.1.2.4 No. of services point repaired	ea.			0
3.1.2.5 No. of services replaced thru open cut trench	ea.			0
3.1.2.6 No. of services replaced thru pipe bursting	ea.			0
3.1.2.7 No. of services replaced through sleeve	ea.			0
3.1.2.8 No. of services replaced thru 'other' methods	ea.			0
3.1.2.9 **Total No. of services rehabilitated**	**ea.**	**0**	**0**	**0**
3.1.3 MANHOLES / CLEANOUTS				
3.1.3.1 No. of manholes/cleanouts repaired	**ea.**	0	48	**48**
3.2 Cross Connection and Other Smoke Test Detected Deficiencies Correction				
3.2.1 No. of cross connections detected	ea.			0
3.2.2 No. of cross connections corrected	ea.			0
3.3 Combined Sewer Separation				
3.3.1 Length of combined sewers separated	m			0
3.3.2 No. of combined services separated	ea.			0
4.0 SANITARY SEWER OVERFLOWS				
4.1 No. of reported SSO due to blockage	ea.			0
4.2 No. of reported SSO due to insufficient capacity	ea.			0
4.3 **Total No. of reported SSO for the period**	**ea.**	**0**	**0**	**0**
5.0 SUMMARY OF COSTS		**Costs for the Reporting Period**		
5.1 Sewer System Evaluation				
5.1.1 Smoke Testing	$			$0
5.1.2 Dye Testing	$			$0

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
5.1.3 CCTV Inspection of Sewers	$	$17,500	$275,000	$292,500
5.1.4 Air Testing of Sewer Joints	$			$0
5.1.5 CCTV Inspection of Service Laterals	$			$0
5.1.6 Visual Inspection of Manholes/Cleanouts	$			$0
5.1.7 Sewer Flow Monitoring	$			$0
5.1.8 Municipal Staff Costs	$			$0
5.2 Capital Improvement Works				
5.2.1 Sewer Rehabilitation	$	$825,000		$825,000
5.2.2 Service Lateral Rehabilitation	$			$0
5.2.3 Manholes/Cleanouts Repair	$		$160,000	$160,000
5.2.4 Cross-connection Rectification	$			$0
5.2.5 Combined Sewer Separation	$			$0
5.2.6 Municipal Staff Costs	$			$0
5.2.7 Other Work (installation of relief sewers)	$	$13,000,000		$13,000,000
TOTAL COST FOR THE BIENNIAL PERIOD	**$**	$13,825,000	**$435,000**	$14,260,000
Submitted by: Jim McAloon	**Signature:**			
Capital Regional District				
625 Fisgard Street, Victoria, BC, V8W 2S6				
Attention:				
Submission Date: January 2009				

COLWOOD
SANITARY SEWER INFRASTRUCTURE MANAGEMENT REPORT

City of Colwood							
SANITARY SEWER SYSTEM INFRASTRUCTURE MANAGEMENT REPORT							
Date:	19	February	2009				
REPORTING PERIOD:	From:	01-Jan-	2007	To:	31-Dec-	2008	

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
1.0 SEWER INVENTORY				
1.1 Sanitary gravity sewers	m	24,304	1,772	26,076
1.2 Sanitary force mains	m	5701	994	6,695
1.3 Sanitary service laterals	ea.	714	225	939
1.4 Combined sewers	m			
1.5 Combined service laterals	ea.			
1.6 No. of manholes/cleanouts	ea.	403	31	434
2.0 SEWER SYSTEM EVALUATION PROGRAM				
2.1 Smoke Testing				
2.1.1 Sanitary sewers smoke tested	m			
2.1.2 % of entire municipality sewers smoke tested	%			
2.1.3 No. of sewer deficiencies detected	ea.			
2.1.4 Sanitary service laterals smoke tested	ea.			
2.1.5 % of entire municipality laterals smoke tested	%			
2.1.6 No. of lateral deficiencies detected by smoke test	ea.			
2.2 Dye Testing				
2.2.1 Sanitary sewers dye tested	m			0
2.2.2 % of entire municipality sewers dye tested	%			0%
2.2.3 No. of sewer deficiencies detected	ea.			0
2.2.4 Sanitary service laterals dye tested	ea.			0
2.2.5 % of entire municipality laterals dye tested	%			0%
2.2.6 No. of lateral deficiencies detected by dye test	ea.			0
2.3 CCTV Inspection of Sewers				
2.3.1 Sanitary sewers CCTV tested	m	24304	1772	26,076
2.3.2 % of entire municipality sewers CCTV tested	%	93%	7%	100%
2.3.3 STRUCTURAL CONDITION				
2.3.3.1 Sewers with a WRc structural rating of 1	m	24304	1772	26076
2.3.3.2 Sewers with a WRc structural rating of 2	m			
2.3.3.3 Sewers with a WRc structural rating of 3	m			
2.3.3.4 Sewers with a WRc structural rating of 4	m			
2.3.3.5 Sewers with a WRc structural rating of 5	m			
2.4 Air Testing of Sewer Joints				
2.4.1 No. of sewer joints air-tested	ea.			0
2.4.2 % of failed sewer joints	%			0%
2.5 CCTV Inspection of Service Laterals				
2.5.1 No. of service laterals CCTV inspected	ea.			0
2.5.2 % of entire municipality laterals CCTV inspected	%			0%
2.5.3 STRUCTURAL CONDITION				
2.5.3.1 Service laterals with a WRc structural rating of 1	ea.	714	225	939

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
2.5.3.2 Service laterals with a WRc structural rating of 2	ea.			0
2.5.3.3 Service laterals with a WRc structural rating of 3	ea.			0
2.5.3.4 Service laterals with a WRc structural rating of 4	ea.			0
2.5.3.5 Service laterals with a WRc structural rating of 5	ea.			0
2.6 Visual Inspection of Manholes / Cleanouts				
2.6.1 No. of manholes/cleanouts inspected	ea.	Each MH is inspected every year		
2.6.2 % of entire municipality manholes/cleanouts inspected	%			100%
2.6.3 No. of structurally defective manholes/cleanouts	ea.			0
2.6.4 No. of leaky manholes/cleanouts	ea.			0
3.0 CAPITAL IMPROVEMENT WORKS				
3.1 Sewer System Rehabilitation				
3.1.1 SEWERS				
3.1.1.1 Length of gravity sewers needing rehabilitation	m			0
3.1.1.2 Length of sewers lined using all lining techniques	m			0
3.1.1.3 Length of sewers grouted using all grouting techniques	m			0
3.1.1.4 Length of sewers point repaired	m			0
3.1.1.5 Length of sewers replaced through open cut trench	m			0
3.1.1.6 Length of sewers replaced thru pipe bursting	m			0
3.1.1.7 Length of sewers replaced through sleeve	m			0
3.1.1.8 Length of sewers replaced thru 'other' methods	m			0
3.1.1.9 **Total length of sewers rehabilitated**	**m**	**0**	**0**	**0**
3.1.2 SERVICE LATERALS				
3.1.2.1 No. of services needing rehabilitation	ea.			0
3.1.2.2 No. of service laterals lined using all lining techniques	ea.			0
3.1.2.3 No. of services grouted using all grouting techniques	ea.			0
3.1.2.4 No. of services point repaired	ea.			0
3.1.2.5 No. of services replaced thru open cut trench	ea.			0
3.1.2.6 No. of services replaced thru pipe bursting	ea.			0
3.1.2.7 No. of services replaced through sleeve	ea.			0
3.1.2.8 No. of services replaced thru 'other' methods	ea.			0
3.1.2.9 **Total No. of services rehabilitated**	**ea.**	**0**	**0**	**0**
3.1.3 MANHOLES / CLEANOUTS				
3.1.3.1 No. of manholes/cleanouts repaired	**ea.**	0	0	**0**
3.2 Cross Connection and Other Smoke Test Detected Deficiencies Correction				
3.2.1 No. of cross connections detected	ea.	2		2
3.2.2 No. of cross connections corrected	ea.	2		2
3.3 Combined Sewer Separation				
3.3.1 Length of combined sewers separated	m			0
3.3.2 No. of combined services separated	ea.			0
4.0 SANITARY SEWER OVERFLOWS				
4.1 No. of reported SSO due to blockage	ea.			0
4.2 No. of reported SSO due to insufficient capacity	ea.			0
4.3 **Total No. of reported SSO for the period**	**ea.**	**0**	**0**	**0**
5.0 SUMMARY OF COSTS		**Costs for the Reporting Period**		
5.1 Sewer System Evaluation				
5.1.1 Smoke Testing	$			$0
5.1.2 Dye Testing	$			$0

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
5.1.3 CCTV Inspection of Sewers	$			$0
5.1.4 Air Testing of Sewer Joints	$			$0
5.1.5 CCTV Inspection of Service Laterals	$			$0
5.1.6 Visual Inspection of Manholes/Cleanouts	$	$66,003	$93,439	$159,442
5.1.7 Sewer Flow Monitoring	$			$0
5.1.8 Municipal Staff Costs	$			$0
5.2 Capital Improvement Works				
5.2.1 Sewer Rehabilitation	$			$0
5.2.2 Service Lateral Rehabilitation	$			$0
5.2.3 Manholes/Cleanouts Repair	$			$0
5.2.4 Cross-connection Rectification	$	$6,742		$6,742
5.2.5 Combined Sewer Separation	$			$0
5.2.6 Municipal Staff Costs	$			$0
5.2.7 Other Work (installation of relief sewers)	$			$0
TOTAL COST FOR THE BIENNIAL PERIOD	**$**	$6,742	**$93,439**	$166,184

Submitted by: Michael Baxter, P.Eng., City Engineer | **Signature:**

Name of Municipality: City of Colwood

Address: 3300 Wishart Road

Victoria, BC V9C 1R1

Submission Date: February 19, 2009

ESQUIMALT
SANITARY SEWER INFRASTRUCTURE MANAGEMENT REPORT

Township of Esquimalt

SANITARY SEWER SYSTEM INFRASTRUCTURE MANAGEMENT REPORT

Date:		February	2009			
REPORTING PERIOD:	From:	01-Jan-	2007	To:	31-Dec-	2008

Description	Unit	Reported to end of this Biennial Report Existing (Prior to this reporting period)	New (During to this reporting period)	Total
1.0 SEWER INVENTORY				
1.1 Sanitary gravity sewers	m	53,498		53,498
1.2 Sanitary force mains	m	3,500		3,500
1.3 Sanitary service laterals	ea.	3,700		3,700
1.4 Combined sewers	m	0		0
1.5 Combined service laterals	ea.	0		0
1.6 No. of manholes/cleanouts	ea.	831		831
2.0 SEWER SYSTEM EVALUATION PROGRAM				
2.1 Smoke Testing				
2.1.1 Sanitary sewers smoke tested	m	3604		3,604
2.1.2 % of entire municipality sewers smoke tested	%	6.7%		6.7%
2.1.3 No. of sewer deficiencies detected	ea.	0		0
2.1.4 Sanitary service laterals smoke tested	ea.	0		0
2.1.5 % of entire municipality laterals smoke tested	%	0		0%
2.1.6 No. of lateral deficiencies detected by smoke test	ea.	0		0
2.2 Dye Testing				
2.2.1 Sanitary sewers dye tested	m	0		0
2.2.2 % of entire municipality sewers dye tested	%	0		0%
2.2.3 No. of sewer deficiencies detected	ea.	0		0
2.2.4 Sanitary service laterals dye tested	ea.	25	69	94
2.2.5 % of entire municipality laterals dye tested	%	0.7	1.8	2.5%
2.2.6 No. of lateral deficiencies detected by dye test	ea.	3	1	4
2.3 CCTV Inspection of Sewers				
2.3.1 Sanitary sewers CCTV tested	m	51215	0	51,215
2.3.2 % of entire municipality sewers CCTV tested	%	96%	0	96%
2.3.3 STRUCTURAL CONDITION				
2.3.3.1 Sewers with a WRc structural rating of 1	m	11379	17324	28,703
2.3.3.2 Sewers with a WRc structural rating of 2	m	7094		7,094
2.3.3.3 Sewers with a WRc structural rating of 3	m	14426	-2613	11,813
2.3.3.4 Sewers with a WRc structural rating of 4	m	5951	-5951	0
2.3.3.5 Sewers with a WRc structural rating of 5	m	8760	-8760	0
2.4 Air Testing of Sewer Joints				
2.4.1 No. of sewer joints air-tested	ea.	938	0	938
2.4.2 % of failed sewer joints	%	46%	0	46%
2.5 CCTV Inspection of Service Laterals				
2.5.1 No. of service laterals CCTV inspected	ea.	35	37	72
2.5.2 % of entire municipality laterals CCTV inspected	%	0.7%	1%	1.7%
2.5.3 STRUCTURAL CONDITION				
2.5.3.1 Service laterals with a WRc structural rating of 1	ea.	0	0	0

Description	Unit	Reported to end of this Biennial Report: Existing (Prior to this reporting period)	New (During to this reporting period)	Total
2.5.3.2 Service laterals with a WRc structural rating of 2	ea.	0	0	0
2.5.3.3 Service laterals with a WRc structural rating of 3	ea.	0	0	0
2.5.3.4 Service laterals with a WRc structural rating of 4	ea.	0	0	0
2.5.3.5 Service laterals with a WRc structural rating of 5	ea.	0	0	0
2.6 Visual Inspection of Manholes / Cleanouts				
2.6.1 No. of manholes/cleanouts inspected	ea.	831	0	831
2.6.2 % of entire municipality manholes/cleanouts inspected	%	100%		100%
2.6.3 No. of structurally defective manholes/cleanouts	ea.	7		7
2.6.4 No. of leaky manholes/cleanouts	ea.			0
3.0 CAPITAL IMPROVEMENT WORKS				
3.1 Sewer System Rehabilitation				
3.1.1 SEWERS				
3.1.1.1 Length of gravity sewers needing rehabilitation	m	12277	-12277	0
3.1.1.2 Length of sewers lined using all lining techniques	m	6102	12277	18,379
3.1.1.3 Length of sewers grouted using all grouting techniques	m	988	0	988
3.1.1.4 Length of sewers point repaired	m	680	0	680
3.1.1.5 Length of sewers replaced through open cut trench	m	0	0	0
3.1.1.6 Length of sewers replaced thru pipe bursting	m	0	0	0
3.1.1.7 Length of sewers replaced through sleeve	m	0	0	0
3.1.1.8 Length of sewers replaced thru 'other' methods	m	0	0	0
3.1.1.9 **Total length of sewers rehabilitated**	**m**	**7770**	**12277**	**20,047**
3.1.2 SERVICE LATERALS				
3.1.2.1 No. of services needing rehabilitation	ea.	0		0
3.1.2.2 No. of service laterals lined using all lining techniques	ea.	0		0
3.1.2.3 No. of services grouted using all grouting techniques	ea.	0		0
3.1.2.4 No. of services point repaired	ea.	0		0
3.1.2.5 No. of services replaced thru open cut trench	ea.	37	73	110
3.1.2.6 No. of services replaced thru pipe bursting	ea.	0		0
3.1.2.7 No. of services replaced through sleeve	ea.	0		0
3.1.2.8 No. of services replaced thru 'other' methods	ea.	0		0
3.1.2.9 **Total No. of services rehabilitated**	**ea.**	**37**	**73**	**110**
3.1.3 MANHOLES / CLEANOUTS				
3.1.3.1 No. of manholes/cleanouts repaired	**ea.**	0	73	**73**
3.2 Cross Connection and Other Smoke Test Detected Deficiencies Correction				
3.2.1 No. of cross connections detected	ea.	0	1	1
3.2.2 No. of cross connections corrected	ea.	0	1	1
3.3 Combined Sewer Separation				
3.3.1 Length of combined sewers separated	m	n.a.	n.a.	0
3.3.2 No. of combined services separated	ea.	n.a.	n.a.	0
4.0 SANITARY SEWER OVERFLOWS				
4.1 No. of reported SSO due to blockage	ea.	0	0	0
4.2 No. of reported SSO due to insufficient capacity	ea.	0		0
4.3 **Total No. of reported SSO for the period**	**ea.**	**0**	**0**	**0**
5.0 SUMMARY OF COSTS		**Costs for the Reporting Period**		
5.1 Sewer System Evaluation				
5.1.1 Smoke Testing	$	$0		$0
5.1.2 Dye Testing	$	$0	$6,272	$6,272

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
5.1.3 CCTV Inspection of Sewers	$	$450,296		$450,296
5.1.4 Air Testing of Sewer Joints	$	$0		$0
5.1.5 CCTV Inspection of Service Laterals	$	$2,000		$2,000
5.1.6 Visual Inspection of Manholes/Cleanouts	$	$0		$0
5.1.7 Sewer Flow Monitoring	$	$61,000	$5,363	$66,363
5.1.8 Municipal Staff Costs	$			$0
5.2 Capital Improvement Works				
5.2.1 Sewer Rehabilitation	$	$1,455,642	$1,734,129	$3,189,771
5.2.2 Service Lateral Rehabilitation	$	$85,000		$85,000
5.2.3 Manholes/Cleanouts Repair	$	$17,732	$763,308	$781,040
5.2.4 Cross-connection Rectification	$	$0	$5,000	$5,000
5.2.5 Combined Sewer Separation	$			$0
5.2.6 Engineering Fees	$	$85,663	$162,439	$248,102
5.2.7 Other Work - Pumping Station Upgrades	$	$331,109	$461,515	$792,624
TOTAL COST FOR THE BIENNIAL PERIOD	**$**	**$2,488,442**	**$3,138,026**	**$5,626,468**

Submitted by: Gilbert Cote, Peng	**Signature:**
Name of Municipality: Township of Esquimalt	
1229 Esquimalt Road A146	
Victoria BC, V9A 3P1+A28	
Attention:	
Submission Date: February 14, 2009	

LANGFORD
SANITARY SEWER INFRASTRUCTURE MANAGEMENT REPORT

City of Langford								
SANITARY SEWER SYSTEM INFRASTRUCTURE MANAGEMENT REPORT								
Date:	6	February	2009	Langford				
REPORTING PERIOD:	From:	01-Jan-	2007	To:	31-Dec-	2008		

Description	Unit	Reported to end of this Biennial Report: Existing (Prior to this reporting period)	New (During to this reporting period)	Total
1.0 SEWER INVENTORY				
1.1 Sanitary gravity sewers	m	66,300	16,138	82,438
1.2 Sanitary force mains	m	17,071	0	17,071
1.3 Sanitary service laterals	ea.	2,478	772	3,250
1.4 Combined sewers	m			0
1.5 Combined service laterals	ea.			0
1.6 No. of manholes/cleanouts	ea.	648	283	931
2.0 SEWER SYSTEM EVALUATION PROGRAM				
2.1 Smoke Testing				
2.1.1 Sanitary sewers smoke tested	m			0
2.1.2 % of entire municipality sewers smoke tested	%			0%
2.1.3 No. of sewer deficiencies detected	ea.			0
2.1.4 Sanitary service laterals smoke tested	ea.			0
2.1.5 % of entire municipality laterals smoke tested	%			0%
2.1.6 No. of lateral deficiencies detected by smoke test	ea.			0
2.2 Dye Testing				
2.2.1 Sanitary sewers dye tested	m			0
2.2.2 % of entire municipality sewers dye tested	%			0%
2.2.3 No. of sewer deficiencies detected	ea.			0
2.2.4 Sanitary service laterals dye tested	ea.			0
2.2.5 % of entire municipality laterals dye tested	%			0%
2.2.6 No. of lateral deficiencies detected by dye test	ea.			0
2.3 CCTV Inspection of Sewers				
2.3.1 Sanitary sewers CCTV tested	m	12,000	12,400	24,400
2.3.2 % of entire municipality sewers CCTV tested	%	18%	15%	30%
2.3.3 STRUCTURAL CONDITION				
2.3.3.1 Sewers with a WRc structural rating of 1	m			0
2.3.3.2 Sewers with a WRc structural rating of 2	m			0
2.3.3.3 Sewers with a WRc structural rating of 3	m			0
2.3.3.4 Sewers with a WRc structural rating of 4	m			0
2.3.3.5 Sewers with a WRc structural rating of 5	m			0
2.4 Air Testing of Sewer Joints				
2.4.1 No. of sewer joints air-tested	ea.			0
2.4.2 % of failed sewer joints	%			0%
2.5 CCTV Inspection of Service Laterals				
2.5.1 No. of service laterals CCTV inspected	ea.			0
2.5.2 % of entire municipality laterals CCTV inspected	%			0%
2.5.3 STRUCTURAL CONDITION				
2.5.3.1 Service laterals with a WRc structural rating of 1	ea.			0

Description	Unit	Reported to end of this Biennial Report: Existing (Prior to this reporting period)	New (During to this reporting period)	Total
2.5.3.2 Service laterals with a WRc structural rating of 2	ea.			0
2.5.3.3 Service laterals with a WRc structural rating of 3	ea.			0
2.5.3.4 Service laterals with a WRc structural rating of 4	ea.			0
2.5.3.5 Service laterals with a WRc structural rating of 5	ea.			0
2.6 Visual Inspection of Manholes / Cleanouts				
2.6.1 No. of manholes/cleanouts inspected	ea.	131	132	263
2.6.2 % of entire municipality manholes/cleanouts inspected	%	20%	14%	28%
2.6.3 No. of structurally defective manholes/cleanouts	ea.	1	0	1
2.6.4 No. of leaky manholes/cleanouts	ea.	2	0	2
3.0 CAPITAL IMPROVEMENT WORKS				
3.1 Sewer System Rehabilitation				
3.1.1 **SEWERS**				
3.1.1.1 Length of gravity sewers needing rehabilitation	m			0
3.1.1.2 Length of sewers lined using all lining techniques	m			0
3.1.1.3 Length of sewers grouted using all grouting techniques	m			0
3.1.1.4 Length of sewers point repaired	m			0
3.1.1.5 Length of sewers replaced through open cut trench	m			0
3.1.1.6 Length of sewers replaced thru pipe bursting	m			0
3.1.1.7 Length of sewers replaced through sleeve	m			0
3.1.1.8 Length of sewers replaced thru 'other' methods	m			0
3.1.1.9 **Total length of sewers rehabilitated**	**m**	**0**	**0**	**0**
3.1.2 **SERVICE LATERALS**				
3.1.2.1 No. of services needing rehabilitation	ea.		84	84
3.1.2.2 No. of service laterals lined using all lining techniques	ea.			0
3.1.2.3 No. of services grouted using all grouting techniques	ea.			0
3.1.2.4 No. of services point repaired	ea.		84	84
3.1.2.5 No. of services replaced thru open cut trench	ea.			0
3.1.2.6 No. of services replaced thru pipe bursting	ea.			0
3.1.2.7 No. of services replaced through sleeve	ea.			0
3.1.2.8 No. of services replaced thru 'other' methods	ea.			0
3.1.2.9 **Total No. of services rehabilitated**	**ea.**	**0**	**84**	**84**
3.1.3 **MANHOLES / CLEANOUTS**				
3.1.3.1 No. of manholes/cleanouts repaired	**ea.**	**3**	**0**	**3**
3.2 Cross Connection and Other Smoke Test Detected Deficiencies Correction				
3.2.1 No. of cross connections detected	ea.	0	0	0
3.2.2 No. of cross connections corrected	ea.	0	0	0
3.3 Combined Sewer Separation				
3.3.1 Length of combined sewers separated	m	0	0	0
3.3.2 No. of combined services separated	ea.	0	0	0
4.0 SANITARY SEWER OVERFLOWS				
4.1 No. of reported SSO due to blockage	ea.	0	0	0
4.2 No. of reported SSO due to insufficient capacity	ea.	0	0	0
4.3 **Total No. of reported SSO for the period**	**ea.**	**0**	**0**	**0**
5.0 SUMMARY OF COSTS		**Costs for the Reporting Period**		
5.1 Sewer System Evaluation				
5.1.1 Smoke Testing	$			$0
5.1.2 Dye Testing	$			$0

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
5.1.3 CCTV Inspection of Sewers	$	$28,603	$12,466	$41,069
5.1.4 Air Testing of Sewer Joints	$			$0
5.1.5 CCTV Inspection of Service Laterals	$			$0
5.1.6 Visual Inspection of Manholes/Cleanouts	$	$4,636	$4,859	$9,495
5.1.7 Sewer Flow Monitoring	$			$0
5.1.8 Municipal Staff Costs	$			$0
5.2 Capital Improvement Works				
5.2.1 Sewer Rehabilitation	$	$0		$0
5.2.2 Service Lateral Rehabilitation	$	$7,896	$13,440	$21,336
5.2.3 Manholes/Cleanouts Repair	$	$2,000	$0	$2,000
5.2.4 Cross-connection Rectification	$			$0
5.2.5 Combined Sewer Separation	$			$0
5.2.6 Municipal Staff Costs	$			$0
5.2.7 Other Work	$			$0
TOTAL COST FOR THE BIENNIAL PERIOD	**$**	**$43,135**	**$30,765**	**$73,900**
Submitted by: I. Vaughan, Operations Manager WSES	**Signature:**			
Name of Municipality: City of Langford				
Address line 1: c/o Westshore Environmental Services(WSES)				
Address line 2: 103, 859 Orono Avenue, Langford, BC V9B 2T9				
Attention:				
Submission Date: 24 Feb 09				

OAK BAY
SANITARY SEWER INFRASTRUCTURE MANAGEMENT REPORT

The Corporation of the District of Oak Bay							
SANITARY SEWER SYSTEM INFRASTRUCTURE MANAGEMENT REPORT							
Date:	15	Jan	2009				
REPORTING PERIOD:	From:	01-Jan-	2007	To:	31-Dec-	2008	

Description	Unit	Reported to end of this Biennial Report: Existing (Prior to this reporting period)	New (During to this reporting period)	Total
1.0 SEWER INVENTORY				
1.1 Sanitary gravity sewers	m	105,833		
1.2 Sanitary force mains	m	402	182	584
1.3 Sanitary service laterals	ea.	8479	3	8,482
1.4 Combined sewers	m	8775		8,775
1.5 Combined service laterals	ea.	422	3	425
1.6 No. of manholes/cleanouts	ea.	1069	5	1,074
Added by GE Esplanade new 150mm SD main?	m		40	40
2.0 SEWER SYSTEM EVALUATION PROGRAM				
2.1 Smoke Testing				
2.1.1 Sanitary sewers smoke tested	m	0		0
2.1.2 % of entire municipality sewers smoke tested	%	0	0	0
2.1.3 No. of sewer deficiencies detected	ea.	0	0	0
2.1.4 Sanitary service laterals smoke tested	ea.	350	0	350
2.1.5 % of entire municipality laterals smoke tested	%	4	0	4
2.1.6 No. of lateral deficiencies detected by smoke test	ea.	200	0	200
2.2 Dye Testing				
2.2.1 Sanitary sewers dye tested	m	25374	0	25,374
2.2.2 % of entire municipality sewers dye tested	%	24.2	0	24
2.2.3 No. of sewer deficiencies detected	ea.	0	0	0
2.2.4 Sanitary service laterals dye tested	ea.	976	28	1,004
2.2.5 % of entire municipality laterals dye tested	%	12	1.2	13
2.2.6 No. of lateral deficiencies detected by dye test	ea.	20	28	48
2.3 CCTV Inspection of Sewers				
2.3.1 Sanitary sewers CCTV tested	m	106677	3,917	110,594
2.3.2 % of entire municipality sewers CCTV tested	%	101.94		100%
2.3.3 STRUCTURAL CONDITION				
2.3.3.1 Sewers with a WRc structural rating of 1	m	not yet rated		
2.3.3.2 Sewers with a WRc structural rating of 2	m	not yet rated		
2.3.3.3 Sewers with a WRc structural rating of 3	m	not yet rated		
2.3.3.4 Sewers with a WRc structural rating of 4	m	not yet rated		
2.3.3.5 Sewers with a WRc structural rating of 5	m	not yet rated		
2.4 Air Testing of Sewer Joints				
2.4.1 No. of sewer joints air-tested	ea.	0	0	0
2.4.2 % of failed sewer joints	%	0	0	0%
2.5 CCTV Inspection of Service Laterals				
2.5.1 No. of service laterals CCTV inspected	ea.	0	0	0
2.5.2 % of entire municipality laterals CCTV inspected	%	0	0	0%
2.5.3 STRUCTURAL CONDITION				
2.5.3.1 Service laterals with a WRc structural rating of 1	ea.	owners responsibility		

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	**New** (During to this reporting period)	**Total**
2.5.3.2 Service laterals with a WRc structural rating of 2	ea.	owners responsibility		
2.5.3.3 Service laterals with a WRc structural rating of 3	ea.	owners responsibility		
2.5.3.4 Service laterals with a WRc structural rating of 4	ea.	owners responsibility		
2.5.3.5 Service laterals with a WRc structural rating of 5	ea.	owners responsibility		
2.6 Visual Inspection of Manholes / Cleanouts				
2.6.1 No. of manholes/cleanouts inspected	ea.	40	100	140
2.6.2 % of entire municipality manholes/cleanouts inspected	%	0.02	0.084	8.22%
2.6.3 No. of structurally defective manholes/cleanouts	ea.	20	0	20
2.6.4 No. of leaky manholes/cleanouts	ea.	10	0	10
3.0 CAPITAL IMPROVEMENT WORKS				
3.1 Sewer System Rehabilitation				
3.1.1 **SEWERS**				
3.1.1.1 Length of gravity sewers needing rehabilitation	m	not known		
3.1.1.2 Length of sewers lined using all lining techniques	m	920	0	920
3.1.1.3 Length of sewers grouted using all grouting techniques	m	0	0	0
3.1.1.4 Length of sewers point repaired	m	340	0	340
3.1.1.5 Length of sewers replaced through open cut trench	m	100	811	911
3.1.1.6 Length of sewers replaced thru pipe bursting	m	0	214	214
3.1.1.7 Length of sewers replaced through sleeve	m	12	0	12
3.1.1.8 Length of sewers replaced thru 'other' methods	m	0	0	0
3.1.1.9 **Total length of sewers rehabilitated**	**m**	**1372**	**1025**	**2,397**
3.1.2 **SERVICE LATERALS**				
3.1.2.1 No. of services needing rehabilitation	ea.	not known		
3.1.2.2 No. of service laterals lined using all lining techniques	ea.	0		0
3.1.2.3 No. of services grouted using all grouting techniques	ea.	0		0
3.1.2.4 No. of services point repaired	ea.	1		1
3.1.2.5 No. of services replaced thru open cut trench	ea.	110	142	252
3.1.2.6 No. of services replaced thru pipe bursting	ea.	3		3
3.1.2.7 No. of services replaced through sleeve	ea.	0		0
3.1.2.8 No. of services replaced thru 'other' methods	ea.	0		0
3.1.2.9 No. of service cleanouts installed/repaired	ea.	unknown	142	142
3.1.2.10 **Total No. of services rehabilitated**	**ea.**	**110**	**142**	**398**
3.1.3 **MANHOLES / CLEANOUTS**				
3.1.3.1 No. of manholes/cleanouts repaired	**ea.**	9	19	**28**
3.2 Cross Connection and Other Smoke Test Detected Deficiencies Correction				
3.2.1 No. of cross connections detected	ea.	223	27	250
3.2.2 No. of cross connections corrected	ea.	219	21	240
3.3 Combined Sewer Separation				
3.3.1 Length of combined sewers separated	m	0		0
3.3.2 No. of combined services separated	ea.	7		7
4.0 SANITARY SEWER OVERFLOWS				
4.1 No. of reported SSO due to blockage	ea.	0		0
4.2 No. of reported SSO due to insufficient capacity	ea.	0		0
4.3 **Total No. of reported SSO for the period***	**ea.**	**12**	**0**	**12**
*(*note: due to power outages: Rutland and Humber not included (CSOs) - CRD monitors)*				
5.0 SUMMARY OF COSTS		**Costs for the Reporting Period**		
5.1 Sewer System Evaluation				
5.1.1 Smoke Testing	$		$0	$0

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
5.1.2 Dye Testing	$		$2,500	$2,500
5.1.3 CCTV Inspection of Sewers	$		$64,000	$64,000
5.1.4 Air Testing of Sewer Joints	$		$0	$0
5.1.5 CCTV Inspection of Service Laterals	$		$10,000	$10,000
5.1.6 Visual Inspection of Manholes/Cleanouts	$		$5,500	$5,500
5.1.7 Sewer Flow Monitoring	$		$24,000	$24,000
5.1.8 Municipal Staff Costs	$		$15,000	$15,000
5.2 Capital Improvement Works				
5.2.1 Sewer Rehabilitation	$		$97,000	$97,000
5.2.2 Service Lateral Rehabilitation	$		$0	$0
5.2.3 Manholes/Cleanouts Repair	$		$40,000	$40,000
5.2.4 Cross-connection Rectification	$		$20,000	$20,000
5.2.5 Combined Sewer Separation	$		$40,000	$40,000
5.2.6 Municipal Staff Costs	$		$17,000	$17,000
5.2.7 Other Work	$		$0	$0
TOTAL COST FOR THE BIENNIAL PERIOD	**$**	**$0**	**$335,000**	$335,000
Submitted by: David Marshall	**Signature:**			
Name of Municipality: The Corporation District of Oak Bay				
Address: 2167 Oak Bay Avenue, Victoria, B.C., V8R 1G6				
Submission Date: January 15, 2009				

SAANICH

SANITARY SEWER INFRASTRUCTURE MANAGEMENT REPORT

DISTRICT OF SAANICH					
SANITARY SEWER SYSTEM INFRASTRUCTURE MANAGEMENT REPORT					
Date: 1 April 2009					
REPORTING PERIOD: From: 01-Jan- 2007		To: 31-Dec- 2008			
			Reported to end of this Biennial Report		
Description		**Unit**	**Existing** (Prior to this reporting period)	**New** (During to this reporting period)	**Total**
1.0	**SEWER INVENTORY**				
1.1	Sanitary gravity sewers	m	565,542	760	566,302
1.2	Sanitary force mains	m	17034	750	17,784
1.3	Sanitary service laterals	ea.	29706	76	29,782
1.4	Combined sewers	m	0	0	0
1.5	Combined service laterals	ea.	0	0	0
1.6	No. of manholes/cleanouts	ea.	8712	40	8,752
2.0	**SEWER SYSTEM EVALUATION PROGRAM**				
2.1	**Smoke Testing**				
2.1.1	Sanitary sewers smoke tested	m	1809	0	1,809
2.1.2	% of entire municipality sewers smoke tested	%	0	0	0%
2.1.3	No. of sewer deficiencies detected	ea.	0	0	0
2.1.4	Sanitary service laterals smoke tested	ea.	0	0	0
2.1.5	% of entire municipality laterals smoke tested	%	0	0	0%
2.1.6	No. of lateral deficiencies detected by smoke test	ea.	4	0	4
2.2	**Dye Testing**				
2.2.1	Sanitary sewers dye tested	m	0	0	0
2.2.2	% of entire municipality sewers dye tested	%	0	0	0%
2.2.3	No. of sewer deficiencies detected	ea.	0	0	0
2.2.4	Sanitary service laterals dye tested	ea.	338	0	338
2.2.5	% of entire municipality laterals dye tested	%	0	0	0%
2.2.6	No. of lateral deficiencies detected by dye test	ea.	5	0	5
2.3	**CCTV Inspection of Sewers**				
2.3.1	Sanitary sewers CCTV tested	m	10860	10700	21,560
2.3.2	% of entire municipality sewers CCTV tested	%	0	0	0%
2.3.3	**STRUCTURAL CONDITION**				
2.3.3.1	Sewers with a WRc structural rating of 1	m	10860	47	10,907
2.3.3.2	Sewers with a WRc structural rating of 2	m	0	28	28
2.3.3.3	Sewers with a WRc structural rating of 3	m	0	2	2
2.3.3.4	Sewers with a WRc structural rating of 4	m	0	47	47
2.3.3.5	Sewers with a WRc structural rating of 5	m	0	4	4
2.4	**Air Testing of Sewer Joints**				
2.4.1	No. of sewer joints air-tested	ea.	0	0	0
2.4.2	% of failed sewer joints	%	0	0	0%
2.5	**CCTV Inspection of Service Laterals**				
2.5.1	No. of service laterals CCTV inspected	ea.	185	0	185
2.5.2	% of entire municipality laterals CCTV inspected	%	0	0	0%
2.5.3	**STRUCTURAL CONDITION**				
2.5.3.1	Service laterals with a WRc structural rating of 1	ea.	103	0	103

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
2.5.3.2 Service laterals with a WRc structural rating of 2	ea.	0	0	0
2.5.3.3 Service laterals with a WRc structural rating of 3	ea.	0	0	0
2.5.3.4 Service laterals with a WRc structural rating of 4	ea.	0	0	0
2.5.3.5 Service laterals with a WRc structural rating of 5	ea.	82	0	82
2.6 Visual Inspection of Manholes / Cleanouts				
2.6.1 No. of manholes/cleanouts inspected	ea.	207	280	487
2.6.2 % of entire municipality manholes/cleanouts inspected	%	0	0	0%
2.6.3 No. of structurally defective manholes/cleanouts	ea.	143	0	143
2.6.4 No. of leaky manholes/cleanouts	ea.	0	0	0
3.0 CAPITAL IMPROVEMENT WORKS				
3.1 Sewer System Rehabilitation				
3.1.1 **SEWERS**				
3.1.1.1 Length of gravity sewers needing rehabilitation	m	0	0	0
3.1.1.2 Length of sewers lined using all lining techniques	m	0	0	0
3.1.1.3 Length of sewers grouted using all grouting techniques	m	0	0	0
3.1.1.4 Length of sewers point repaired	m	0	0	0
3.1.1.5 Length of sewers replaced through open cut trench	m	806	705	1,511
3.1.1.6 Length of sewers replaced thru pipe bursting	m	0	395	395
3.1.1.7 Length of sewers replaced through sleeve	m	0	0	0
3.1.1.8 Length of sewers replaced thru 'other' methods	m	0	0	0
3.1.1.9 **Total length of sewers rehabilitated**	**m**	**806**	**1100**	**1,906**
3.1.2 **SERVICE LATERALS**				
3.1.2.1 No. of services needing rehabilitation	ea.	0	0	0
3.1.2.2 No. of service laterals lined using all lining techniques	ea.	3	0	3
3.1.2.3 No. of services grouted using all grouting techniques	ea.	0	0	0
3.1.2.4 No. of services point repaired	ea.	0	0	0
3.1.2.5 No. of services replaced thru open cut trench	ea.	129	196	325
3.1.2.6 No. of services replaced thru pipe bursting	ea.	0	48	48
3.1.2.7 No. of services replaced through sleeve	ea.	0	0	0
3.1.2.8 No. of services replaced thru 'other' methods	ea.	0	0	0
3.1.2.9 **Total No. of services rehabilitated**	**ea.**	**132**	**244**	**376**
3.1.3 **MANHOLES / CLEANOUTS**				
3.1.3.1 No. of manholes/cleanouts repaired	**ea.**	135	54	**189**
3.2 Cross Connection and Other Smoke Test Detected Deficiencies Correction				
3.2.1 No. of cross connections detected	ea.	5	0	5
3.2.2 No. of cross connections corrected	ea.	5	0	5
3.3 Combined Sewer Separation				
3.3.1 Length of combined sewers separated	m	0	0	0
3.3.2 No. of combined services separated	ea.	0	0	0
4.0 SANITARY SEWER OVERFLOWS				
4.1 No. of reported SSO due to blockage	ea.	3	5	8
4.2 No. of reported SSO due to insufficient capacity	ea.	11	15	26
4.3 Total No. of reported SSO for the period	**ea.**	**14**	**20**	**34**
5.0 SUMMARY OF COSTS		**Costs for the Reporting Period**		
5.1 Sewer System Evaluation				
5.1.1 Smoke Testing	$	$0		$0
5.1.2 Dye Testing	$	$0		$0

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
5.1.3 CCTV Inspection of Sewers	$	$215,500		$215,500
5.1.4 Air Testing of Sewer Joints	$	$0		$0
5.1.5 CCTV Inspection of Service Laterals	$	$20,000		$20,000
5.1.6 Visual Inspection of Manholes/Cleanouts	$	$38,800		$38,800
5.1.7 Sewer Flow Monitoring	$	$0		$0
5.1.8 Municipal Staff Costs	$	$35,000		$35,000
5.2 Capital Improvement Works				
5.2.1 Sewer Rehabilitation	$	$596,000	$902,000	$1,498,000
5.2.2 Service Lateral Rehabilitation	$	$277,200	$450,000	$727,200
5.2.3 Manholes/Cleanouts Repair	$	$169,000	$150,000	$319,000
5.2.4 Cross-connection Rectification	$	$20,000	$0	$20,000
5.2.5 Combined Sewer Separation	$	$0	$0	$0
5.2.6 Municipal Staff Costs	$	$28,000	$90,000	$118,000
5.2.7 Other Work	$	$0	$0	$0
TOTAL COST FOR THE BIENNIAL PERIOD	**$**	$0	**$1,592,000**	$1,592,000

Submitted by: Sean Elliott, A.Sc.T
Sewer Infrastructure Technologist

Signature:

Name of Municipality: District of Saanich

Address line 1: 770 Vernon Ave., Victoria, B.C., V8X 2W7

Address line 2

Attention:

Submission Date: March 27, 2009

VICTORIA
SANITARY SEWER INFRASTRUCTURE MANAGEMENT REPORT

CITY OF VICTORIA

SANITARY SEWER SYSTEM INFRASTRUCTURE MANAGEMENT REPORT

Date:	10	2	2009			
REPORTING PERIOD:	From:	01-Jan-	2007	To:	31-Dec-	2008

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
1.0 SEWER INVENTORY				
1.1 Sanitary gravity sewers	m	244,000		244,000
1.2 Sanitary force mains	m	2652		2,652
1.3 Sanitary service laterals	ea.	14108	0	14,108
1.4 Storm service laterals	ea.	9867	0	9,867
1.5 Combined sewers	m	n/a	n/a	n/a
1.6 Combined service laterals	ea.	n/a	n/a	n/a
1.7 No. of sanitary sewer manholes/vents	ea.	3969	2	3,971
2.0 SEWER SYSTEM EVALUATION PROGRAM				
2.1 Smoke Testing				
2.1.1 Sanitary sewers smoke tested	m	46166	19086.4	65,252
2.1.2 % of entire municipality sewers smoke tested	%	18.9%	7.8%	26.7%
2.1.3 Total no. of sewer deficiencies detected	ea.	93	122	215
2.1.4 Sanitary service laterals smoke tested	ea.	2377	885	3,262
2.1.5 % of entire municipality SS laterals smoke tested	%	16.8%	6.3%	23.1%
2.1.6 No. of deficiencies detected by smoke test	ea.	81	122	203
2.2 Dye Testing				
2.2.1 Sanitary sewer mains dye tested	m	1	0	1
2.2.2 % of entire municipality sewer mains dye tested	%	0	0	0%
2.2.3 No. of sanitary sewer main deficiencies detected	ea.	1	0	1
2.2.4 Storm drain mains dye tested	m	1	0	1
2.2.5 % of entire municipality drain mains dye tested	%	0	0	0%
2.2.6 No. of storm drain main deficiencies detected	ea.	1	0	1
2.2.7 Sanitary service laterals dye tested	ea.	600	18	618
2.2.8 % of entire municipality sanitary laterals dye tested	%	4.3%	0.1%	4.4%
2.2.9 No. of sanitary lateral x-connections detected	ea.	81	3	84
2.2.10 Storm service laterals dye tested	ea.	1083	87	1,170
2.2.11 % of entire municipality storm laterals dye tested	%	11.0%	0.9%	11.9%
2.2.12 No. of storm drain lateral x-connections detected	ea.	197	26	223
2.3 CCTV Inspection of Sewers				
2.3.1 Sanitary sewers CCTV tested (City crews)	m	42074.0	6266.1	48,340
2.3.2 Sanitary sewers CCTV tested (Contracted)	m	16822.0	40246.1	57,068
2.3.3 % of entire municipality sewers CCTV tested	%	24.1%	19.1%	43.2%
2.3.4 STRUCTURAL CONDITION				
2.3.4.1 Sewers with a WRc structural rating of 1	m	5598	not yet rated	5,598
2.3.4.2 Sewers with a WRc structural rating of 2	m	3369	not yet rated	3,369
2.3.4.3 Sewers with a WRc structural rating of 3	m	77	not yet rated	77
2.3.4.4 Sewers with a WRc structural rating of 4	m	1481	not yet rated	1,481
2.3.4.5 Sewers with a WRc structural rating of 5	m	2585	not yet rated	2,585

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
2.4 Air Testing of Sewer Joints				
2.4.1 No. of sewer joints air-tested	ea.	0	0	0
2.4.2 % of failed sewer joints	%	0	0	0%
2.5 CCTV Inspection of Service Laterals				
2.5.1 No. of sanitary service laterals CCTV inspected	ea.	266	143	409
2.5.2 % of entire municipality SS laterals CCTV inspected	%	1.9%	1.0%	2.9%
2.5.3 No. of storm service laterals CCTV inspected	ea.	272	148	420
2.5.4 % of entire municipality SD laterals CCTV inspected	%	2.8%	1.5%	4.3%
2.5.5 STRUCTURAL CONDITION				
2.5.5.1 Service laterals with a WRc structural rating of 1	ea.	n/a	n/a	n/a
2.5.5.2 Service laterals with a WRc structural rating of 2	ea.	n/a	n/a	n/a
2.5.5.3 Service laterals with a WRc structural rating of 3	ea.	n/a	n/a	n/a
2.5.5.4 Service laterals with a WRc structural rating of 4	ea.	n/a	n/a	n/a
2.5.5.5 Service laterals with a WRc structural rating of 5	ea.	n/a	n/a	n/a
2.6 Visual Inspection of Manholes / Cleanouts				
2.6.1 No. of sanitary manholes/vents inspected	ea.	569	53	622
2.6.2 % of entire municipality manholes/vents inspected	%	14.3%	1.3%	15.7%
2.6.3 No. of structurally defective sanitary manholes/vents	ea.	10	5	15
2.6.4 No. of leaky sanitary manholes/vents	ea.	59	5	64
2.7 Rainfall and Sewer Flow Monitoring				
2.7.1 No. of rain gauges in the municipality (temp & perm)	ea.	2	1	3
2.7.2 No. of sewer flow monitors in the mun. (temp & perm)	ea.	22	15	37
3.0 CAPITAL IMPROVEMENT WORKS				
3.1 Sewer System Rehabilitation				
3.1.1 SEWERS				
3.1.1.1 Length of gravity sewers needing rehabilitation	m			
3.1.1.2 Length of sewers lined using all lining techniques	m	2630	655.4	3,285
3.1.1.3 Length of sewers grouted using all grouting techniques	m	0	0	0
3.1.1.4 Length of sewers point repaired	m	1	0.0	1
3.1.1.5 Length of sewers replaced through open cut trench	m	414	53.5	468
3.1.1.6 Length of sewers replaced thru pipe bursting	m	0	0	0
3.1.1.7 Length of sewers replaced through sleeve	m	0	0	0
3.1.1.8 Length of sewers replaced thru 'other' methods	m	0	0	0
3.1.1.9 **Total length of sewers rehabilitated**	**m**	**3045**	**708.9**	**3,754**
3.1.2 SERVICE LATERALS				
3.1.2.1 No. of services needing rehabilitation	ea.			
3.1.2.2 No. of service laterals lined using all lining techniques	ea.	51	7	58
3.1.2.3 No. of services grouted using all grouting techniques	ea.	0	0	0
3.1.2.4 No. of services point repaired	ea.	0	0	0
3.1.2.5 No. of services replaced thru open cut trench	ea.	56	28	84
3.1.2.6 No. of services replaced thru pipe bursting	ea.	0	0	0
3.1.2.7 No. of services replaced through sleeve	ea.	0	0	0
3.1.2.8 No. of services replaced thru 'other' methods	ea.	0	0	0
3.1.2.9 **Total No. of services rehabilitated**	**ea.**	**107**	**35**	**142**
3.1.3 MANHOLES / VENTS				
3.1.3.1 No. of manholes/vents repaired	ea.	26	3	**29**
3.2 SD-to-SS Cross Connection and Other Smoke &/or Dye Test Detected Deficiencies Correction				
3.2.1 No. of cross connections & deficiencies detected	ea.	166	29	195
3.2.2 No. of cross connections & deficiencies corrected	ea.	2	3	5

Description	Unit	Reported to end of this Biennial Report: Existing (Prior to this reporting period)	New (During to this reporting period)	Total
3.3 Combined Sewer Separation				
3.3.1 Length of combined sewers separated	m	n/a	n/a	n/a
3.3.2 No. of combined services separated	ea.	n/a	n/a	n/a
4.0 SANITARY SEWER OVERFLOWS				
4.1 No. of reported SSO due to blockage	ea.	0	0	0
4.2 No. of reported SSO due to insufficient capacity	ea.	1	1	2
4.3 **Total No. of reported SSO for the period**	**ea.**	**1**	**1**	**2**
5.0 SUMMARY OF COSTS		**Costs for the Reporting Period**		
5.1 Sewer System Evaluation				
5.1.1 Smoke Testing	$	---	$26,442	---
5.1.2 Dye Testing	$	---	$6,300	---
5.1.3 CCTV Inspection of Sewers	$	---	$116,357	---
5.1.4 Air Testing of Sewer Joints	$	---	$0	---
5.1.5 CCTV Inspection of Service Laterals	$	---	$97,725	---
5.1.6 Visual Inspection of Manholes/Vents	$	---	$2,650	---
5.1.7 Sewer Flow Monitoring	$	---	$174,555	---
5.1.8 Municipal Staff Costs	$	---	$45,000	---
5.1.9 Other (Consultants, Software, Rain Gauge, Piezo)	$	---	$126,663	---
5.2 Capital Improvement Works				
5.2.1 Sewer Rehabilitation (Open Cut)	$	---	$138,177	---
5.2.2 Sewer Rehabilitation (Trenchless)	$	---	$200,558	---
5.2.3 Service Lateral Rehabilitation	$	---	$44,224	---
5.2.4 Sanitary Manholes/Vents Repair	$	---	$15,000	---
5.2.5 Cross-connection Rectification	$	---	$11,250	---
5.2.6 Combined Sewer Separation	$	---	n/a	---
5.2.7 Municipal Staff Costs	$	---	$0	---
5.2.8 Other Work	$	---	$0	---
TOTAL COST FOR THE BIENNIAL PERIOD	**$**	---	**$1,004,901**	---

Submitted by: Derk J. Wevers **Signature:**

Name of Municipality: CITY Of VICTORIA

Address: #1 Centennial Square
Victoria, British Columbia
V8W 1P6

Submission Date: February 10, 2009

VIEW ROYAL
SANITARY SEWER INFRASTRUCTURE MANAGEMENT REPORT

Town of View Royal						
SANITARY SEWER SYSTEM INFRASTRUCTURE MANAGEMENT REPORT						
Date:	**1**	**April**	**2009**			
REPORTING PERIOD:	**From: 01-Jan-**	**2007**		**To: 31-Dec-**	**2008**	

Description	Unit	Reported to end of this Biennial Report: **Existing** (Prior to this reporting period)	**New** (During to this reporting period)	**Total**
1.0 SEWER INVENTORY				
1.1 Sanitary gravity sewers	m	43,582		43,582
1.2 Sanitary force mains	m	5233		5,233
1.3 Sanitary service laterals	ea.	2486		2,486
1.4 Combined sewers	m			0
1.5 Combined service laterals	ea.			0
1.6 No. of manholes/cleanouts	ea.	661		661
2.0 SEWER SYSTEM EVALUATION PROGRAM				
2.1 Smoke Testing				
2.1.1 Sanitary sewers smoke tested	m			0
2.1.2 % of entire municipality sewers smoke tested	%			0%
2.1.3 No. of sewer deficiencies detected	ea.	2		2
2.1.4 Sanitary service laterals smoke tested	ea.			0
2.1.5 % of entire municipality laterals smoke tested	%			0%
2.1.6 No. of lateral deficiencies detected by smoke test	ea.			0
2.2 Dye Testing				
2.2.1 Sanitary sewers dye tested	m	500		500
2.2.2 % of entire municipality sewers dye tested	%			0%
2.2.3 No. of sewer deficiencies detected	ea.	3		3
2.2.4 Sanitary service laterals dye tested	ea.			0
2.2.5 % of entire municipality laterals dye tested	%			0%
2.2.6 No. of lateral deficiencies detected by dye test	ea.			0
2.3 CCTV Inspection of Sewers				
2.3.1 Sanitary sewers CCTV tested	m	45200	2800	48,000
2.3.2 % of entire municipality sewers CCTV tested	%		6%	100%
2.3.3 STRUCTURAL CONDITION				
2.3.3.1 Sewers with a WRc structural rating of 1	m			0
2.3.3.2 Sewers with a WRc structural rating of 2	m			0
2.3.3.3 Sewers with a WRc structural rating of 3	m			0
2.3.3.4 Sewers with a WRc structural rating of 4	m			0
2.3.3.5 Sewers with a WRc structural rating of 5	m			0
2.4 Air Testing of Sewer Joints				
2.4.1 No. of sewer joints air-tested	ea.			0
2.4.2 % of failed sewer joints	%			0%
2.5 CCTV Inspection of Service Laterals				
2.5.1 No. of service laterals CCTV inspected	ea.	7		7
2.5.2 % of entire municipality laterals CCTV inspected	%			0%
2.5.3 STRUCTURAL CONDITION				
2.5.3.1 Service laterals with a WRc structural rating of 1	ea.			0

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	New (During to this reporting period)	Total
2.5.3.2 Service laterals with a WRc structural rating of 2	ea.			0
2.5.3.3 Service laterals with a WRc structural rating of 3	ea.			0
2.5.3.4 Service laterals with a WRc structural rating of 4	ea.			0
2.5.3.5 Service laterals with a WRc structural rating of 5	ea.			0
2.6 Visual Inspection of Manholes / Cleanouts				
2.6.1 No. of manholes/cleanouts inspected	ea.	246	20	266
2.6.2 % of entire municipality manholes/cleanouts inspected	%		0.1	10%
2.6.3 No. of structurally defective manholes/cleanouts	ea.			0
2.6.4 No. of leaky manholes/cleanouts	ea.			0
3.0 CAPITAL IMPROVEMENT WORKS				
3.1 Sewer System Rehabilitation				
3.1.1 **SEWERS**				
3.1.1.1 Length of gravity sewers needing rehabilitation	m			0
3.1.1.2 Length of sewers lined using all lining techniques	m			0
3.1.1.3 Length of sewers grouted using all grouting techniques	m			0
3.1.1.4 Length of sewers point repaired	m			0
3.1.1.5 Length of sewers replaced through open cut trench	m			0
3.1.1.6 Length of sewers replaced thru pipe bursting	m			0
3.1.1.7 Length of sewers replaced through sleeve	m			0
3.1.1.8 Length of sewers replaced thru 'other' methods	m			0
3.1.1.9 **Total length of sewers rehabilitated**	**m**	**0**	**0**	**0**
3.1.2 **SERVICE LATERALS**				
3.1.2.1 No. of services needing rehabilitation	ea.			0
3.1.2.2 No. of service laterals lined using all lining techniques	ea.			0
3.1.2.3 No. of services grouted using all grouting techniques	ea.			0
3.1.2.4 No. of services point repaired	ea.			0
3.1.2.5 No. of services replaced thru open cut trench	ea.			0
3.1.2.6 No. of services replaced thru pipe bursting	ea.			0
3.1.2.7 No. of services replaced through sleeve	ea.			0
3.1.2.8 No. of services replaced thru 'other' methods	ea.			0
3.1.2.9 **Total No. of services rehabilitated**	**ea.**	**0**	**0**	**0**
3.1.3 **MANHOLES / CLEANOUTS**				
3.1.3.1 No. of manholes/cleanouts repaired	**ea.**	0	5	**5**
3.2 Cross Connection and Other Smoke Test Detected Deficiencies Correction				
3.2.1 No. of cross connections detected	ea.	5		5
3.2.2 No. of cross connections corrected	ea.	5		5
3.3 Combined Sewer Separation				
3.3.1 Length of combined sewers separated	m			0
3.3.2 No. of combined services separated	ea.			0
4.0 SANITARY SEWER OVERFLOWS				
4.1 No. of reported SSO due to blockage	ea.			0
4.2 No. of reported SSO due to insufficient capacity	ea.			0
4.3 **Total No. of reported SSO for the period**	**ea.**	**0**	**0**	**0**
5.0 SUMMARY OF COSTS		**Costs for the Reporting Period**		
5.1 Sewer System Evaluation				
5.1.1 Smoke Testing	$			$0
5.1.2 Dye Testing	$			$0

Description	Unit	Reported to end of this Biennial Report		
		Existing (Prior to this reporting period)	**New** (During to this reporting period)	**Total**
5.1.3 CCTV Inspection of Sewers	$		$15,000	$15,000
5.1.4 Air Testing of Sewer Joints	$			$0
5.1.5 CCTV Inspection of Service Laterals	$	$2,000		$2,000
5.1.6 Visual Inspection of Manholes/Cleanouts	$	$8,000		$8,000
5.1.7 Sewer Flow Monitoring	$	$12,000	$20,000	$32,000
5.1.8 Municipal Staff Costs	$	$45,000	$45,000	$90,000
5.2 Capital Improvement Works				
5.2.1 Sewer Rehabilitation	$	$11,000	$55,000	$66,000
5.2.2 Service Lateral Rehabilitation	$			$0
5.2.3 Manholes/Cleanouts Repair	$	$3,000	$5,000	$8,000
5.2.4 Cross-connection Rectification	$	$3,500		$3,500
5.2.5 Combined Sewer Separation	$			$0
5.2.6 Municipal Staff Costs	$	$5,500	$6,000	$11,500
5.2.7 Other Work	$			$0
TOTAL COST FOR THE BIENNIAL PERIOD	**$**	$90,000	**$146,000**	$236,000

Submitted by: Darryl Woodley	**Signature:**
Name of Municipality: Town of View Royal	
Address: 45 View Royal Avenue Victoria BC V9B 1A6	
Attention:	
Submission Date:	

APPENDIX E

Municipal I&I Initiatives:
Expanded Descriptions of Specific Programs

Oak Bay – South Oak Bay Project
James Bay Project

KERR WOOD LEIDAL
associates limited
CONSULTING ENGINEERS
201 - 3045 Douglas Street
Victoria, B.C.
V8T 4N2
250-595-4223 P
250-595-4224 F
www.kwl.ca

Technical Memorandum

DATE: February 9, 2009

TO: Dave Marshall, B.Sc., A.Sc.T.

FROM: Jeff Howard, P.Eng.
Chris Johnston, P.Eng.

RE: **MUNICIPAL I&I PROJECT**
South Oak Bay I&I Pilot Study – 3rd Annual Analysis
Our File 547.019.300

1. INTRODUCTION

As part of the I&I pilot study of two catchments in South Oak Bay, KWL has performed the third annual data analysis and calculation of I&I rates. This memorandum represents the data collection and analysis from July 2007 to June 2008 for the catchments contributing to the flow meters at Linkleas Avenue (control catchment) and Lafayette Street (upgrade catchment) in south Oak Bay.

Over a number of years, a series of physical upgrades will be made to the Lafayette catchment and the I&I rates calculated will be compared to those in the Linkleas catchment. By comparing the I&I reduction for each year of physical upgrades, the best return on investment can be calculated. This will form a strategy for reducing I&I in other areas of Oak Bay.

The subject of this memorandum is the analysis and verification of the third year (July 2007 to June 2008) of flow data received from SFE, and the calculation of the I&I rates in both catchments. For details on site locations, catchments, quality control procedures, and data analysis methodology please refer to the first year analysis (memorandum dated September 25, 2006).

2. RAINFALL DATA

Rainfall data for the monitoring period between July 2007 and June 2008 was obtained from the KWL rain gauge located on the roof of our Victoria Office (3045 Douglas Street). This rain gauge is reasonable distance (approximately 5 km) to the study area. This rain gauge station deploys a 'tipping bucket' gauge with 0.25 mm signals in 5-minute intervals.

The following table summarizes the storm events that were chosen for the I&I analysis:

Table 2-1: Storm Event Summary

Storm Event	Approx. Storm Duration (hrs)	Maximum 24-hour Rainfall Total (mm)	Approx. Return Period (6-hour duration)
16 Sep 07, 09:00 to 16 Sep 07, 22:00	13	8.8	< 2 Year
18 Oct 07, 22:00 to 20 Oct 07, 06:00	30	24.8	< 2 Year
02 Dec 07, 05:00 to 04 Dec 07, 07:00	32	64.5	5 Year
09 Jan 08, 22:00 to 10 Jan 08, 24:00	26	18.8	< 2 Year
06 Feb 08, 10:00 to 07 Feb 08, 07:00	21	24.0	< 2 Year
18 Apr 08, 21:00 to 19 Apr 08, 12:00	12	6.75	< 2 Year

IDF statistical data was obtained for Victoria UVic rain gauge from Environment Canada and is provided in the following table:

Table 2-2: IDF Data for Victoria UVic (mm)

Duration	2-Year	5-Year	10-Year	25-Year	100-Year
6 hours	24.6	30.1	33.7	38.3	45.2
24 hours	47.4	63.4	74.1	87.5	107.4

To be consistent and comparable with previous years' analysis, the 6-hour rainfall duration was selected for the peak 1-hour I&I analysis. The results could be used for input to a hydraulic sewer model. The 24-hour average I&I rates have also been included in the analysis as this may be used for considering volumes contributing to a regional system.

Based on the IDF data and the identified correlation between rainfall and sewage flows from the flow monitoring results, return periods for I&I events can be identified.

3. DATA ANALYSIS

The data is analyzed by comparing the rainfall amounts with the measured flows for each of the six storm events. The results for all of these storms are then plotted to generate the 5-year return period I&I rates.

3.1 Lafayette Street Results

The following table summarizes the RDI&I (rainfall dependant I&I) response for each of the storm events.

Table 3-1: Lafayette St. RDI&I Response Summary

Storm Event	24-Hour Rainfall Total	Peak 1-hour RDI&I (6h rain) [L/s]	Peak 24-hour RDI&I (24h rain) [L/s]
16 Sep 07, 09:00 to 16 Sep 07, 22:00	8.8	No Data	No Data
18 Oct 07, 22:00 to 20 Oct 07, 06:00	24.8	No Data	No Data
02 Dec 07, 05:00 to 04 Dec 07, 07:00	64.5	2.28	1.39
09 Jan 08, 22:00 to 10 Jan 08, 24:00	18.8	Data Error	Data Error
06 Feb 08, 10:00 to 07 Feb 08, 07:00	24.0	Data Error	Data Error
18 Apr 08, 21:00 to 19 Apr 08, 12:00	6.75	Data Error	Data Error

Graphs for each of these storm events are provided in Appendix A. Visual inspection of the flow data indicates that only the December storm event did the meter show a reasonable response. We asked SFE to provide comments on the data. They indicated that the meters are starting to get old, and showing it. Fortunately the December event was a 5-year return period event and therefore the 5-year return period RDI&I can be estimated based on this single event.

The following table summarizes the data analysis results for the Lafayette Street catchment. As mentioned, the RDI&I values are based solely on the December event.

Table 3-2: Lafayette St. I&I Analysis Summary

Average Dry Weather Flow ADWF [L/s]	Base Flow BSF [L/s]	GWI [L/s]	5-Year Peak 1-hour RDI&I (6h rain) [L/s]	5-Year Peak 1-hour RDI&I (6h rain) [l/ha/d]	5-Year Peak 1-hour I&I [l/ha/d]	5-Year Peak 24-hour RDI&I (24h rain) [L/s]	5-Year Peak 24-hour RDI&I (24h rain) [l/ha/d]	5-Year Peak 24-hour I&I [l/ha/d]	R^2 Value (6-hour)
1.78	0.76	1.02	2.28	34,319	49,672	1.39	20,922	36,276	N/A
Note: RDI&I and I&I values are based on a single event, Dec 02-04, 2007.									

3.2 Linkleas Avenue Results

The following table summarizes the RDI&I response for each of the storm events.

Table 3-3: Linkleas Av. RDI&I Response Summary

Storm Event	24-Hour Rainfall Total	Peak 1-hour RDI&I (6h rain) [L/s]	Peak 24-hour RDI&I (24h rain) [L/s]
16 Sep 07, 09:00 to 16 Sep 07, 22:00	8.8	1.6	0.4
18 Oct 07, 22:00 to 20 Oct 07, 06:00	24.8	6.4	1.3
02 Dec 07, 05:00 to 04 Dec 07, 07:00	64.5	10.0	4.9
09 Jan 08, 22:00 to 10 Jan 08, 24:00	18.8	4.3	2.5
06 Feb 08, 10:00 to 07 Feb 08, 07:00	24.0	5.6	2.3
18 Apr 08, 21:00 to 19 Apr 08, 12:00	6.75	6.8	2.4

Graphs for each of these storm events are provided in Appendix A. Visual inspection of the flow data indicates the January and April storm events show an unusual response to the precipitation and therefore were not used in the development of the RDI&I envelope.

The following table summarizes the data analysis results for the Linkleas Avenue catchment.

Table 3-4: Linkleas I&I Analysis Summary

Average Dry Weather Flow ADWF [L/s]	Base Flow BSF [L/s]	GWI [L/s]	5-Year Peak 1-hour RDI&I (6h rain) [L/s]	5-Year Peak 1-hour RDI&I (6h rain) [l/ha/d]	5-Year Peak 1-hour I&I [l/ha/d]	5-Year Peak 24-hour RDI&I (24h rain) [L/s]	5-Year Peak 24-hour RDI&I (24h rain) [l/ha/d]	5-Year Peak 24-hour I&I [l/ha/d]	R^2 Value (6-hour)
2.39	0.90	1.49	12.27	126,356	141,700	5.39	55,506	70,850	0.81

The RDI&I Envelopes for the Linkleas catchment are illustrated in Appendix B.

An estimate of the directly connected impervious areas based on the early season storm events (September and October) was calculated. These calculations indicate the directly connected imperious area for this catchment is approximately 3000 m^2 to 4000 m^2.

4. I&I REDUCTION PROGRAM

The I&I reduction program that occurred in late 2007 included the following components:

- Dye testing, in both catchments;
- Smoke testing, in both catchments, and;
- Correspondence with homeowners indicating a grant of up to $1200 for homeowners that may have a storm drain connecting to the sanitary sewers plus up to $150 for a camera inspection showing a properly connected storm drain, in both catchments.

The results of the above I&I reduction program for the 67 lot Lafayette catchment are as follows:

- Smoke and dye testing found 42 lots with cross-connections or were inconclusive (i.e. potential cross-connections);
- 32 of these 42 cross-connection/inconclusive homes have been resolved, and;
- 10 of these 42 cross-connection/inconclusive homes have not been resolved.

The results of the above I&I reduction program for the 111 lot Linkleas catchment are as follows:

- Smoke and dye testing found 61 lots with cross-connections or were inconclusive (i.e. potential cross-connections);
- 36 of these 61 cross-connection/inconclusive homes have been resolved, and;
- 25 of these 61 cross-connection/inconclusive homes have not been resolved.

5. I&I RATE SUMMARY

The 2007/2008 flow monitoring season represents the third year of flow monitoring for this project. A summary of the I&I rates and the I&I reduction programs for these three years are summarized in the following tables.

Table 5-1: Lafayette I&I Analysis Summary

Flow Monitoring Period	5-Year Peak 1-hour I&I [l/ha/d]	5-Year Peak 24-hour I&I [l/ha/d]	I&I Reduction Program Since Previous Year	Total Reduction in 5-Year Peak 1-hour I&I[3]	Total Reduction in 5-Year Peak 24-hour I&I[3]
2005/2006	77,068	64,273	N/A	N/A	N/A
2006/2007	51,479	48,167	Minor Spot Repairs	33%	25%
2007/2008	49,672[1]	36,276[1]	Cross-connection removal program[2]	36%	44%

Notes:
1. Value based on single event due to lack of good flow monitoring data and are less accurate compared to previous year values.
2. I&I reduction program occurred during storm event used for I&I rate calculation. I&I rate may not represent completion of I&I reduction program.
3. Percentage reductions represent total reduction from 2005/2006 flow monitoring period.

Table 5-2: Linkleas I&I Analysis Summary

Flow Monitoring Period	5-Year Peak 1-hour I&I [l/ha/d]	5-Year Peak 24-hour I&I [l/ha/d]	I&I Reduction Program Since Previous Year	Total Reduction in 5-Year Peak 1-hour I&I[2]	Total Reduction in 5-Year Peak 24-hour I&I[2]
2005/2006	248,078	143,554	N/A	N/A	N/A
2006/2007	269,549	147,088	Minor Spot Repairs	-9%	-3%
2007/2008	141,700	70,850	Cross-connection removal program[1]	43%	51%

Notes:
1. I&I reduction program occurred during storm events used for I&I rate calculation. I&I rate may not represent completion of I&I reduction program.
2. Percentage reductions represent total reduction from 2005/2006 flow monitoring period.

For the Lafayette catchment the 2007/2008 I&I rates show a minor and moderate reduction in I&I rates compared with the previous year for the 5-year 1-hour and 5-year 24-hour durations, respectively. The following should be considered when evaluating these reduction values:

- Calculations are based on a single event for 2007/2008 which is likely less accurate than previous year calculations which were calculated using the envelope method of multiple storm events.

- The event used for the 2007/2008 I&I rates occurred during the cross-connection removal program and may not represent the fully completed program.

For the Linkleas catchment the 2007/2008 I&I rates show a significant reduction in I&I rates compared with the previous year for both the 5-year 1-hour and 5-year 24-hour durations.

6. CONCLUSIONS AND RECOMMENDATIONS

The flow monitoring for the third year (2007/2008) of the South Oak Bay I&I Pilot Study has been completed. This year represents the results of the cross-connection removal program which occurred in both catchments.

The I&I analysis was prepared based on six storm events which were recorded by the KWL rain gauge located on the roof of our Victoria Office (3045 Douglas Street). Unfortunately only flows from one of these six storm events was properly recorded by the SFE flow monitoring gauge for the Lafayette catchment. Four of these six storm events were used in the calculation of I&I rates for the Linkleas catchment.

For the Lafayette catchment the 2007/2008 I&I rates show a minor and moderate reduction in I&I rates compared with the previous year for the 5-year 1-hour and 5-year 24-hour durations, respectively. However, the I&I rates may be greater due to inaccurate I&I calculations because it was calculated base don a single event and the cross-connection removal program was not yet completed. For the Linkleas catchment the 2007/2008 I&I rates show a significant reduction in I&I rates.

For this project, we recommend the following:

- Continue with the South Oak Bay I&I Pilot Study including implementing the step by step annual repairs in the Lafayette catchment.
- Repair the major defects within the Linkleas catchment which should bring the I&I rates down for better comparison with the Lafayette catchment.
- The flow monitoring data should be reviewed more frequently (e.g. on a monthly basis) in order to minimize loss of data due to flow meter problems.
- Oak Bay should record the costs for the upgrades made to the system (both staff time and expenditures) so that at the conclusion of the project the most cost effective method for reduction of I&I can be estimated.
- Considering the significant I&I reduction in the Linkleas catchment, Oak Bay should consider implementing cross-connection removal programs in other areas of similar age.

We trust this submission meets your requirements for this project. If you need further information or clarification, please contact the undersigned.

KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by:

FEB 9, 2009

Jeff Howard, P.Eng.
Project Manager

Reviewed by:

Feb 9, 2009

Chris Johnston, P.Eng.
Project Reviewer

JH/jh
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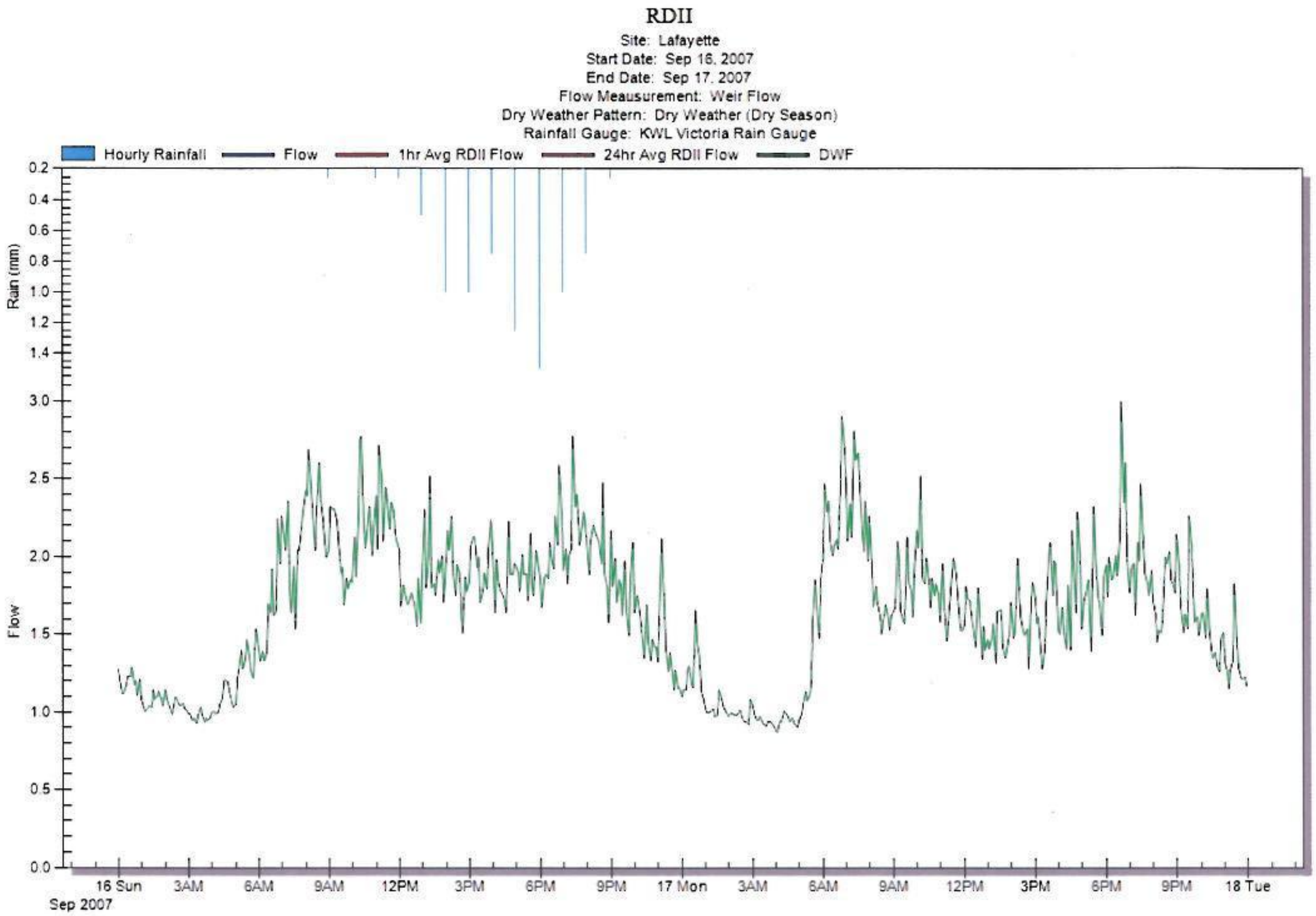
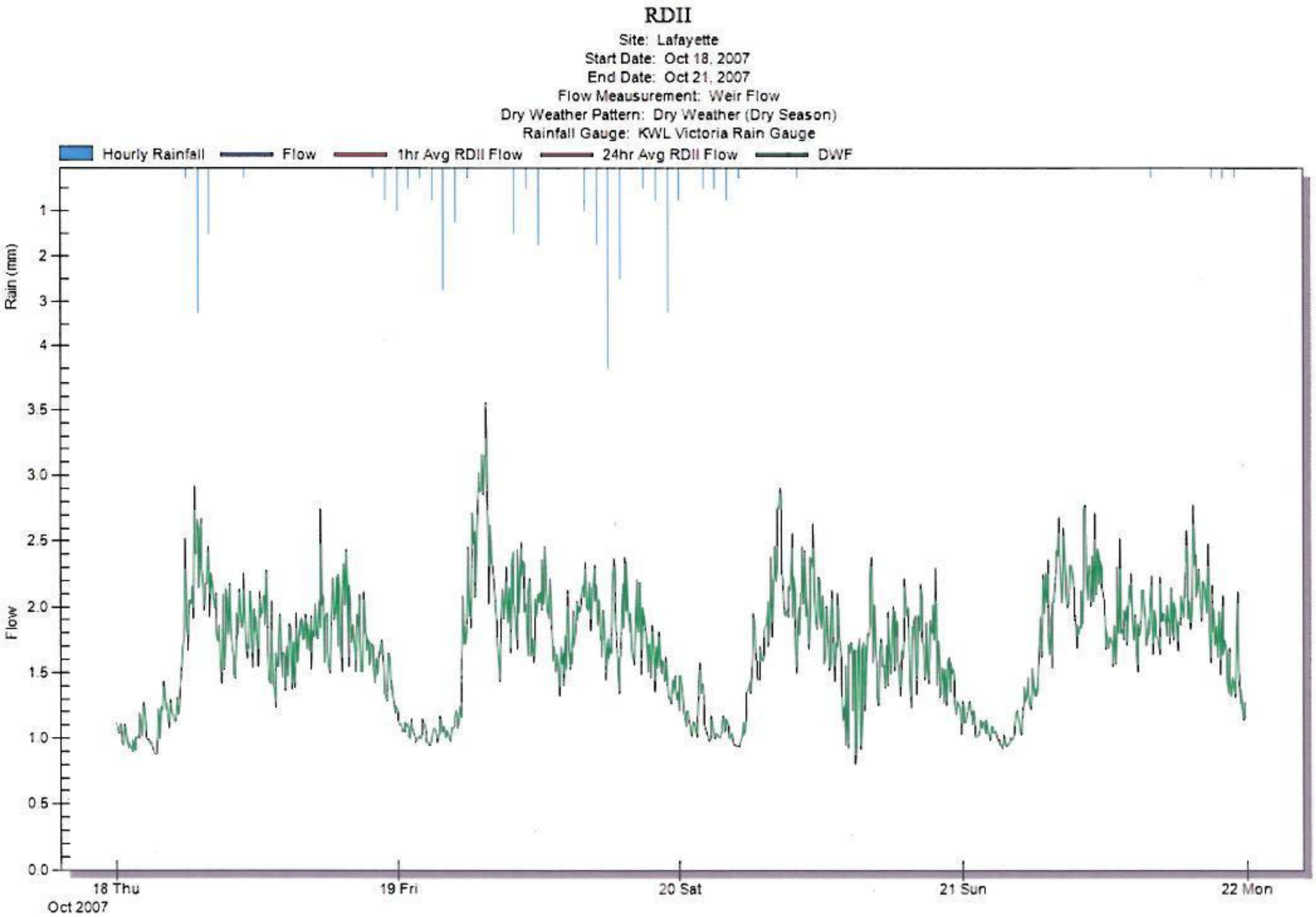
Appendix A

RDI&I Graphs for Selected Storm Events

KERR WOOD LEIDAL
associates limited


RDII
Site: Lafayette
Start Date: Sep 16, 2007
End Date: Sep 17, 2007
Flow Meausurement: Weir Flow
Dry Weather Pattern: Dry Weather (Dry Season)
Rainfall Gauge: KWL Victoria Rain Gauge
Hourly Rainfall
Flow
1hr Avg RDII Flow
24hr Avg RDII Flow
DWF
Rain (mm)
Flow
16 Sun
Sep 2007
3AM
6AM
9AM
12PM
3PM
6PM
9PM
17 Mon
18 Tue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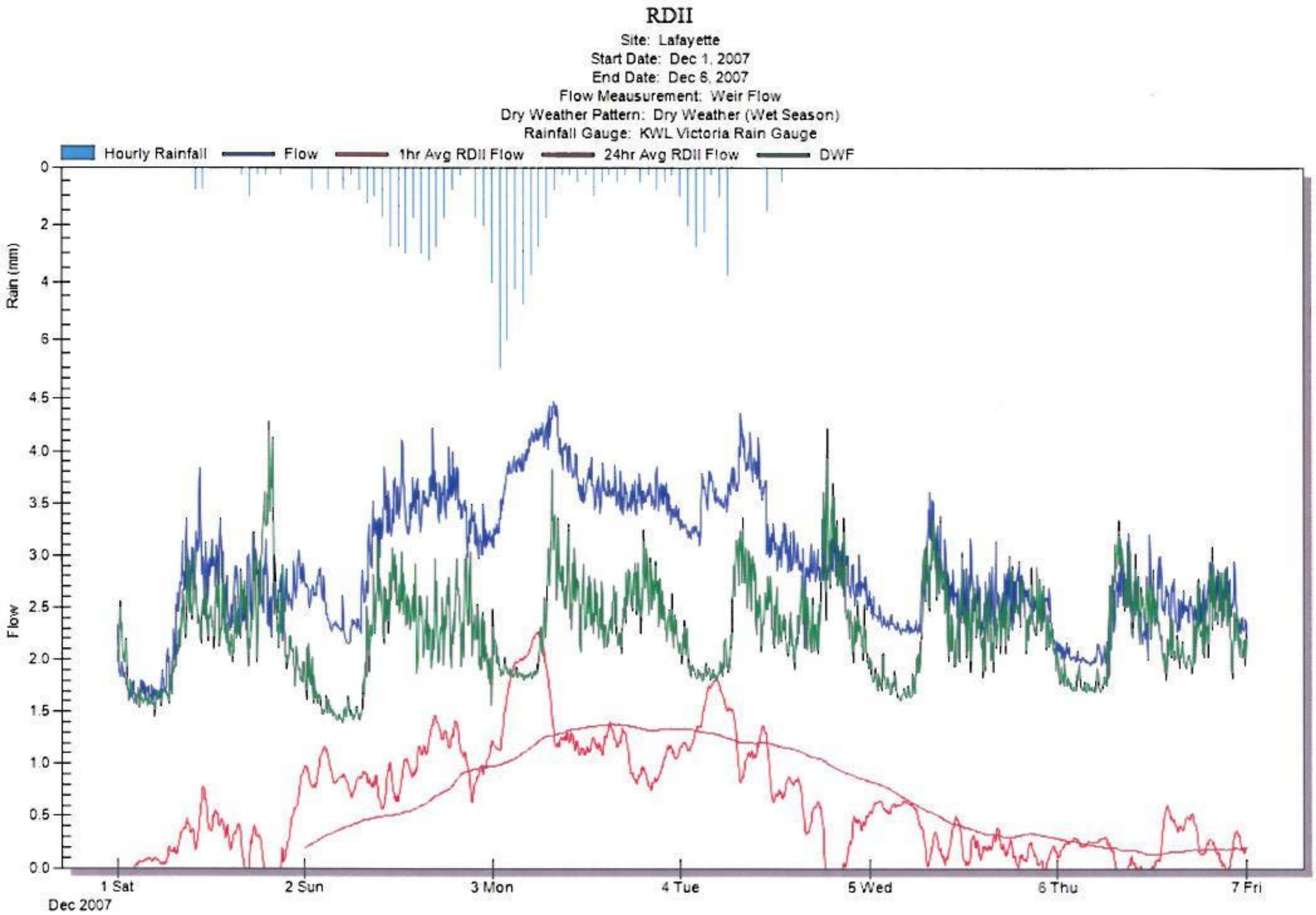
Site: Lafayette
Start Date: Oct 18, 2007
End Date: Oct 21, 2007
Flow Meausurement: Weir Flow
Dry Weather Pattern: Dry Weather (Dry Season)
Rainfall Gauge: KWL Victoria Rain Gauge
Hourly Rainfall
Flow
1hr Avg RDII Flow
24hr Avg RDII Flow
DWF
Rain (mm)
Flow
18 Thu
Oct 2007
19 Fri
20 Sat
21 Sun
22 Mon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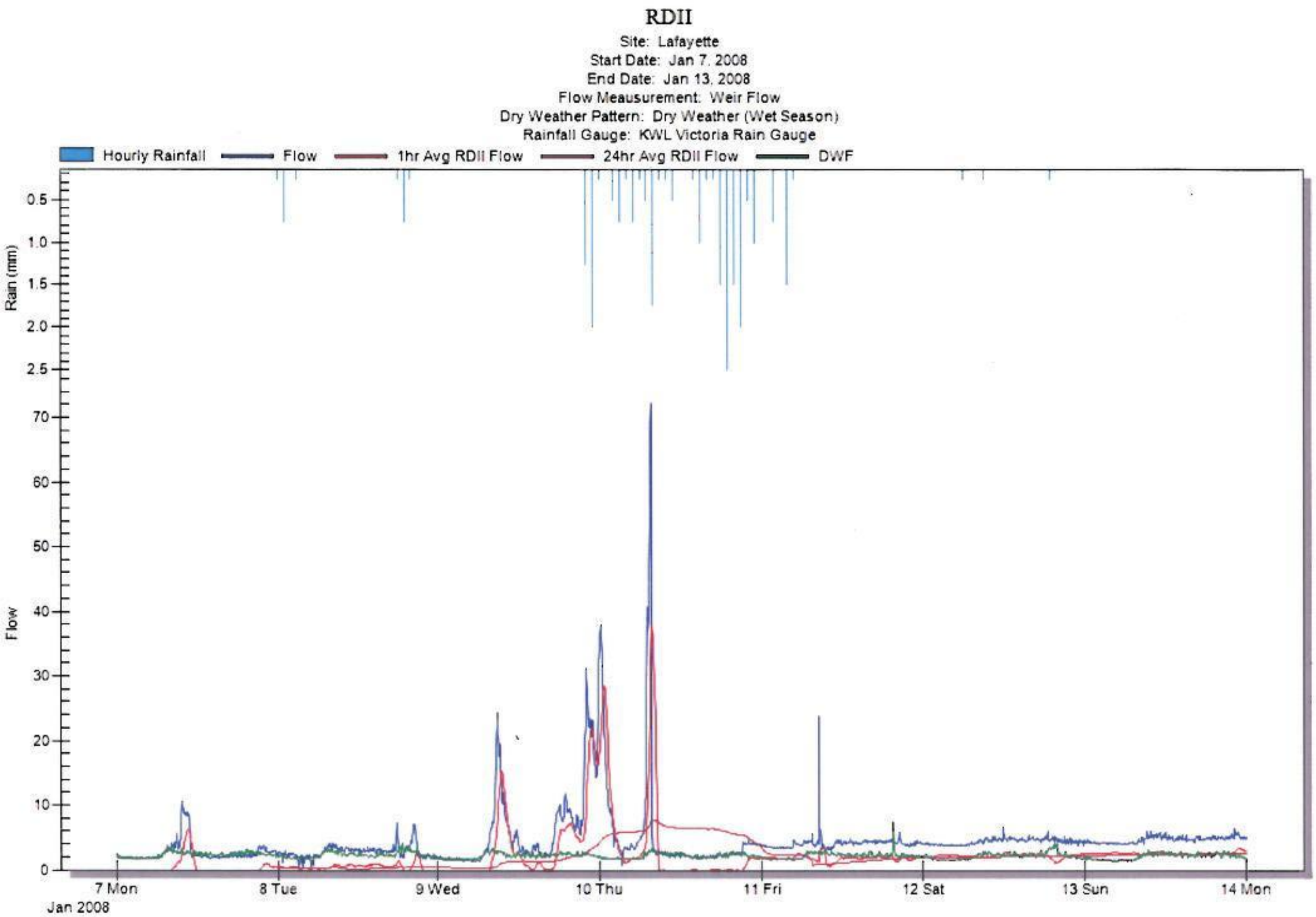
Site: Lafayette
Start Date: Dec 1, 2007
End Date: Dec 6, 2007
Flow Meausurement: Weir Flow
Dry Weather Pattern: Dry Weather (Wet Season)
Rainfall Gauge: KWL Victoria Rain Gauge
Hourly Rainfall
Flow
1hr Avg RDII Flow
24hr Avg RDII Flow
DWF
Rain (mm)
Flow
1 Sat
Dec 2007
2 Sun
3 Mon
4 Tue
5 Wed
6 Thu
7 Fri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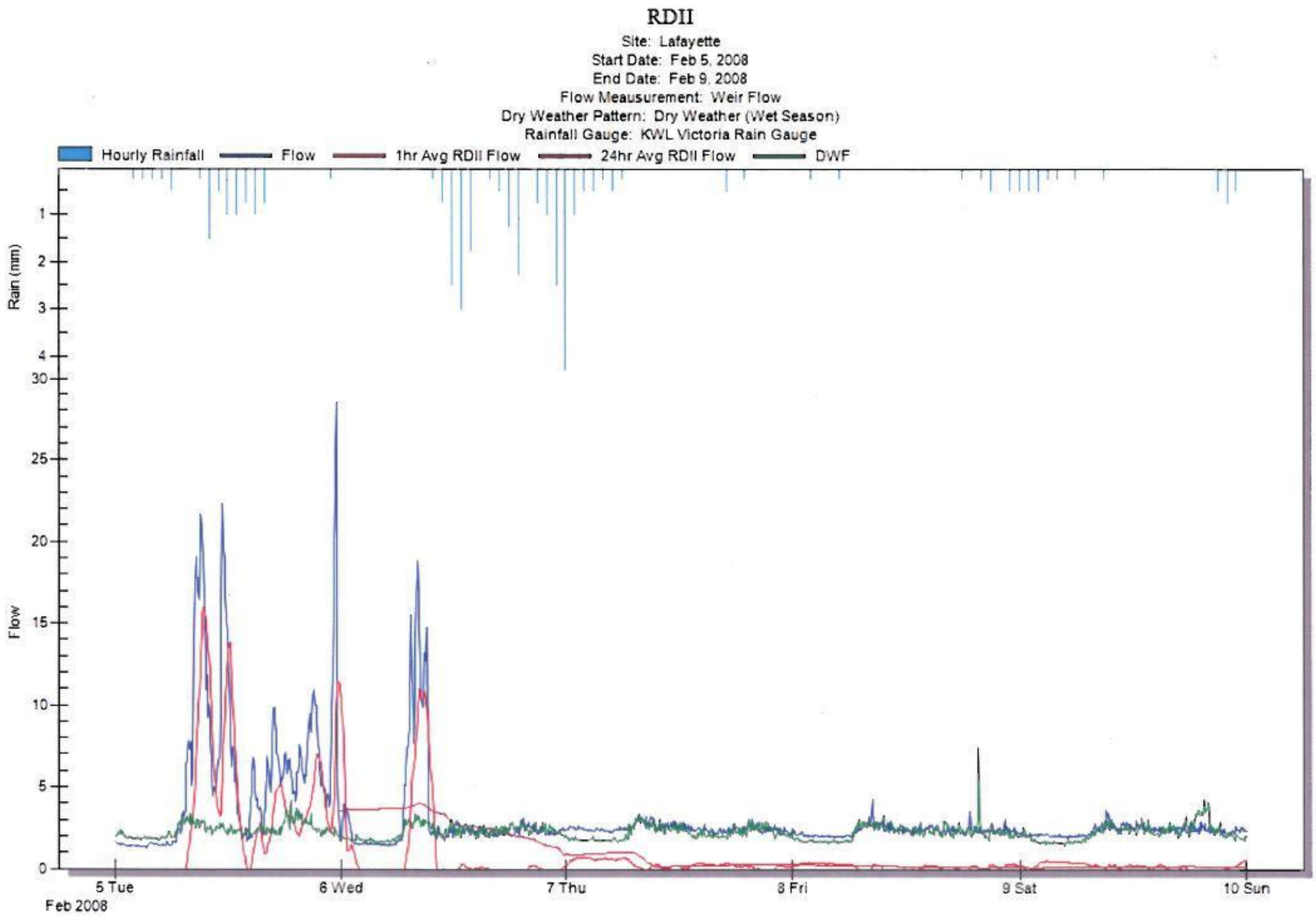
Site: Lafayette
Start Date: Jan 7, 2008
End Date: Jan 13, 2008
Flow Meausurement: Weir Flow
Dry Weather Pattern: Dry Weather (Wet Season)
Rainfall Gauge: KWL Victoria Rain Gauge
Hourly Rainfall
Flow
1hr Avg RDII Flow
24hr Avg RDII Flow
DWF
Rain (mm)
0.5
1.0
1.5
2.0
2.5
Flow
70
60
50
40
30
20
10
0
7 Mon
Jan 2008
8 Tue
9 Wed
10 Thu
11 Fri
12 Sat
13 Sun
14 Mon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End Date: Feb 9, 2008
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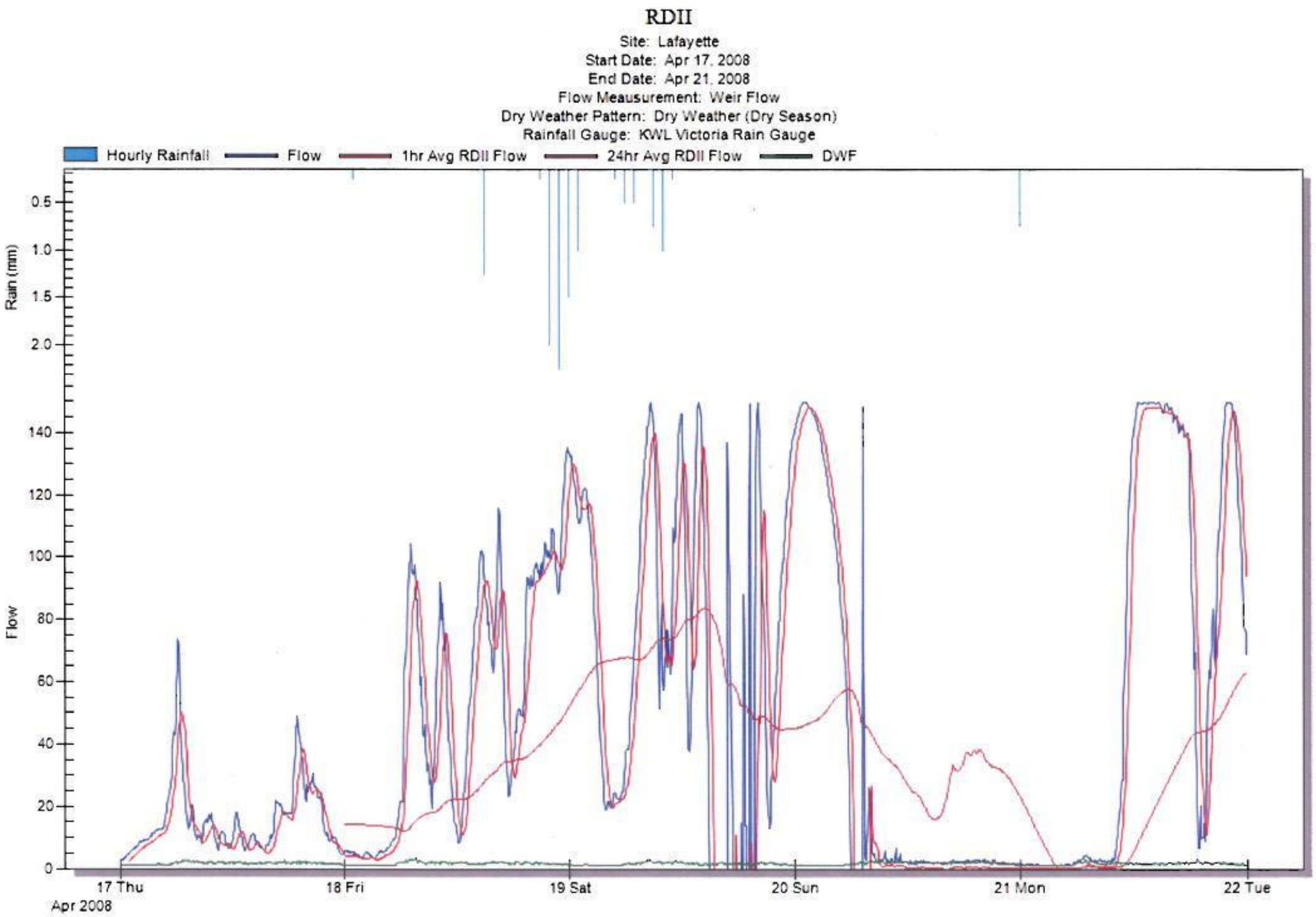
Dry Weather Pattern: Dry Weather (Wet Season)
Rainfall Gauge: KWL Victoria Rain Gauge
Hourly Rainfall
Flow
1hr Avg RDII Flow
24hr Avg RDII Flow
DWF
Rain (mm)
Flow
5 Tue
Feb 2008
6 Wed
7 Thu
8 Fri
9 Sat
10 Sun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Site: Lafayette
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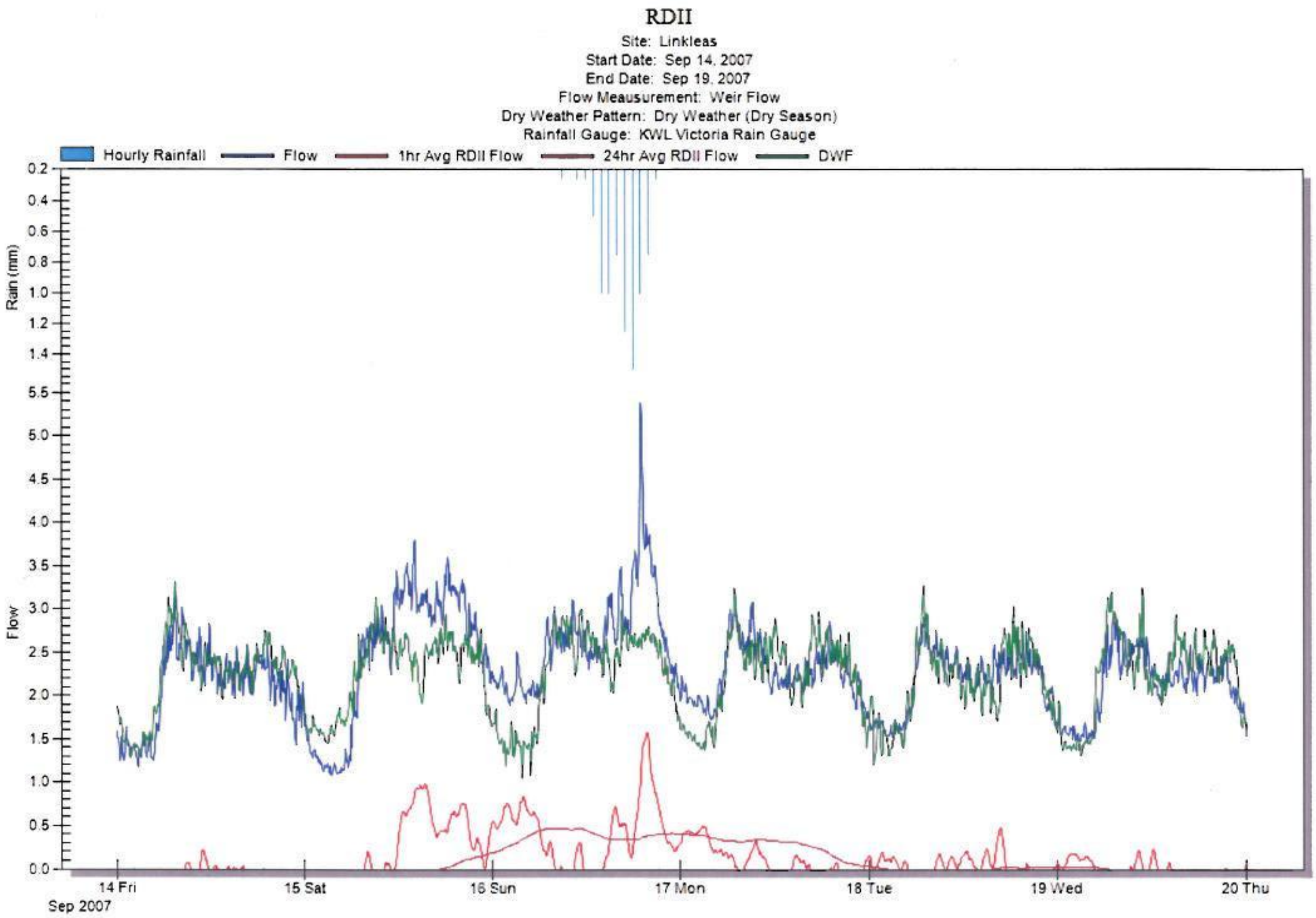
End Date: Apr 21, 2008
Flow Meausurement: Weir Flow
Dry Weather Pattern: Dry Weather (Dry Season)
Rainfall Gauge: KWL Victoria Rain Gauge
Hourly Rainfall
Flow
1hr Avg RDII Flow
24hr Avg RDII Flow
DWF
Rain (mm)
0.5
1.0
1.5
2.0
Flow
140
120
100
80
60
40
20
0
17 Thu
Apr 2008
18 Fri
19 Sat
20 Sun
21 Mon
22 Tue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End Date: Sep 19, 2007
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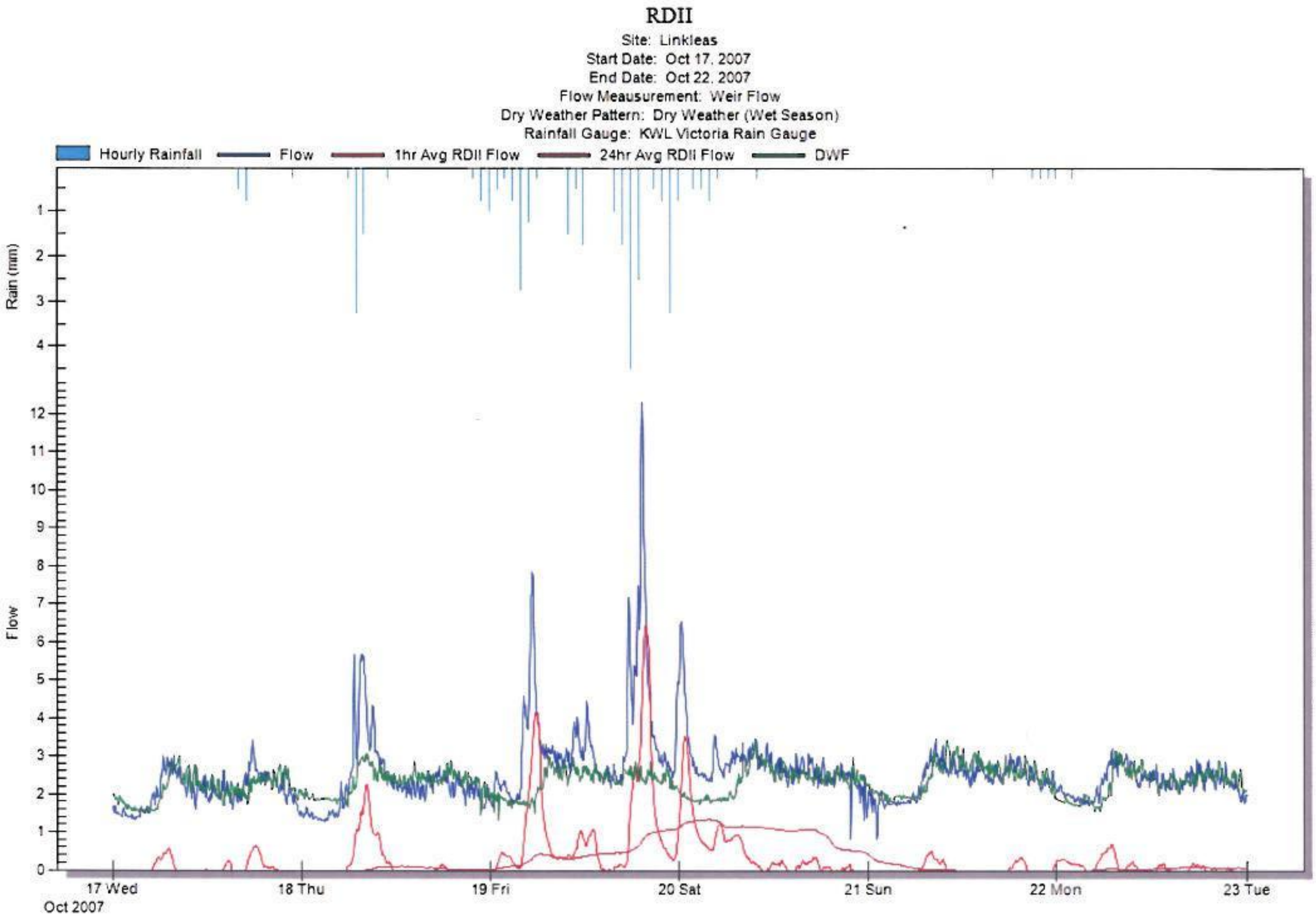
Dry Weather Pattern: Dry Weather (Dry Season)
Rainfall Gauge: KWL Victoria Rain Gauge
Hourly Rainfall
Flow
1hr Avg RDII Flow
24hr Avg RDII Flow
DWF
Rain (mm)
Flow
0.2
0.4
0.6
0.8
1.0
1.2
1.4
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
14 Fri
Sep 2007
15 Sat
16 Sun
17 Mon
18 Tue
19 Wed
20 Thu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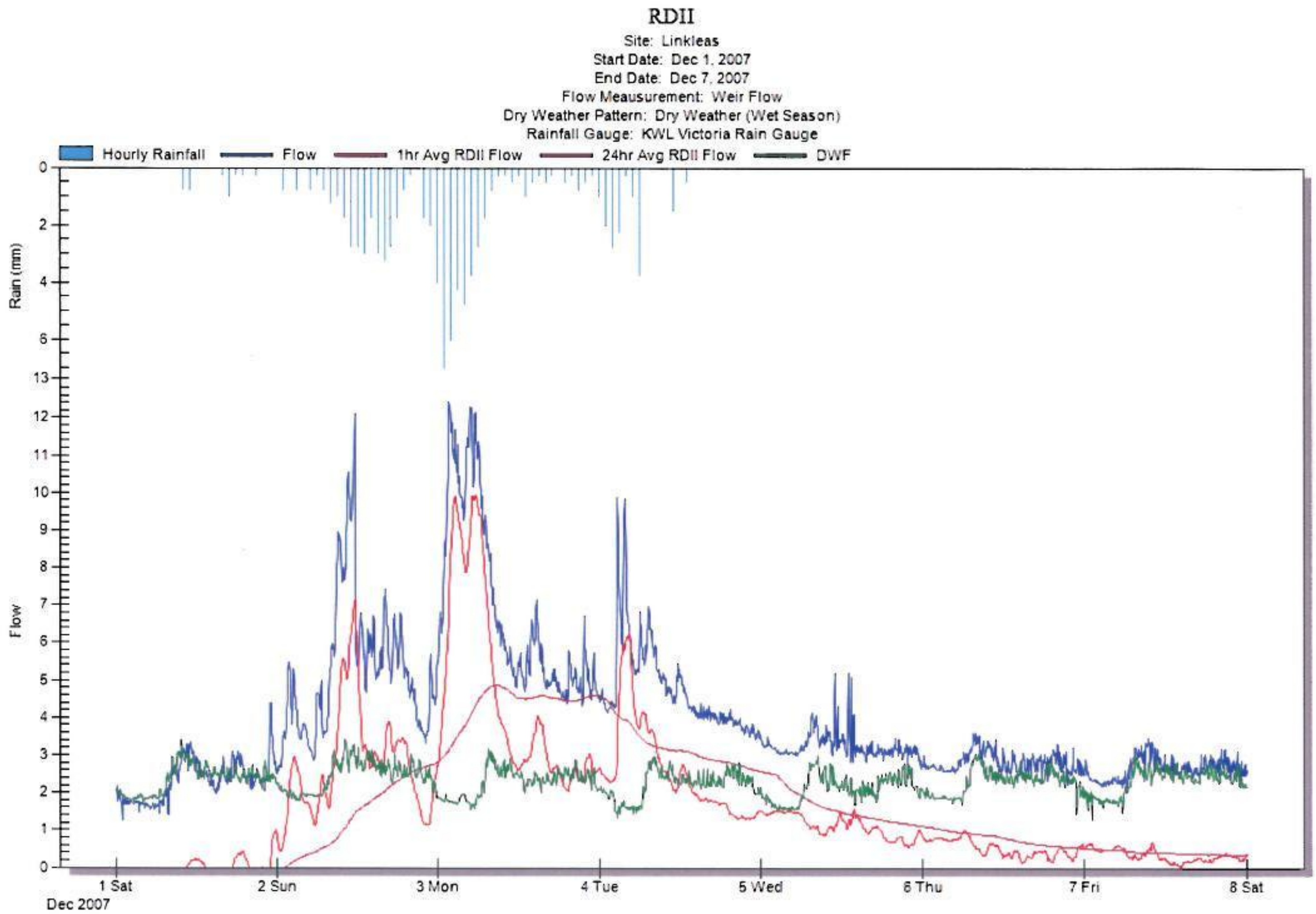
Site: Linkleas
Start Date: Oct 17, 2007
End Date: Oct 22, 2007
Flow Meausurement: Weir Flow
Dry Weather Pattern: Dry Weather (Wet Season)
Rainfall Gauge: KWL Victoria Rain Gauge
Hourly Rainfall
Flow
1hr Avg RDII Flow
24hr Avg RDII Flow
DWF
Rain (mm)
Flow
17 Wed
Oct 2007
18 Thu
19 Fri
20 Sat
21 Sun
22 Mon
23 Tue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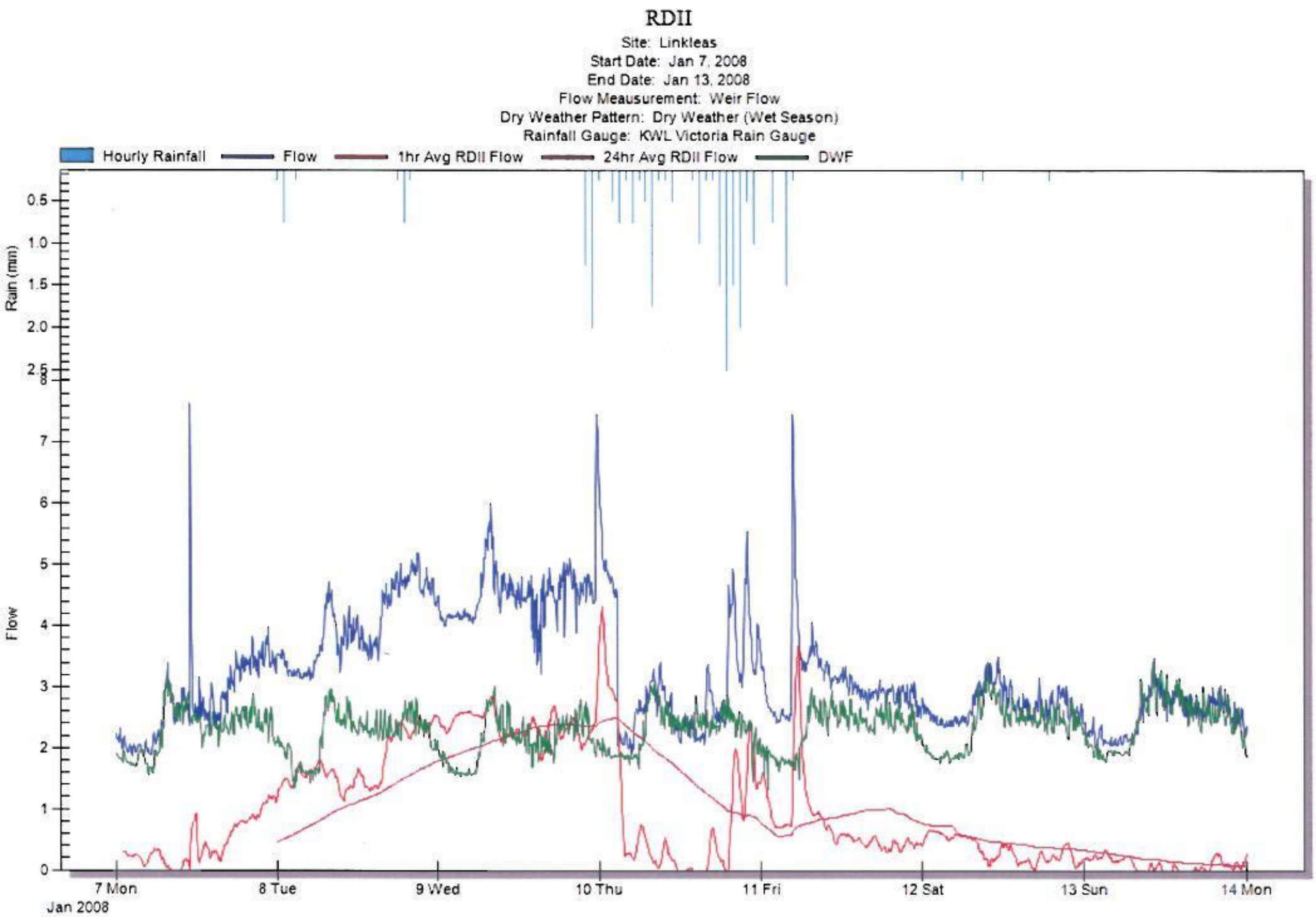
Start Date: Dec 1, 2007
End Date: Dec 7, 2007
Flow Meausurement: Weir Flow
Dry Weather Pattern: Dry Weather (Wet Season)
Rainfall Gauge: KWL Victoria Rain Gauge
Hourly Rainfall
Flow
1hr Avg RDII Flow
24hr Avg RDII Flow
DWF
Rain (mm)
Flow
1 Sat
Dec 2007
2 Sun
3 Mon
4 Tue
5 Wed
6 Thu
7 Fri
8 Sat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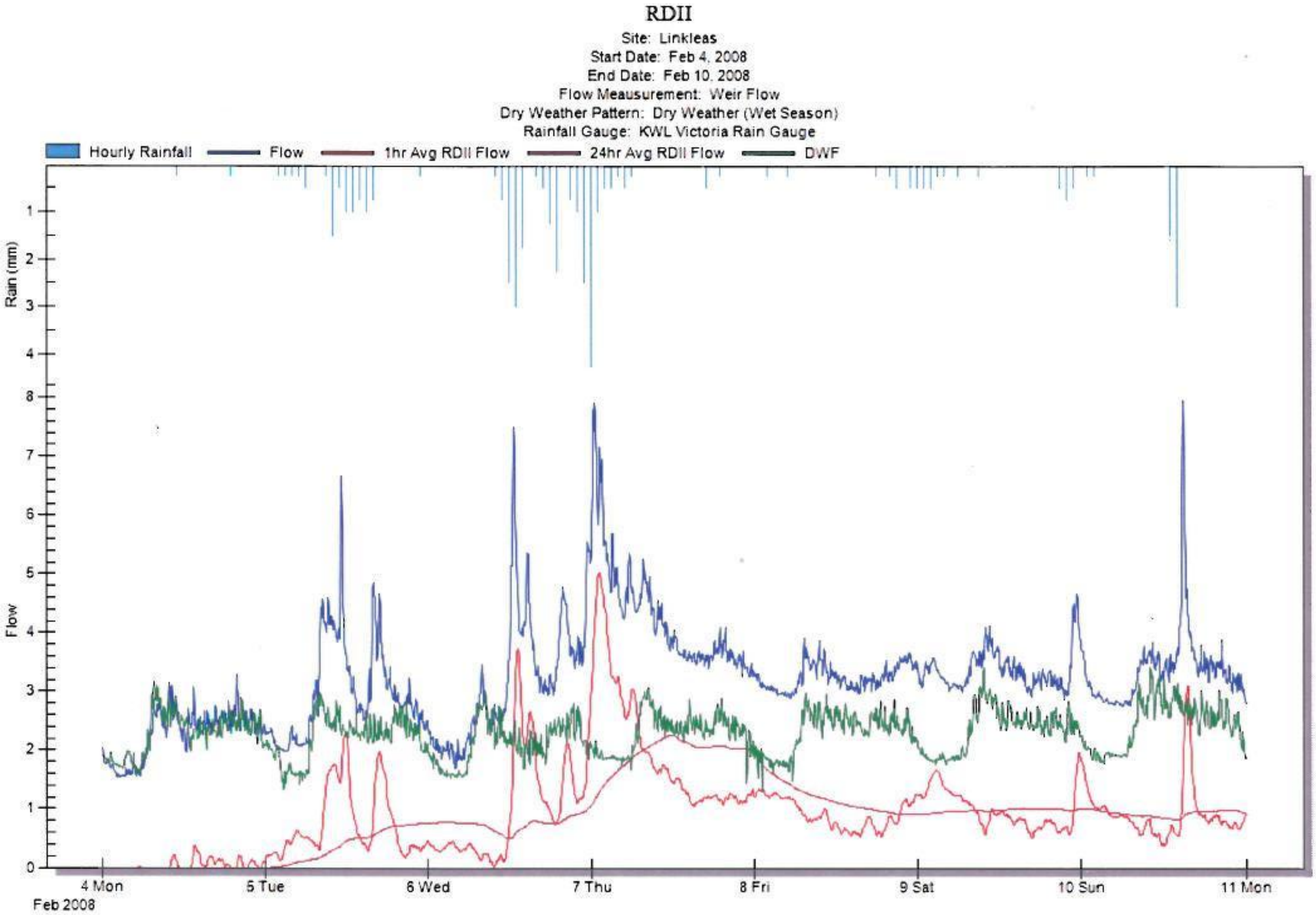
Start Date: Jan 7, 2008
End Date: Jan 13, 2008
Flow Meausurement: Weir Flow
Dry Weather Pattern: Dry Weather (Wet Season)
Rainfall Gauge: KWL Victoria Rain Gauge
Hourly Rainfall
Flow
1hr Avg RDII Flow
24hr Avg RDII Flow
DWF
Rain (mm)
Flow
7 Mon
Jan 2008
8 Tue
9 Wed
10 Thu
11 Fri
12 Sat
13 Sun
14 Mon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Start Date: Feb 4, 2008
End Date: Feb 10, 2008
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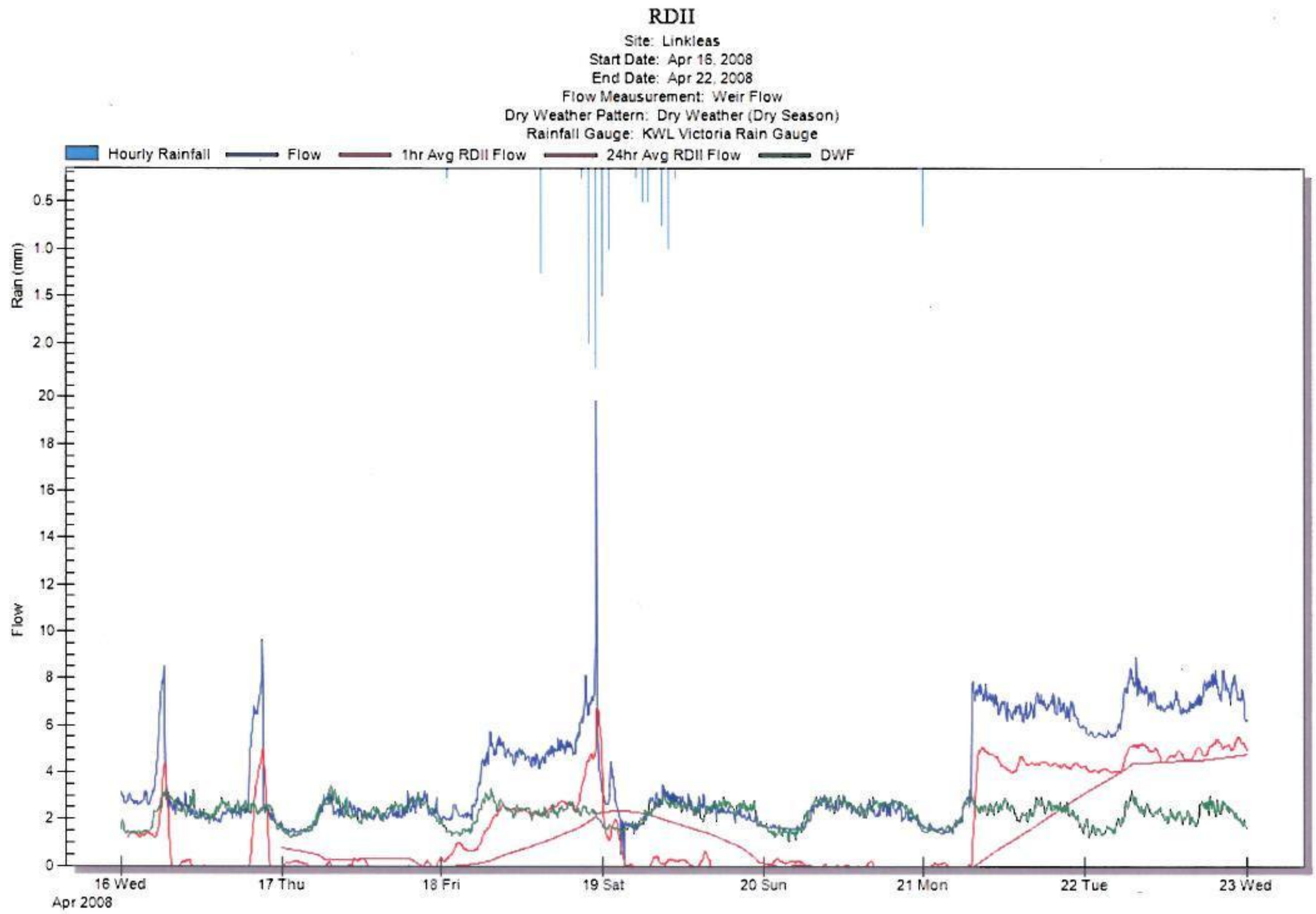
Dry Weather Pattern: Dry Weather (Wet Season)
Rainfall Gauge: KWL Victoria Rain Gauge
Hourly Rainfall
Flow
1hr Avg RDII Flow
24hr Avg RDII Flow
DWF
Rain (mm)
Flow
4 Mon
Feb 2008
5 Tue
6 Wed
7 Thu
8 Fri
9 Sat
10 Sun
11 Mon


RDII
Site: Linkleas
Start Date: Apr 16, 2008
End Date: Apr 22, 2008
Flow Meausurement: Weir Flow
Dry Weather Pattern: Dry Weather (Dry Season)
Rainfall Gauge: KWL Victoria Rain Gauge
Hourly Rainfall
Flow
1hr Avg RDII Flow
24hr Avg RDII Flow
DWF
Rain (mm)
0.5
1.0
1.5
2.0
Flow
20
18
16
14
12
10
8
6
4
2
0
16 Wed
Apr 2008
17 Thu
18 Fri
19 Sat
20 Sun
21 Mon
22 Tue
23 Wed

Appendix B

RDI&I Envelopes

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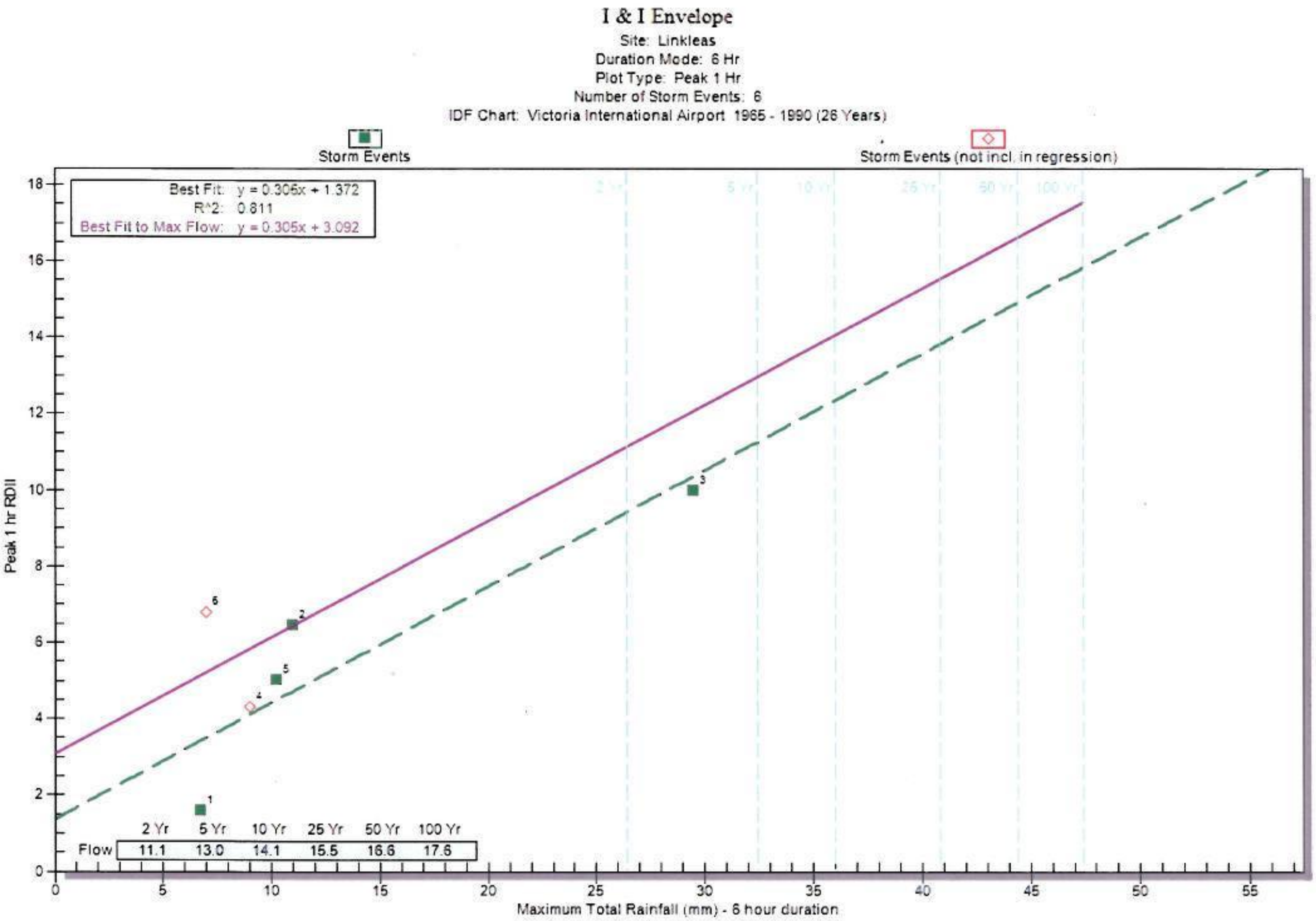
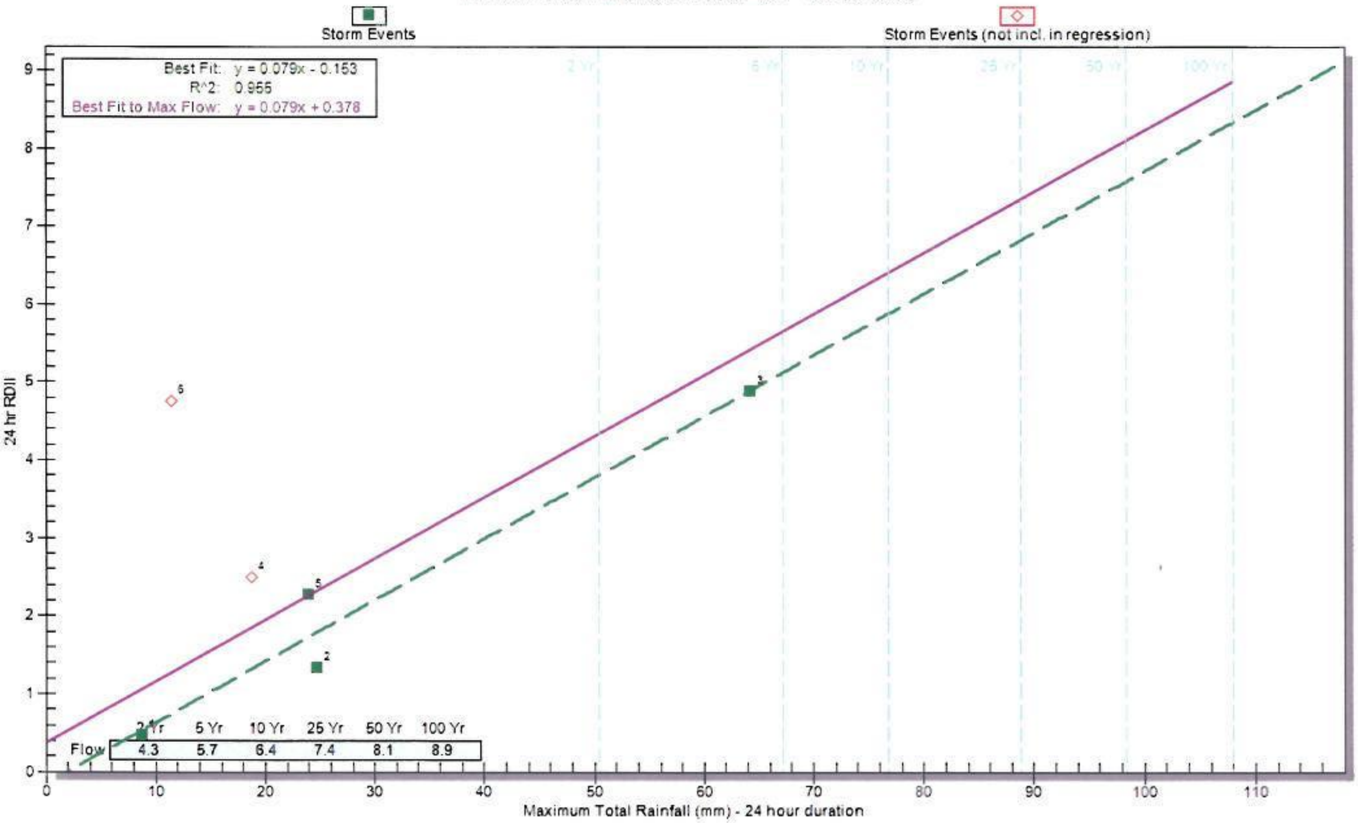

I & I Envelope
Site: Linkleas
Duration Mode: 6 Hr
Plot Type: Peak 1 Hr
Number of Storm Events: 6
IDF Chart: Victoria International Airport 1965 - 1990 (26 Years)
Storm Events
Storm Events (not incl. in regression)
Best Fit: y = 0.306x + 1.372
R^2: 0.811
Best Fit to Max Flow: y = 0.305x + 3.092
Peak 1 hr RDII
Maximum Total Rainfall (mm) - 6 hour duration
2 Yr 5 Yr 10 Yr 25 Yr 50 Yr 100 Yr
Flow 11.1 13.0 14.1 15.5 16.6 17.6

I & I Envelope

Site: Linkleas
Duration Mode: 24 Hr
Plot Type: 24 Hr
Number of Storm Events: 6
IDF Chart: Victoria International Airport 1965 - 1990 (26 Years)



James Bay I&I Reduction Pilot Program

Phase 1 Draft Report
January 2009

KERR WOOD LEIDAL
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James Bay I&I Reduction Pilot Program

Phase 1 Draft Report
January 2009

KWL File No. 809.032

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STATEMENT OF LIMITATIONS

This document has been prepared by Kerr Wood Leidal Associates Ltd. (KWL) for the exclusive use and benefit of the City of Victoria for the James Bay I&I Pilot Project. No other party is entitled to rely on any of the conclusions, data, opinions, or any other information contained in this document.

This document represents KWL's best professional judgement based on the information available at the time of its completion and as appropriate for the project scope of work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by members of the engineering profession currently practising under similar conditions. No warranty, express or implied, is made.

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Appendix B: Detailed Budget Estimates

Section 1

Introduction

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1. INTRODUCTION

1.1 BACKGROUND

The James Bay I&I Reduction Pilot Project (JBIIRPP) was initiated by the City of Victoria as part of its commitment to the Capital Regional District Core Area Liquid Waste Management Plan (CALWMP). The intent of the project is to reduce I&I using a variety of primarily trenchless construction methods in three of four study catchments in the James Bay neighbourhood. Flows monitored before and after the rehabilitation work will indicate the successfulness of each approach, and help to form a 'blueprint' for future I&I reduction efforts in the City.

Kerr Wood Leidal Associates Ltd. (KWL) was retained by the City in July 2008 to further develop, administer and report on the findings of this project.

1.2 SCOPE

The JBIIRPP is divided into three phases:

1. **Planning** – Assembly of pre-rehab field inspection, flow monitoring and technology research to refine the program prior to developing detailed design and construction documents.

2. **Design & Construction** – Based on the findings of the planning phase, design of I&I reduction measures in each study area, preparation of drawings, specifications and tender documents, construction and inspection.

3. **Evaluation and Reporting** – Post-rehab flow monitoring, determination of I&I reduction levels, evaluation of technologies and costs, development of recommendations for future I&I reduction efforts.

This document is intended to summarize the first phase of the project, and provides a recommended concept for moving to the second phase of the project.

1.3 STUDY AREAS

The James Bay sewerage system was primarily built before the 1920s, and much of the pipe system requires some level of rehabilitation. Moreover, because the system was built in the early 20th century, engineering standards for managing wastewater were based on conveying sewage to the nearest discharge point, and cross-connections between the storm drain and sanitary sewer were commonly accepted. According to the

ASTM[1], sewer systems of this age often required I&I to flush out the system. In many cases, overflows have been built-in to relieve the sanitary or storm sewer and prevent surface or basement flooding from occurring.

The sanitary sewer system in the selected study areas primarily consists of vitrified clay (VC) piping. A database of sewer information was provided by the City, which was subsequently linked to spatial records from AutoCAD. This is presented as Figure 1-1. Table 1-1 summarizes the sanitary sewer asset inventories for each study area.

Table 1-1: Sewer Asset Inventory

Study Area	1 Niagara	2 Superior South	3 Superior North	4 Belleville South	Total
Mainline Length (m)	3,151	3,151	3,146	3,902	13,350
No. Nodes	62	49	58	57	226
No. Lots	159	188	179	235	761
No. Active Services	262	304	299	349	1,214
No. Capped Services	88	54	79	107	328
Lot Area (ha)	18.6	16.8	19.7	18.9	74
Gross Area (ha)	25.4	22.9	27.1	25.6	101
ROW Area (ha)	6.8	6.1	7.4	6.7	27
Services/Lots Ratio	1.65	1.62	1.67	1.49	1.60
Average Catchment Age (years)	102	104	79	102	97

1.4 GLOSSARY OF ABBREVIATIONS

A number of acronyms and abbreviations will be used commonly throughout this project.

Abbreviation	Description
JBIIRPP	James Bay I&I Reduction Pilot Project.
WRc	Water Research Centre (UK).
NAAPI	North American Association of Pipeline Inspectors.
NASSCO	National Association of Sewer Service Companies.
GWI	Groundwater Infiltration, which is groundwater that has entered the sanitary sewer system. GWI occurs during all weather conditions and may vary on a seasonal basis, but is not considered to vary on an event basis. GWI is typically estimated as 85% of minimum daily dry weather flow for residential areas.
SWI	Stormwater inflow, surface water that has entered the sanitary sewer through direct connections such as manhole lids or cross-connections.

[1] American Society for Testing and Materials. <<http://www.astm.org/SNEWS/AUGUST_2004/sikora_aug04.html>>

Abbreviation	Description
RII	Rainfall-induced infiltration, groundwater that has entered the sanitary sewer system through soil during and after a rainfall event. RII occurs in the greatest magnitude during fully-saturated soil conditions.
RDII	Rainfall-Dependent Inflow & Infiltration (SWI + RII).
Total I&I	All inflow and infiltration (GWI + SWI + RII).
R&R	Rehabilitation and/or Replacement.
PWWF	Peak Wet Weather Flow.

1.5 PREVIOUS STUDIES

The City supplied KWL with the following background documents:

- "Inflow and Infiltration Management Plan" (UMA, 2004);
- "Inflow and Infiltration Study" (GEOtivity, 2006);
- "Clover System – Sanitary Sewer Study" (Focus, 2008);
- "Sewer Use Bylaw No. 82-44" (City of Victoria, rev. 1993);
- "Sewer User Charge Bylaw No. 91-234" (City of Victoria, rev. 1993);
- "Sewer Receipts Bylaw No. 6790" (City of Victoria, rev. 1993); and
- "Core Area Liquid Waste Management Plan" (Capital Regional District, 2000).

City of Victoria
James Bay I&I Reduction Pilot Project

Legend

Study Areas
Pump Station
Sanitary Vent/Cleanout
Existing Gravity Sewer
Existing Forcemain

Sanitary Manhole

Standard
Combined
Flush Tank

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100 0 100
Scale in Metres 1:7,500

Project No.	Date
809-032	December 2008

Study Area Overview

Figure 1-1

Map Document: (O:\0800-0899\809-032\430-GIS\MXD-Rp\809032_Fig1-1_StudyArea.mxd)
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Section 2

Flow Monitoring and I&I Characterization

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2. FLOW MONITORING AND I&I CHARACTERIZATION

2.1 I&I ENVELOPE ANALYSIS

In order to evaluate the results of an I&I reduction program, it is necessary to have a system that compares pre- and post-rehabilitation I&I rates using similar ambient conditions. This means that a) rainfall rates must be identical (i.e. return-period and duration) and b) I&I rates must be estimated at the most-saturated condition available.

The I&I Envelope Method is a graphical process for estimating return-period I&I flow rates at monitoring locations. RDII is estimated by subtracting a dry-weather flow signal from the flow recorded during a storm event. The resulting peak (hourly or daily) flow is then plotted as a regression against a rainfall intensity of a duration no less than the statistical flow duration. A best-fit line is then extended through the regressed data points to approximate a rate of rainfall-RDII response.

The 'most-saturated' event is identified as the point with the highest ratio of RDII per unit rainfall. The slope of the best-fit line is projected through this most-saturated point to establish an upper limit of the I&I Envelope. Design flows can then be estimated based on rainfall intensity to derive return-period RDII rates.

2.2 FLOW MONITORING SITES

The City established six flow monitoring locations in manholes in the James Bay study area to develop a baseline I&I rate for this study. In addition, flow data from the Niagara and Superior pump stations are available through SCADA from January 2006 to July 2007. The pump stations provide redundant monitoring and can be used to verify results from the manhole sites. As discussed in following sections, only the pump station data has had I&I analysis conducted. Figure 2-1 indicates the locations and upstream catchment areas of each site.

These sites were initially installed by GEOtivity Inc. (GT) using area-velocity meters in early 2008. A previous monitoring program was carried out in 2005/06 that utilized a number of the same locations as the current monitoring program.

During the previous 2005/06 monitoring program, GT produced a summary report titled "Inflow and Infiltration Study" (June 2006). This report documented quality control procedures that GT had conducted. Of the five sites in the James Bay study area, only Site 3 had independent velocity verification. The lack of verification of velocity data suggests that this information may not be reliable for I&I analysis.

From the 2008 monitoring program, two of the sites installed by GT were determined to have problems based on the data collected. This may have been a result of equipment faults, improper calibration, build-up of debris or a combination of factors.

In early September, GT entered into receivership, and the City has since ceased operations with GT. SFE Global Ltd. has been retained by the City to replace the flow monitoring equipment and resume the monitoring program in approximately the same locations for the remaining duration of the JBIIRPP. Flow monitoring had resumed by early December 2008. Subsequent comparisons between the current and previous monitoring and are proposed to evaluate the quality of the data previously collected by GT. If determined to be suitable, the previous flow monitoring data will be helpful in estimating I&I rates.

2.3 GROUNDWATER MONITORING

Groundwater level is currently being measured by four piezometers located throughout the James Bay area. To date, the monitors indicate a seasonal variation in groundwater level, but response to individual rainfall events is generally not identifiable from the records. This may be due to the frequency of level readings, which were taken at irregular intervals on a monthly to bi-monthly basis, but may also simply indicate that groundwater levels in the monitoring locations do not show a strong response to rainfall events. Figure 2-2 shows the data collected in 2006/2007.

The minima and maxima in the data collected is consistent from 2006 to 2007, and it remains to be seen if the upcoming I&I reduction program will have any effect upon ambient groundwater conditions.

Also of note is that the elevation of the sewers are higher relative to the water table at all the monitoring locations, with the exception of TH06-2, where the water table is consistently higher than the sewer.

2.4 DRY WEATHER FLOW

Dry weather flow for Niagara PS was selected from May 7-13, 2006 and for Superior PS from August 19-25, 2006. The dry weather flow patterns were subtracted from flow hydrographs during storm events to estimate RDII and also provide an estimate of groundwater infiltration (GWI). GWI has been estimated as 85% of the minimum dry weather flow.

2.5 I&I EVENTS

The 2008 winter season yielded very few significant rainfall events in Victoria. Only one storm, which occurred on February 12, was considered to be sizeable enough to produce I&I conditions suitable for envelope analysis. A number of I&I events were recorded during the 2005-06 monitoring program that were deemed suitable for analysis. Further, the pump station sites have coverage from January 2006 to July 2007. Only the pump station sites have been analysed using the I&I Envelope Method, with the manhole sites to be analysed at the end of the upcoming wet weather season.

Table 2-1: I&I Analysis Event Summary

Storm Event	Rainfall Intensity (mm/hr)		RDII at Niagara PS (L/s)		RDII at Superior PS (L/s)	
	Peak 1-hr	24-hr	Peak 1-hr	24-hr	Peak 1-hr	24-hr
January 8-15, 2006	4.8	0.9	16.6	8.9	N/A	N/A
November 3-8, 2006	9.4	3.1	35.0	16.3	161.1[1]	97.9[1]
November 8-20, 2006	4.2	1.1	19.4	7.9	96.2	29.7
December 10-19, 2006	4.8	0.8	16.3	7.8	124.4	47.5
January 2-12, 2007	10.8	1.9	39.7	15.8	180.8[1]	85.7[1]
February 17-24, 2007	5.1	1.3	14.6	6.6	137.0	43.5
March 9-15, 2007	7.6	1.6	22.8	8.2	148.3[1]	54.3[1]
October 16-22, 2007	4.6	0.9	6.3	2.0	74.5	19.1
November 30 - December 7, 2007	5.6	2.2	15.5	6.6	147.8	74.5
November 10-15, 2007	5.5	0.7	6.5	0.6	152.0[1]	23.7[1]

Note:
1. Overflow was suspected at Superior Pump Station. These events have not been included in the I&I Envelope analysis.

RDII hydrographs of these events are provided in Appendix A.

2.6 I&I QUANTIFICATION RESULTS

The I&I Envelopes for Niagara and Superior pump stations are presented as Figures 2-3 through 2-6. The following table lists the calculated I&I rates for these catchment areas.

Table 2-2: RDII Rates for Niagara and Superior Catchments

	Niagara PS	Superior PS
Catchment Area (ha)	25.4	93.9
GWI Flow (L/s)	1.0	13.8
GWI Rate (L/ha/d)	3,400	12,700[1]
RDII Flow (L/s)		
5-Year Peak 1-Hour	50.0	389.8
100-Year Peak 1-Hour	162.5	696.8
5-Year 24-Hour	19.4	104.3
100-Year 24-Hour	28.3	162.5

	Niagara PS	Superior PS
RDII Rate (L/ha/d)		
5-Year Peak 1-Hour	170,000	359,000
100-Year Peak 1-Hour	553,000	641,000
5-Year 24-Hour	66,000	96,000
100-Year 24-Hour	96,000	149,500
Note: 1. GWI rate for Superior is much higher than would normally be expected, and additional verification is recommended.		

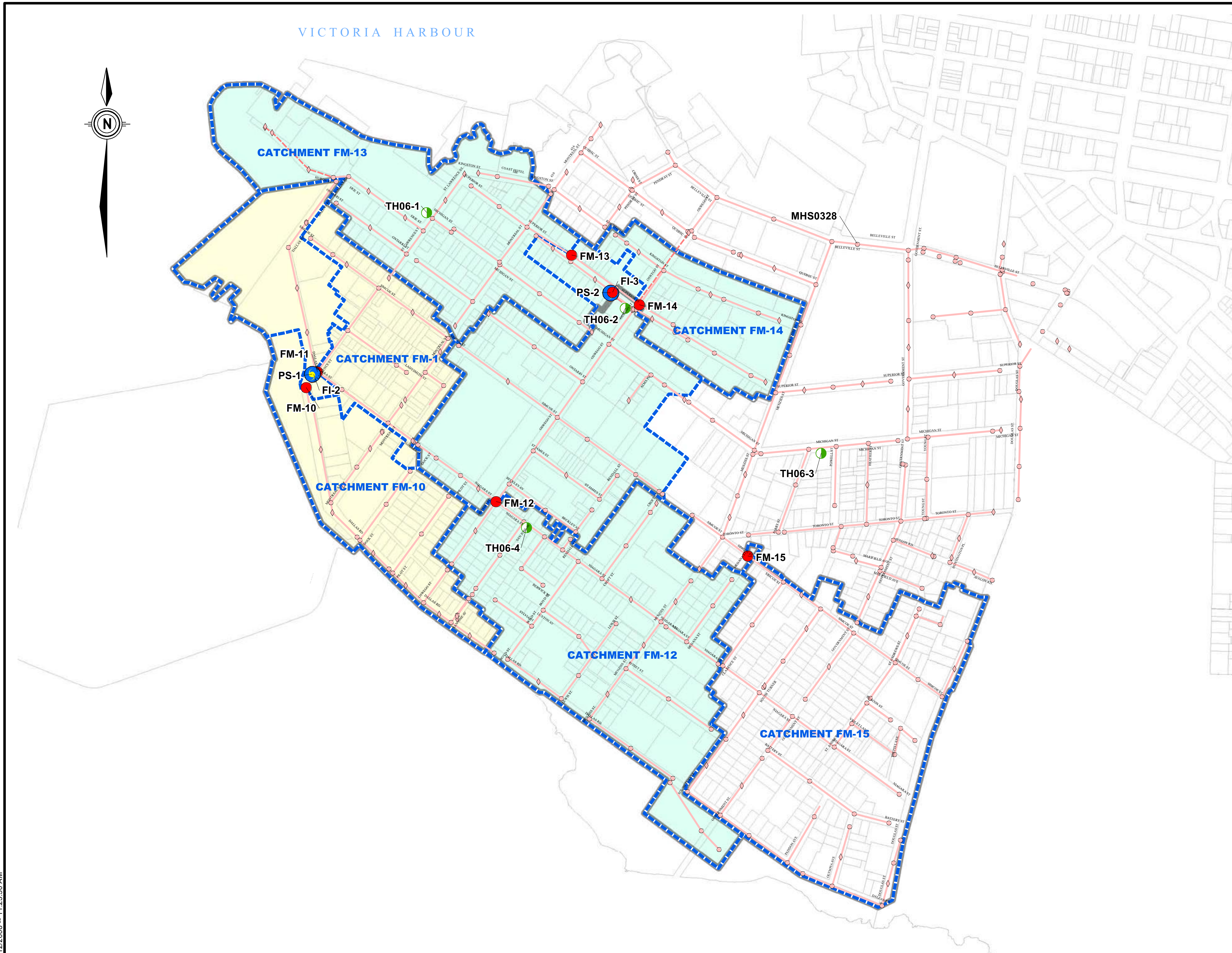
2.7 CHARACTERIZATION OF I&I SOURCES

The I&I analysis indicates high rates of SWI influence in both Niagara and Superior catchments. SWI characteristics indicated in the study area include rapid responses to rainfall, little deviation between the best-fit and most-saturated lines of the I&I envelopes and generally very high RDII rates. Generally, this would be confirmed by using summer storm events to estimate RDII under non-saturated soil conditions.

GWI rates in the Superior catchment are also significantly higher than in Niagara. However, the rate estimated at Superior PS is much higher than would typically be observed. The high GWI rate may be attributable to sources other than infiltration such as leaking indoor plumbing. Post-rehab monitoring will likely assist in determining this.

The Superior catchment has notably higher I&I than Niagara, and when compared with smoke testing results (see Section 3.2), a high number of catch basins are indicated as being cross-connected.

In general, it is anticipated that targeting SWI sources will yield the largest reductions in RDII in all study areas.



City of Victoria
James Bay I&I Reduction Pilot Project

Legend

- Study Areas
- Flow Monitoring Catchment
- Catchment PS-1 (Niagara)
- Catchment PS-2 (Superior)
- Existing Sanitary Fitting
- Existing Sanitary Manhole
- Existing Gravity Sewer
- Existing Forcemain

Existing Sanitary Facility
- Pump Station

Existing Monitoring Location
- Piezometer
- Flow Monitor
- Pump Station

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100 0 100
Scale in Metres 1:7,500

Project No.	Date
809-032	November 2008

Flow Monitoring Plan

Figure 2-1

James Bay Groundwater Level Monitoring 2006-2007

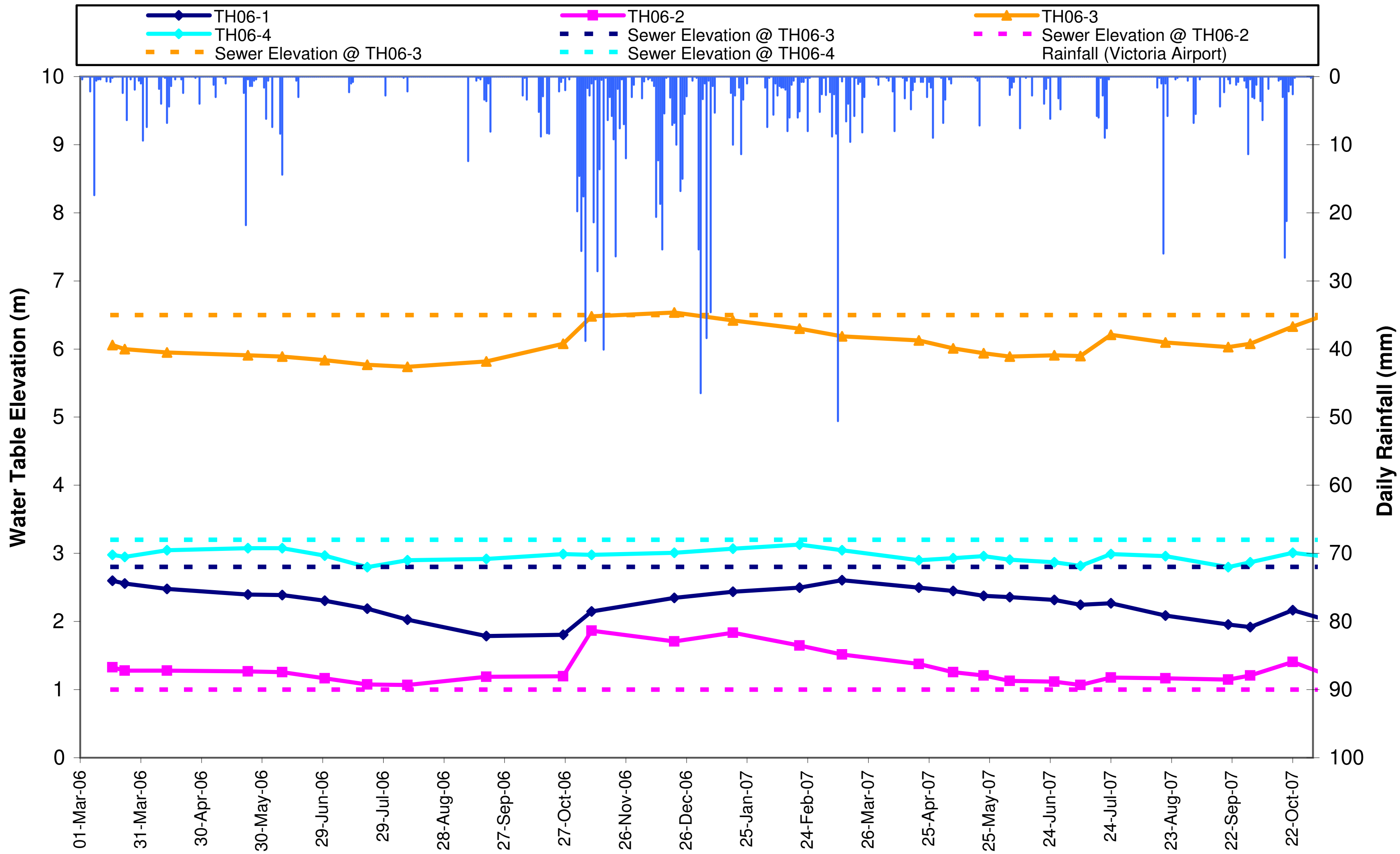

Figure 2-2

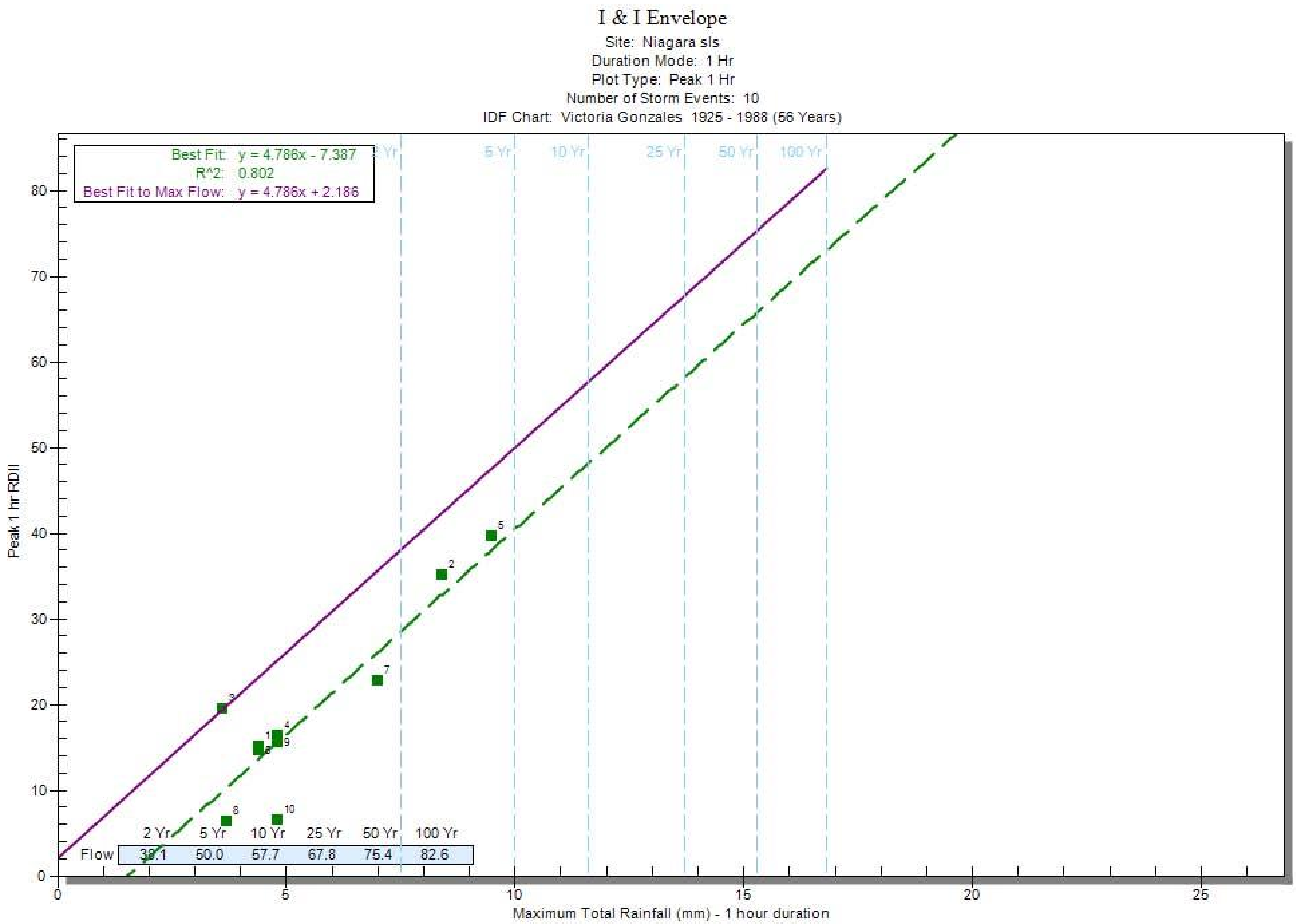
I & I Envelope
Site: Niagara sls
Duration Mode: 1 Hr
Plot Type: Peak 1 Hr
Number of Storm Events: 10
IDF Chart: Victoria Gonzales 1925 - 1988 (56 Years)
Best Fit: y = 4.786x - 7.387
R^2: 0.802
Best Fit to Max Flow: y = 4.786x + 2.186
2 Yr 5 Yr 10 Yr 25 Yr 50 Yr 100 Yr
Flow 38.1 50.0 57.7 67.8 75.4 82.6
Peak 1 hr RDII
Maximum Total Rainfall (mm) - 1 hour duration

FIGURE 2-3

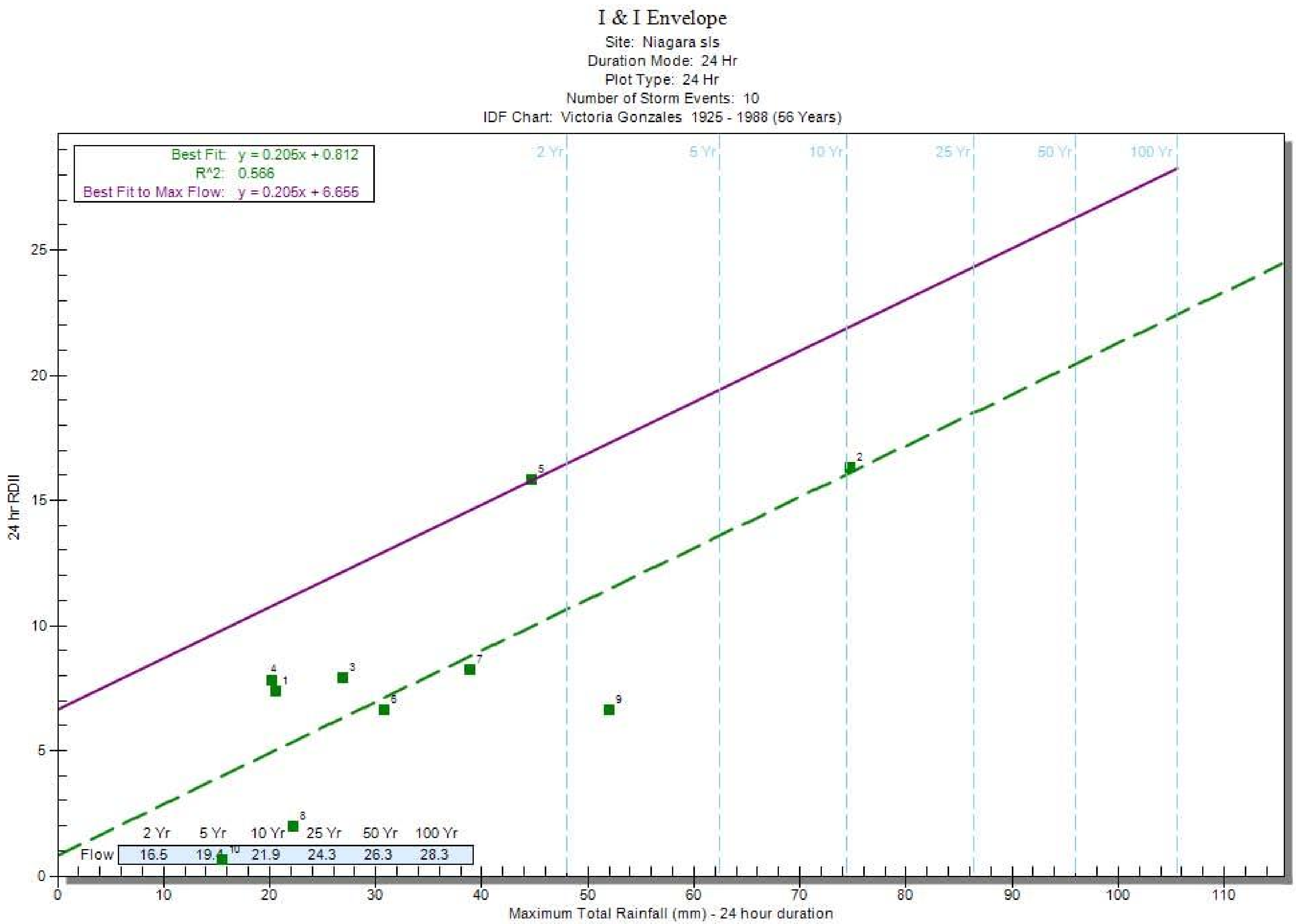
I & I Envelope
Site: Niagara sls
Duration Mode: 24 Hr
Plot Type: 24 Hr
Number of Storm Events: 10
IDF Chart: Victoria Gonzales 1925 - 1988 (56 Years)
Best Fit: y = 0.205x + 0.812
R^2: 0.566
Best Fit to Max Flow: y = 0.205x + 6.655
2 Yr
5 Yr
10 Yr
25 Yr
50 Yr
100 Yr
Flow 16.5 19.4 21.9 24.3 26.3 28.3
24 hr RDII
Maximum Total Rainfall (mm) - 24 hour duration

FIGURE 2-4

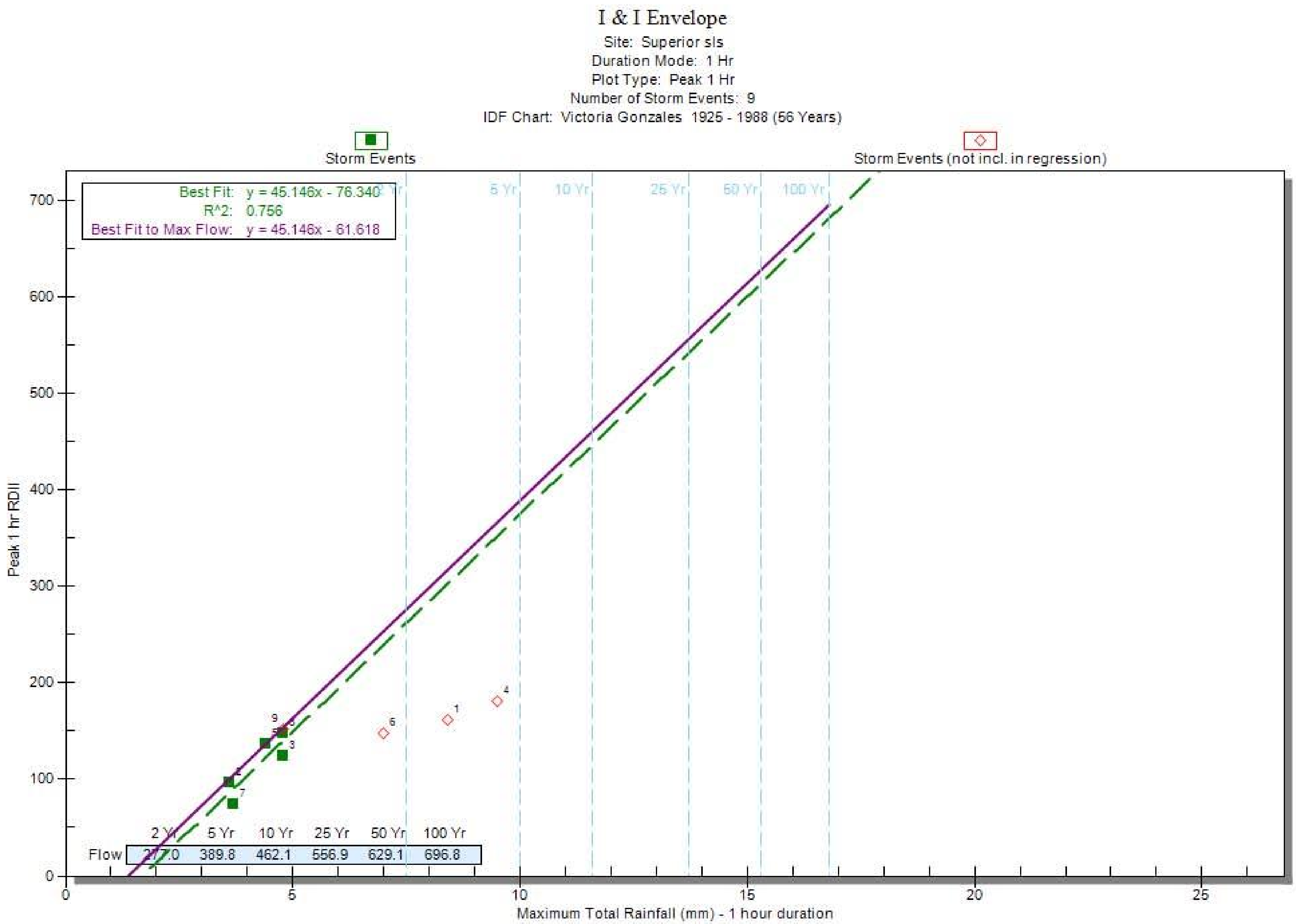
I & I Envelope
Site: Superior sls
Duration Mode: 1 Hr
Plot Type: Peak 1 Hr
Number of Storm Events: 9
IDF Chart: Victoria Gonzales 1925 - 1988 (56 Years)
Storm Events
Storm Events (not incl. in regression)
Best Fit: y = 45.146x - 76.340
R^2: 0.756
Best Fit to Max Flow: y = 45.146x - 61.618
5 Yr
10 Yr
25 Yr
50 Yr
100 Yr
2 Yr
5 Yr
10 Yr
25 Yr
50 Yr
100 Yr
Flow
389.8
462.1
556.9
629.1
696.8
Peak 1 hr RDII
Maximum Total Rainfall (mm) - 1 hour duration

FIGURE 2-5

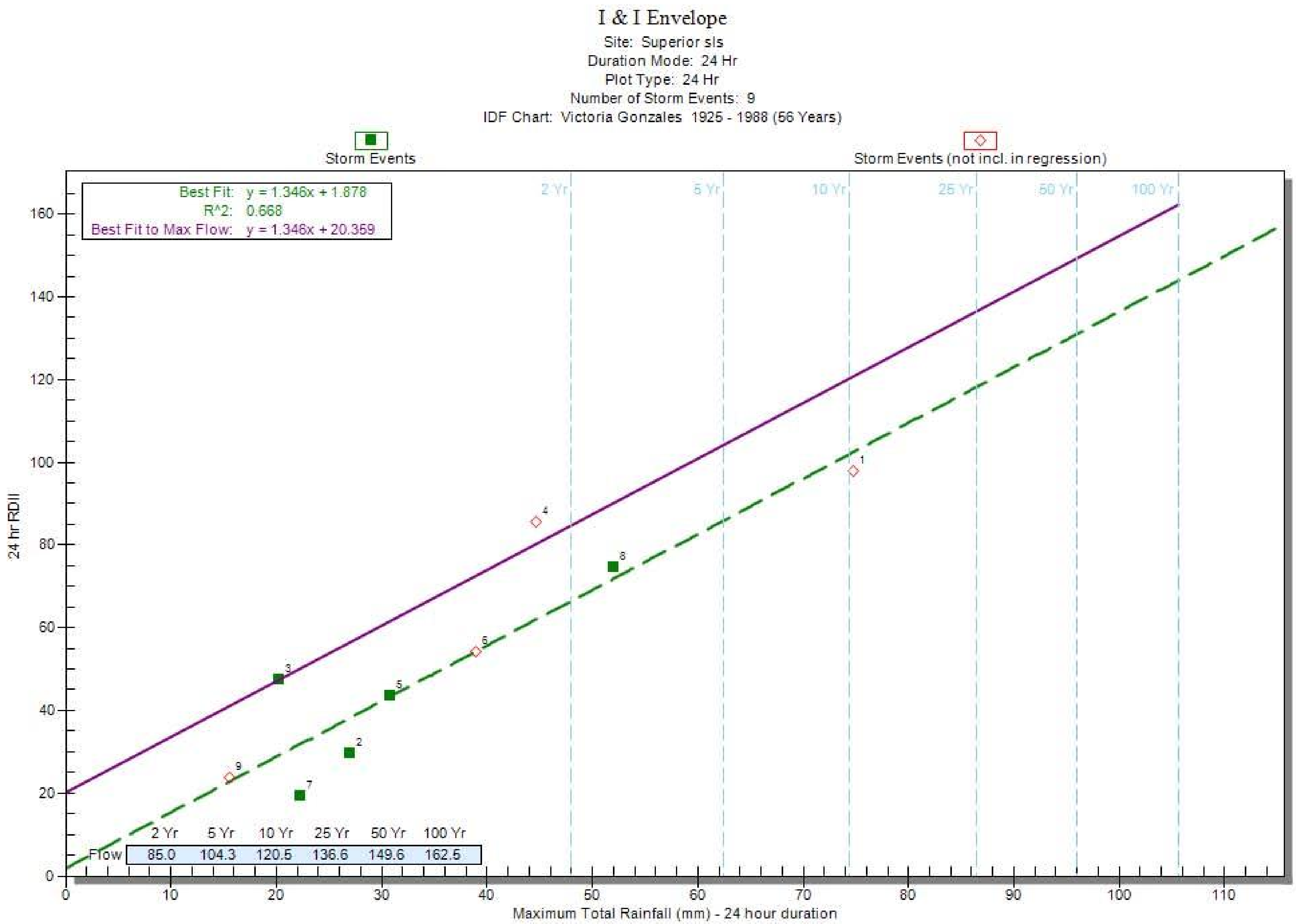
I & I Envelope
Site: Superior sls
Duration Mode: 24 Hr
Plot Type: 24 Hr
Number of Storm Events: 9
IDF Chart: Victoria Gonzales 1925 - 1988 (56 Years)
Storm Events
Storm Events (not incl. in regression)
Best Fit: y = 1.346x + 1.878
R^2: 0.668
Best Fit to Max Flow: y = 1.346x + 20.359
2 Yr
5 Yr
10 Yr
25 Yr
50 Yr
100 Yr
Flow 85.0 104.3 120.5 136.6 149.6 162.5
24 hr RDII
Maximum Total Rainfall (mm) - 24 hour duration

FIGURE 2-6

Section 3

Field Investigations

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3. FIELD INVESTIGATIONS

3.1 CCTV INSPECTIONS

CCTV inspections were conducted by McRae's Environmental in 2007. Attempts to inspect were made for approximately 98% of the mainlines in the study area. The following table summarizes the CCTV survey completion rates.

A database containing information from the CCTV program was supplied by the City. In general, the data collected is of good quality, with consistent application of observation coding to NASSCO/NAAPI/WRc standards. Standardized codes are applied to observations in the sewer system, which can be generalized in four categories:

- structural defects (breaks, cracks, fractures, holes, collapses, open/displaced joints, deformation);
- service or operational defects (roots, encrustation, debris, obstructions, visible infiltration);
- construction features (service connections, pipe junctions, manholes/nodes, changes to pipe material or diameter); and
- miscellaneous survey codes (start/finish of survey, abandonment of survey, water level, etc.).

CCTV observations include a standard code as well as the linear distance from the start of the survey of a given pipe (usually a manhole). Using this information in combination with ArcGIS linear referencing tools a map of all CCTV observations has been generated for the James Bay study area, and included as Figure 3-1.

Observations of particular interest in this study include all structural defects, some service defects such as roots and infiltration, and service connections. Table 3-1 summarizes the number of such observations encountered by the CCTV inspection program.

Table 3-1: CCTV Summary

	1 Niagara	2 Superior South	3 Superior North	4 Belleville South	Total
Total Structural Defects	133	88	54	62	337
Total Defect Score	3,332	2,168	1,910	1,562	8,972
No. Breaks	7	3	2	4	16
No. Large Joint Displacements	0	0	1	0	1
No. Collapses	0	1	0	0	1
Total Structural Defects/ 1,000 m Mainline	42.2	27.9	17.2	15.9	25.2
Average Defect Score (Score/m)	1.1	0.7	0.6	0.4	0.7

Niagara has the poorest overall structural condition, and would thereby benefit the most from a mainline R&R program. The observed frequency and severity of defects in the study area is consistent with expected rates. Specific structural defects are difficult to correlate with I&I rates in a quantitative manner, other than older sewer systems tend to have higher rates of both I&I and structural defects.

3.2 SMOKE AND DYE TESTING

Smoke testing involves blowing a smoke compound into the sanitary sewer system in order to identify pathways that may allow for the ingress of surface runoff. The primary usage of smoke testing data is to identify direct surface water connections to the sanitary sewer system. Commonly, these may result from catch basins, open pipes, storm sewer overflows, rainwater leaders and building drain tiles.

Dye tests are typically conducted as a follow up to a smoke test program to confirm where potential cross-connections are located. Dye tests involve introduction of water-soluble and highly visible dye to suspected cross-connections, and observation at downstream access points of the storm drain and sanitary sewer systems.

Superior City Services Ltd. was retained by the City for a smoke testing program in 2006. All sanitary lines in the study area were tested, with 239 leak observations resulting. A standardized coding system has been developed to describe various leak sources.

The smoke test results database supplied by the City has been geo-coded to the cadastral plan by legal address. Public-side observations have been further re-mapped to the nearest indicated catch basins, manholes or cleanouts as described in the smoke test database. The following table summarizes the smoke test observations by study area.

Table 3-2: Smoke Test Summary

	1 Niagara		2 Superior South		3 Superior North		4 Belleville South		Total	
	Priv.	Pub.	Priv.	Pub.	Priv.	Pub.	Priv.	Pub.	Priv.	Pub.
Length of Mainline Showing Leaks (m)	1,389		1,600		2,007		2,728		7,724	
% Catchment Length with Leaks	44%		51%		64%		70%		58%	
Catchment Area (ha)	18.6	6.8	16.3	6.9	21.1	6.1	18.9	6.7	74.9	26.5
Total Smoke Test Observations	22	14	25	19	28	28	57	46	132	107
Suspected SWI Connections	7	14	5	19	14	28	26	46	52	107
'No Smoke' Observations	12	-	19	-	11	-	28	-	70	-
Observation Occurrence Rate (#/ha)	1.2	2.1	1.5	2.8	1.0	4.6	3.0	6.9	1.8	4.0

Note: 1. Public-side observations refer to leaks detected within the road ROW, not necessarily including all public properties.

A large number of the smoke observations were catch basins within the public right-of-way. This is not a definitive indicator that these are directly connected to the sanitary sewer system, especially if the adjacent storm sewer manhole was shown to be producing smoke during the test. The presence of a smoking storm sewer manhole would generally tend to indicate an overflow between the storm and sanitary sewers, but not necessarily a direct connection (i.e. a pathway through the soil and pipe defects is possible). In cases where catch basins showed leaks, it is recommended that follow-up dye tests be conducted to determine if a direct pathway from the catch basin to the sanitary sewer exists.

Another situation where dye testing is recommended is when a NS code is used, which indicates that no smoke was observed from a property connected to the sewer being tested. Typically, smoke should exit from a building's sanitary drain vent stack during a smoke test. No smoke would indicate an unvented drain, a potential blockage in the sewer connection or a sump pump. In buildings with sump pumps it is possible that surface water is being directed to the sanitary sump, which can be verified using dye tests.

3.3 MANHOLE INSPECTIONS

The City has previously inspected a number of manholes. The database provided by the City indicates that the riser, levelling rings, benching and rungs have had condition assessments completed, with a rating of 1-5 assigned (1 being good, 5 being complete deterioration). Any visible signs of infiltration were noted as comments in the database. In general, most manholes were rated as being in good-to-fair condition (1 or 2). This database has been linked to the node features and mapped as Figure 3-3. Table 3-4 summarizes the manhole defect observations made by the City inspectors, with all ratings greater than 2 being included.

Table 3-3: Manhole Inspection Summary

	1 Niagara	2 Superior South	3 Superior North	4 Belleville South	Total
Total Nodes	62	49	58	57	226
Total Inspected	58	49	52	54	213
Inspection Rate	94%	100%	90%	95%	94%
I&I Observed	5	4	0	11	20
Surcharging	0	2	1	0	3
Surface Ponding	0	0	0	0	0
Grade Ring Deterioration	2	3	0	3	8
Other Structural Deterioration	3	3	0	9	15

Based on limited field observations, a significant number of manhole covers have widely-spaced gratings such that a large amount of inflow could enter, particularly if the rim elevation is lower than the surrounding surface grade. It is recommended that all of these grated covers be replaced or cover inserts be used to reduce inflow in study areas where direct connections or public-side rehabilitation are being targeted.

For budget-level cost estimation purposes, it will be assumed that a portion of manholes in areas selected for manhole rehabilitation will be grouted or coated, and those indicating structural deterioration will be repaired as needed. While material is not indicated in the database, it is suspected that most manholes will be brick, given the age of the system. Brick manholes may require extensive grouting.

3.4 FIELD INSPECTION SUMMARY

Based on the information supplied to date, the following recommendations are made for inspection work prior to tendering of construction:

- mainline CCTV is adequate, no further pre-construction inspection is required;
- manhole inspections cover most manholes in the study area, however locations where a cross-connection has been indicated will require additional inspection time to locate overflow pipes. Additional manhole inspections may be needed to locate suitable coating candidates;
- service connection CCTV inspection is recommended for all catchments where service R&R work is to occur;

- service connections near manholes where overflows have been indicated by smoke testing may require CCTV work if an overflow pipe is not visible within the manhole; and

- dye testing is required for all ‘no smoke’ and public catch basin observations prior to commencing construction work. Approximately 170 dye tests are anticipated based on the number of ‘no smoke’ and catch basin leaks detected by the smoke test program.

City of Victoria
James Bay I&I Reduction Pilot Project

Legend

Study Areas
Existing Sanitary Manhole
Existing Gravity Sewer
Existing Forcemain

Structural Defect

Break/Hole/Collapse
Fracture
Open/Displaced Joint
Deformation
Crack
Wear/Spalling

Operation Defect

Debris
Encrustation/Scale
Infiltration
Line Deviation
Roots

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Scale in Metres 1:7,500

Project No.	Date
809-032	November 2008

CCTV Results

Figure 3-1

Map Document: (O:\0800-0899\809-032\430-GIS\MXD-Rpt\809032_Fig3-1_CCTVResults.mxd)
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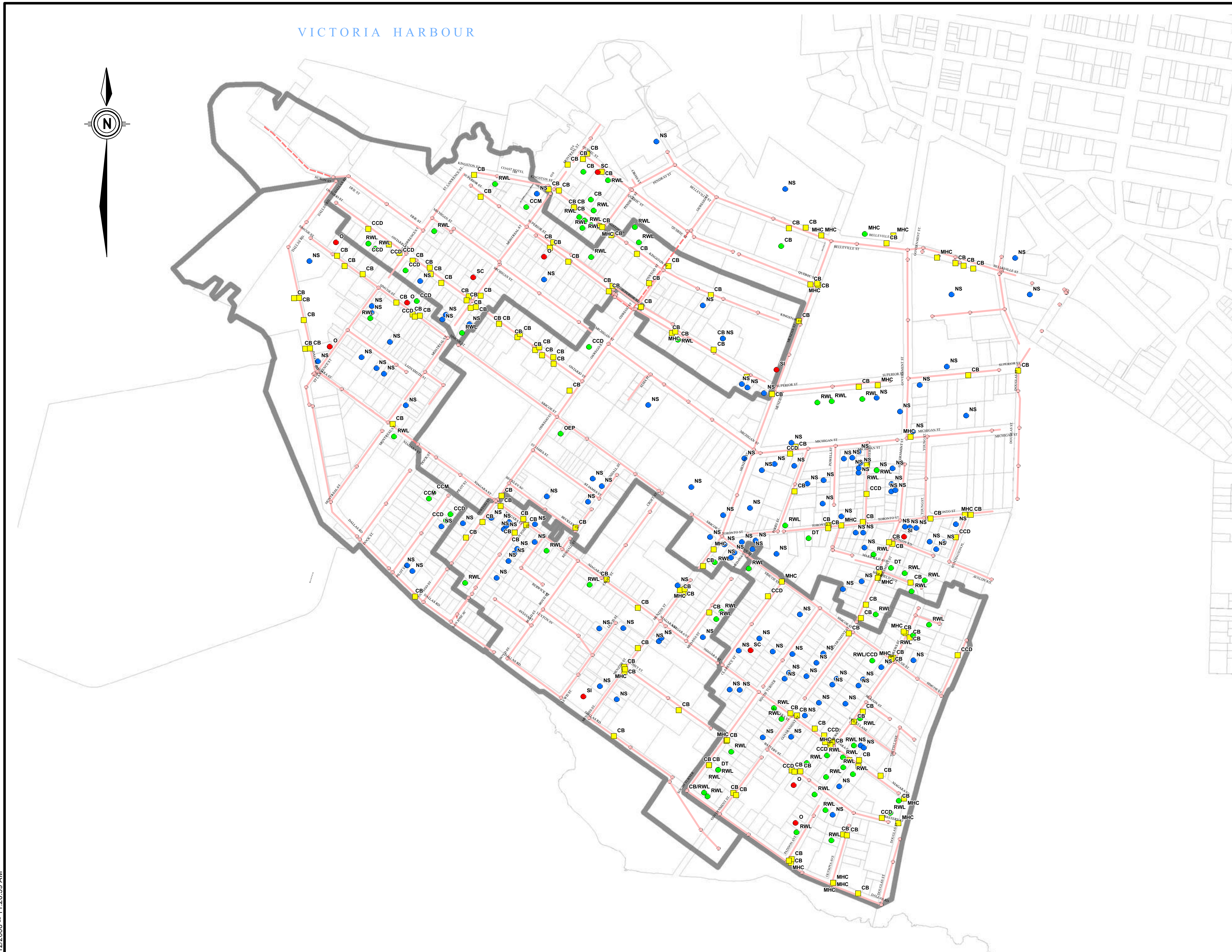

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Project No.	Date
809-032	December 2008

Smoke Test Results

Figure 3-2

Map Document: (O:\0800-0899\809-032\430-GIS\MXD-Rp\809032_Fig3-2_SmokeTestResults.mxd)
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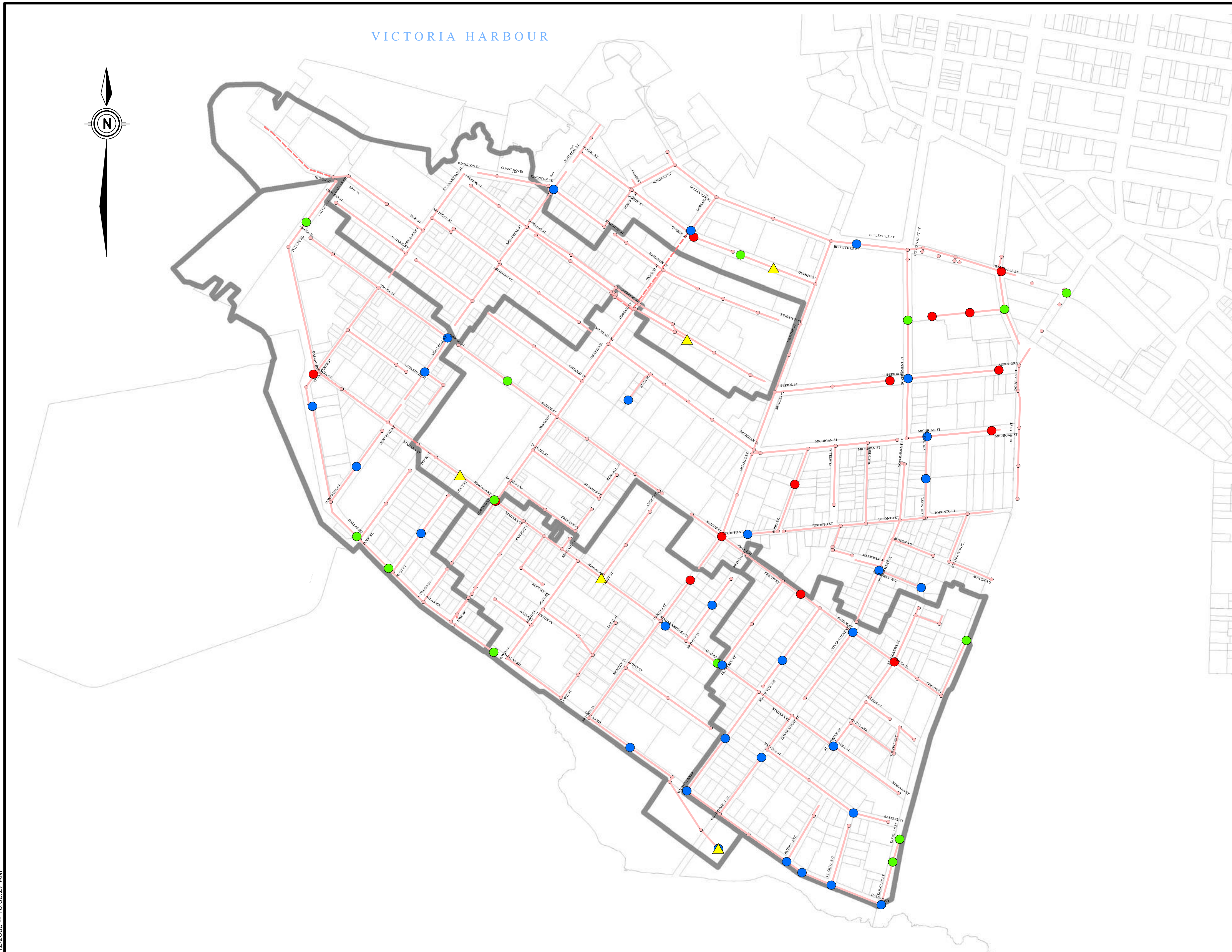

City of Victoria
James Bay I&I Reduction Pilot Project

Legend

- Study Areas
- Existing Sanitary Manhole
- Existing Gravity Sewer
- Existing Forcemain
- Surcharging
- Infiltration Observed
- Grade Ring Deterioration
- Structural Deterioration

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Scale in Metres 1:7,500

Project No.	Date
809-032	December 2008

Manhole Inspection Results

Figure 3-3

Map Document: (O:\0800-0899\809-032\430-GIS\MXD-Rpt\809032_Fig3-3_ManholeInspections.mxd)
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Section 4

Rehabilitation and Replacement Methods

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4. REHABILITATION AND REPLACEMENT METHODS

4.1 REHABILITATION OVERVIEW

The rehabilitation program will focus on a number of areas within a collection system, including mainlines, manholes, service connections and direct connection pathways. As budget is a limiting factor, work on any given buried portion of the collection system will be limited to one of the study areas. This still provides the ability to evaluate a range of technologies, as the intended outcome in each area remains the same – reduction of I&I.

As stated in the overall pilot project terms of reference, usage of trenchless technology in completing repairs shall be highlighted, with evaluation of a variety of technologies as a key objective. This section will present which technologies are available in the B.C. market, and of these, which are expected to be feasible for use on this project.

4.2 AVAILABLE TRENCHLESS TECHNOLOGY

Trenchless technologies can be utilized on any of the buried portions of the collection system, including mainlines, manholes and service connections. The following list is not meant to be exhaustive, but presents an overview of what is currently available for the purposes of this project.

MAINLINES

Internal Chemical Grouting: This is the most common method for sealing leaking joints in sewer collection systems. Grouting generally does not provide a structural repair, but fills the void space between the pipe and surrounding soils, and is typically applied at joints, small cracks and holes, and service/mainline interfaces. Most commonly an acrylamide grout compound is used, which is injected using a specialized machine that has a camera, air test tool, grout injector and packer. Each joint, defect and service connection is first air-tested, and if the location fails to hold a minimum air pressure for a specific amount of time (typically 3 psi for 10 minutes), grout is injected into the air test area, and a bladder is inflated which forces the grout into the joint and the void space behind. The volume of grout used varies depending upon the size of pipe and void space behind the joint, defect or service interface.

Sliplining: Sliplining involves inserting a new pipe inside an existing one using either continuous lengths such as HDPE, or discrete pipe lengths. The annulus between the host pipe and new pipe should be grouted to seal the installation and provide additional strength and support.

Deformed Pipe/Fold-And-Form Lining: This is a rehabilitation method by which flexible deformed pipes are inserted into an existing line by pulling a continuous length from access point to access point. The inserted liner is then heated and pressurized to form a tight fit within the host pipe. The two most common methods are by using a dye to deform heated HDPE pipe such that it stretches lengthwise and reduces in diameter so it can be inserted, and as the pipe cools it returns to its normal dimensions, which makes the pipe expand for a tight fit. The other method uses a PVC pipe liner that has been folded upon itself to such that it fits inside the host pipe. The PVC liner is then heated and pressurized to expand and fit to the host pipe.

Spiral-Wound Pipe: Spiral-wound installation involves using a PVC strip that is pulled through a winding machine to form a circular pipe, which can be expanded outward to fit to the host pipe, or left as a fixed diameter pipe, which later has the annular space grouted. The spiral joint is made using an interlocking clip, twin rubber gaskets, or a mechanically-locked male/female edge.

Cured-In-Place Pipe (CIPP) Lining: The CIPP process involves inserting a flexible felt sleeve impregnated with PVC resin into the host pipe by either an inversion process or by winching the liner in place. The liner is then cured using recirculating hot water, steam or UV light. The CIPP lining can be designed to have the same physical properties as a new PVC pipe.

Pipe Bursting: Pipe bursting involves replacing the host pipe in-situ with a continuous length of new pipe that may be of the same or larger diameter. An entry and exit pit is excavated at each end of the run of pipe to be replaced. A specialized bursting head is used to break the host pipe and pull the new pipe through the broken host pipe. The bursting head is either designed to crack (brittle pipes) or cut (flexible pipes) the host pipe and push soil out of the way. Pipe bursting can be used to replace the host pipe with a larger or same-sized pipe. In cases where a much larger diameter pipe replaces the host pipe a pilot hole may need to be directional-drilled above the host pipe to prevent buckling of the surface. Service connections are typically re-instated with open-cuts. HDPE is the typical material of the replacement pipe. Service connections should be thermally-welded to the pipe in order to develop a permanent seal for preventing I&I.

Pipe Eating: Pipe eating is a horizontal boring technique that utilizes a suitable crusher-type microtunneling machine to literally ‘eat’ the host pipe and pull a new pipe in place behind. The machine is controlled by a sophisticated laser-guided alignment system.

MANHOLES

Grouting: Chemical grouts can be applied to manholes in a number of ways to reduce infiltration of groundwater. When applied properly, this can be a very cost effective way to reduce I&I. Grout is typically applied manually from the interior of the manhole by drilling holes near visible leakage and injecting grout under pressure into the soil surrounding the manhole. A number of compounds are typically used, including acrylate, acrylamide, acrylic, urethane gel and urethane foam.

Manhole Cover Insert: Manhole covers can be a significant source of inflow into a sanitary sewer system. Location is an important factor when deciding how much inflow is entering through the manhole cover. Manholes located near street gutters or in low depression areas are prime candidates for a manhole cover insert. A manhole cover insert is placed underneath the manhole cover and prevents water from entering. Inserts are made from either stainless steel or ABS plastic and there are designs to release pressure build up from within the manhole. Neoprene is used to seal the insert to the manhole rim and allows for easy removal of the insert.

Coating Systems: Coating systems are used to restore the inside of a manhole. A mixture of Portland cement, finely graded mineral fillers, and chemical additives is sprayed on the inside of a cleaned manhole. Once the mixture is dry it forms a physical barrier against incoming water. Coatings are ideally suited for brick structures that show no sign of movement or subsidence as the coating does not provide any substantial structural strength to the manhole. Some coating systems can be installed without requirement for confined space entry.

Structural Lining: Structural linings may be installed in a number of ways, including cast-in-place concrete, prefabricated HDPE or FRP liners, or CIPP lining. Generally, structural repairs are not cost-effective for controlling I&I compared to coating and grouting, and if settlement is causing the deterioration of the manhole, the only solution may be replacement. Lining is best suited to situations where erosion or corrosion is an issue.

SERVICE CONNECTIONS

Pipe Bursting and CIPP Lining: Service connections can be rehabilitated or replaced much in the same way as mainline pipe. If a cleanout is available at the property line, a liner can be inserted without the requirement to excavate. New lining technologies may also allow for insertion of a liner from the sewer main, further reducing the need to excavate.

Segmental CIPP Lining: Abandoned service connections can be dealt with either by excavating, capping and sealing, or alternatively a segmental liner can be installed in the mainline to seal off the connection. This latter method can potentially be executed simultaneously with a service lateral inspection program to reduce mobilization costs.

Directional Drilling: Direct SWI connections can also be dealt with using trenchless methods. Directional drilling allows for installation of a new service connection to the storm main with only small entry and exit pits at each end. This method is expected to be particularly advantageous when working on private property, however catch basins in the public right-of-way are still likely to be re-connected using open-cut methods.

4.3 DESIGN CONSIDERATIONS & UNIT PRICING

The R&R techniques selected will be determined based on the condition assessments performed to date for mainlines and manholes.

The following table presents generalized details for selecting the R&R techniques for sewer mainlines based on CCTV results.

Table 4-1: Mainline R&R Methods

Repair Method	Situational Usage	Unit Cost Range
Grouting	Failed Air Test	$50/joint, $450/service interface (incl. air testing)
Full Pipe Re-Lining (CIPP, slipline, fold & form, spiral wound)	Cracks, Fractures, Holes, Small to Medium Joint Displacements, Roots, Infiltration, Wear; multiple locations indicated	$100 - $400 per lineal metre, depending upon pipe size
Pipe Bursting/Eating	Breaks, Collapses, , Large Joint Displacement, Upsizing; multiple locations encountered	$400 - $900 per lineal metre, depending upon pipe size, plus allowance for service reinstatement
Trenchless Point Repairs	Same as re-lining, but for single locations	$300 - $500 per lineal metre depending upon pipe size, plus $1,000 for setup
Excavated Point Repairs	Breaks, Collapses Large Joint Displacements; single locations	$3,000 - $9,000 per repair, depending upon depth of excavation
Excavated Mainline Repairs	Same as pipe bursting, but likely only to be used for short pipe runs	$600 - $1,200 per lineal metre

Other factors that usually affect the cost of any given repair include the number of services requiring reinstatement, root cutting, flushing and cleaning, removal of protruding service connections. These costs typically amount to approximately 3-5% of overall R&R costs. If utility relocation work is required, costs may escalate significantly depending upon the type and extent of relocation work required. Contingency allowances in the range of 10-15% are added to costs to cover unplanned work such as utility relocation.

Table 4-2 describes situations where various manhole R&R techniques may be employed.

Table 4-2: Manhole R&R Methods

Repair Method	Situational Usage	Unit Cost Range
Grouting	Light to moderate infiltration, missing grout, cracks	$700 per manhole
Cover Insert	Any manhole, those in recessed areas or low drainages in particular	$200 - $250 per cover
Coatings	Brick manholes with infiltration but no deformation	No cost info currently available
Liner Inserts	Damage to structure due to settlement, abrasion or corrosion	Ranges depending upon components and size
Excavated Replacement	Severe damage to all or portions of manhole	Up to $10,000 for complete replacement of manhole

Manhole repair methods vary greatly depending upon the expertise of contractors. Most repairs require confined space entry, which can affect price significantly. I&I problems for manholes are commonly associated with the top portion, including the cone, riser, frame and cover. Because these are at shallow depths, these measures are expected to be cost-effective to implement. Manhole infiltration can be difficult to control and detect, and for budget purposes a portion (30%) of manhole rehab with coating technology will be allowed for.

Service connection R&R methods are listed in the following table.

Table 4-3: Service Connection R&R Methods

Repair Method	Situational Usage	Unit Cost Range
Full CIPP Lining (Rehab)	Non-collapsed service lines, preferably with cleanout/inspection chamber at property line	$3,000 - $4,000 per service connection
Segmental CIPP Lining (Seal)	Abandoned service connection to mainline	$300 - $500 per lineal metre depending upon pipe size, plus $1,000 for setup
Pipe Bursting	Severely damaged or undersized service connections	$4,000 - $5,000 per service connection
Directional Drilling	Re-connection of surface inlets to storm drain	Similar to pipe bursting

In general, most service connections should be dealt with using trenchless methods. Lining will result in a diameter reduction that may contravene the City's *Plumbing Bylaw*, which should e considered prior to approval of any R&R work. Based on previous experience in other jurisdictions, existing service connections are expected to be in generally poor condition, and extensive pipe bursting is anticipated.

4.4 PROPOSED REHABILITATION AND REPLACEMENT PLAN

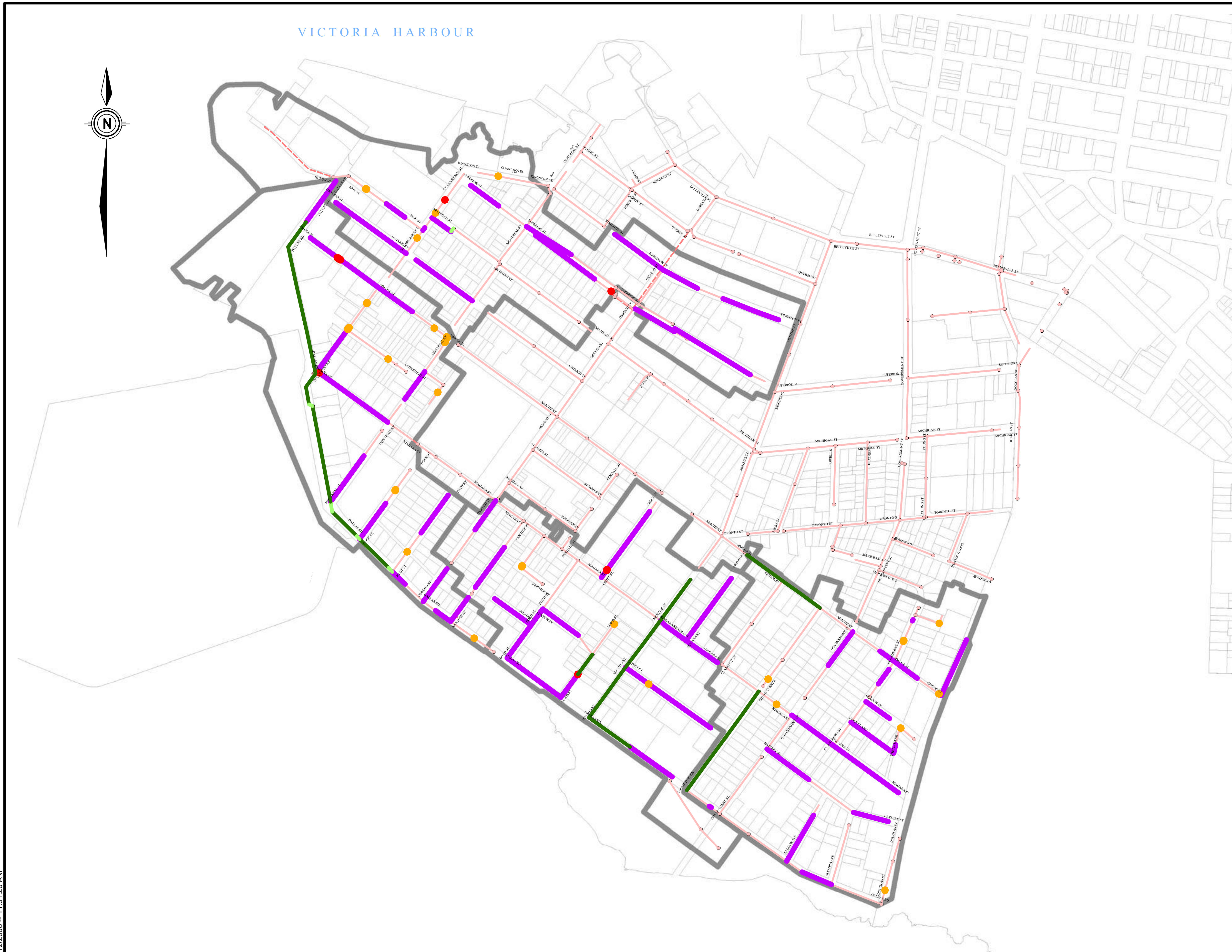
A preliminary R&R plan has been developed based on works completed to date. The R&R methods discussed in the previous section have been applied in specifying repair methods. It should be noted that all R&R work is based on suggested methods and approximate quantities. The next project phase will include detailed design that will account for indeterminate items.

Figure 4-1 presents the proposed rehabilitation works for each study area. Quantities are summarized in Table 4-4.

Table 4-4: Estimated Rehabilitation and Replacement Quantities

Description	Units	Quantity				Percentage Rehab Assumed for Budgeting	Unit Cost $/Unit
		Area 1	Area 2	Area 3	Area 4		
Pre-Rehab Maintenance/Inspections							
Flush/Clean/Post-Rehab Inspection	lin.m	3151	3151	3146	3902	100%	5
Service CCTV	each	222	277	259	320	100%	200
Dye Testing	each	25	36	35	54	100%	150
Direct Inflow Connections							
Reconnect CB (Public)	each	13	18	24	36	100%	5,000
Redirect Storm Drain (Private)	each	6	11	13	34	100%	7,500
Replace Cleanout Cap	each	6	0	5	7	100%	150
Remove Storm Overflow	each	0	2	1	14	100%	8,000
Mainline Rehabilitation							
Grout Pipe Joint	each	2,397	2,524	3,858	4,072	100%	60
Grout Service Interface	each	167	249	259	288	100%	550
CIPP Full Lining - 200 mm	lin. m	1,225	1,458	1,304	1,152	100%	210
CIPP Full Lining - 250 mm	lin. m					100%	230
CIPP Full Lining - 300 mm	lin. m			38		100%	260
CIPP Point Repair - 200 mm	each	10	5	5	7	100%	2,500
Pipe Burst - 200 mm	lin. m	62	332			100%	400
Pipe Burst - 250 mm	lin. m	264	119		132	100%	400
Pipe Burst - 300 mm	lin. m	419			93	100%	600
Pipe Burst - 375 mm	lin. m				206	100%	600
Excavated Point Repair 2 - 3 m Depth	each	2	2	2		100%	5,000
Excavated Replacement - 200 mm	lin. m					100%	950
Excavated Replacement - 250 mm	lin. m	11		8		100%	1,050
Excavated Replacement - 300 mm	lin. m	38				100%	1,100
Manhole Rehabilitation							
Replace Cover	each	62	49	58	57	100%	200
Replace Frame/Ring	each	2	3	0	3	100%	350
Structural Repair	each	3	3	0	9	100%	2,000
Manhole Coating	each	62	49	58	57	30%	6,500
Service Connections							
Pipe Burst Private Only	each	207	244	233	306	100%	3,700
Pipe Burst Public Only	each	207	244	233	306	100%	3,400
Pipe Burst Entire Connection	each	207	244	233	306	100%	4,600
Cap with CIPP Point Repair	each	143	114	145	151	100%	2,500

O:\0800-0899\809-032\400-Work\ProgramDevelopment\[I&IReductionPlanner_20081211.xls]Table4-4



City of Victoria
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Legend

- Study Areas
- Existing Sanitary Manhole
- Existing Gravity Sewer
- Existing Forcemain

Proposed Sanitary Point Repair

- Excavated
- Trenchless
- Proposed Sanitary Pipe Lining

Proposed Pipe Replacement

- Excavated
- Pipe Bursting

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Scale in Metres 1:7,500

Project No.	Date
809-032	December 2008

Proposed Mainline Rehabilitation Program

Figure 4-1

Map Document: (O:\0800-0899\809-032\430-GIS\MXD-Rp\809032_Fig4-1_MainlineWorkProgram.mxd)
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Section 5

Hydraulic Capacity

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5. HYDRAULIC CAPACITY

5.1 SANSYS MODEL

Focus was retained by the City in 2006 to develop a hydraulic model for the Clover catchment area, which includes James Bay. The modelling exercise was completed using the SANSYS platform, and existing (2007) and future (2026, 2056) scenarios were developed. An I&I rate of 130,000 L/ha/d was selected as the design I&I rate for analysis in the model, although this is considerably less than the 5-year return period I&I rates estimated by the CRD for the James Bay area, which ranged from 170,000-389,000 L/ha/d[2]. Rates estimated in Section 2 are also considerably higher than modelled, and correlate with those measured by the CRD.

The modelling study identified a number of pipes in the JBIIRPP study area as being undersized for the "2056 - No I&I Reduction" scenario. These sections are described in the following table and shown on Figure 5-1.

Table 5-1: Proposed Sanitary Sewer Upsizing Projects

Section ID	Existing Size(s)	Upgrade Size(s)	Length (m)	Location
1-1	200	300	183	Dallas Rd: Pilot St. to Montreal St.
1-2	200	300	133	100 blk. Dallas Rd.
1-3	200	250	93	000 blk. Dallas Rd.
2-1	200/300/375	250/375/450	330	Boyd St.: Luxton Ave. to Niagara St.; Niagara St.: Boyd St. to Oswego St.
2-2	200	250/300	183	Menzies St.: 000 blk. to Niagara St
4-1	200	250	132	South Turner St.: Dallas Rd. to Rithet St
4-2	200/300	375	420	South Turner St.: Rithet St. to Niagara St.; Niagara St.: South Turner St. to Clarence St.; Clarence St.: Niagara St. to Simcoe St.
4-3	200/250	300/375	183	Simcoe St.: South Turner St. to Medana St.

According to the modelling study, significant upgrades are also required for the trunk sewers downstream of the Superior South and Belleville South catchments, and the downstream trunk sewers that drain to the Clover Point Outfall. The effect of I&I reduction upon these facilities will be of interest for capital planning beyond the JBIIRPP.

[2] p. 11, "Clover System – Sanitary Sewer Study", Focus Corporation, 2008

5.2 CONSIDERATION OF HYDRAULIC DEFICIENCIES ON REHABILITATION WORKS

It will be of key importance to ensure that sewer rehabilitation work does not reduce the hydraulic capacity of any sections that have been determined to be undersized to safely convey the existing PWWF. This is generally a concern for relining work, and in cases where rehabilitation is required on pipes requiring hydraulic upgrades, pipe bursting to a larger diameter is anticipated to be a more suitable option.

Also of consideration is whether or not to upgrade pipes that do not have structural defects within the scope of the JBIIRPP. As this program is focused on the reduction of I&I, upgrading pipes that are in good condition will not contribute to the objectives of the study, and since the City may be able to fund capacity upgrades through other capital programs, it is recommended that pipes not requiring rehabilitation be earmarked for future capital programs. Further, depending on the amount of I&I reduction achieved, a reduction in sizing or elimination of upgrades may be possible.

5.3 DESIGN CRITERIA

For program planning purposes, the pipe sizing determined in the model exercise shall be considered suitable for estimating rehabilitation budgets. This pipe sizing will be reviewed in the design stage, primarily in light of design I&I rates. While it is expected that the pilot project will result in reduction of peak flows, this information will not be available until the rehabilitation work is complete. It is therefore recommended that preliminary pipe sizing be based upon the “2056 - No I&I Reduction” scenario developed in the Clover sewer model.

The CRD’s Core Area Liquid Waste Management Plan has presented a policy of upgrading sewers that overflow to sensitive areas to a 100-year return period peak wet weather flow. As any overflows that may occur in the JBIIRPP study area will be to the storm sewer system, and therefore untreated/unscreened, the 100-year PWWF is recommended as the governing design flow rate.

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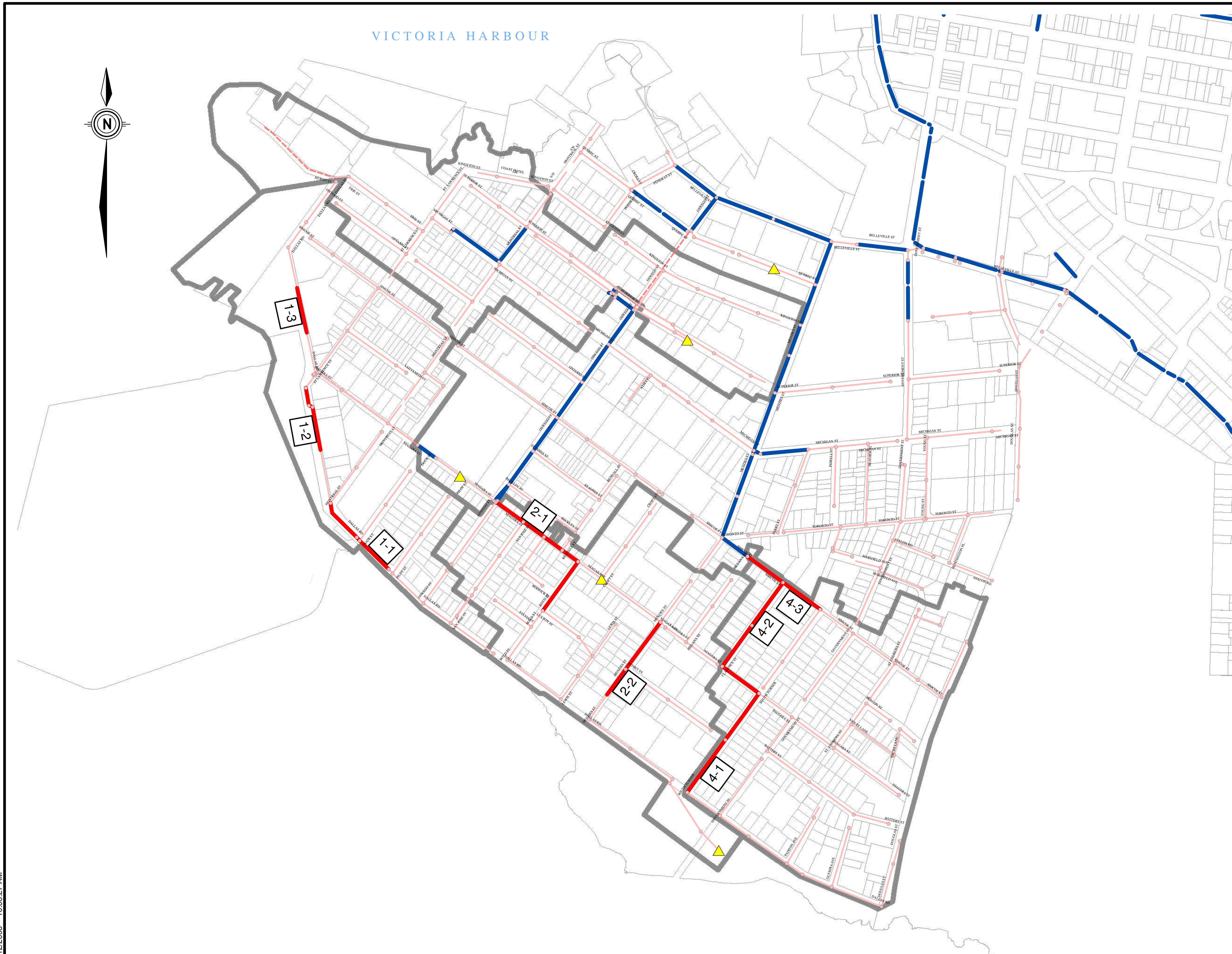
James Bay I&I Reduction Pilot Project



Legend

- Surcharging Observed
- Hydraulic Deficiency (2056)
- Section ID
- Upgrade Section in Study Area
- Study Areas
- Existing Sanitary Manhole
- Existing Gravity Sewer
- Existing Forcemain

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Scale in Metres 1:7,500

Project No.	Date
809-032	December 2008

Hydraulic Capacity Upgrades

Figure 5-1

Map Document: (O:\0800-0899\809-032\430-GIS\MXD-Rp\809032_Fig3-3_ManholeInspections.mxd)
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Section 6

Preliminary I&I Reduction Plan

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6. PRELIMINARY I&I REDUCTION PLAN

6.1 PLANNING CRITERIA

The development of the preliminary rehabilitation program is based on goals and objectives identified by the City and others through liquid waste management planning processes. Also steering this project are the guidelines of the Innovation Funds Grant.

Key objectives identified in the JBIIRPP RFP and grant application include:

- reduce or eliminate I&I using different approaches of trenchless technology;
- reduce impact of construction-related GHG emissions by maximizing use of trenchless technology;
- eliminate or reduce the number of existing overflows in the system;
- improve public safety by lowering risk of sewer collapse;
- determine which approach to I&I reduction (i.e., mains/manholes, service connections, direct SWI connections) has the highest benefit/cost ratio; and
- develop a “blueprint” for I&I reduction.

Several I&I reduction concepts (refer to Section 6.2) have been developed, primarily based on the initial concept envisioned by the City. Table 6-1 describes the specific criteria and metrics that have been evaluated at this stage of the JBIIRPP, which forms the basis for deciding how to proceed with the rehabilitation program.

Table 6-1: I&I Reduction Concept Evaluation Criteria

Criteria	Description	Metric	Rationale
Cost			
Budget Allowance	Cost of concept relative to budget	$	Meet budget requirement
Infrastructure			
I&I Component Isolation	Attempted isolation of I&I components (inflow vs. infiltration/private vs. public)	Rank of perceived ability of concepts to isolate components	Provide basis for development of “blueprint”
I&I Reduction Potential	Attempted removal of I&I components (mains/manholes, connections, SWI)	Number of I&I Sources Targeted	Increase potential for reduction in I&I rates
Needs Assessment	Average needs ranking for portions of system targeted in concept	Rank/I&I Sources Targeted	Effective use of budget

Criteria	Description	Metric	Rationale
Environment			
Storm Overflow Elimination	Number of [known] overflows to be removed in each concept	Number of detected overflows	Prevent aquatic impacts from untreated sewage
GHG Emission Reduction	Estimated reduction in GHGs due to use of trenchless technology	Tonnes CO2 (estimated with NASTT-BC GHG calculator)	Use innovative technologies that reduce environmental impact
Public Safety			
Sewer Condition Improvement	Reduction in number and severity of structural defects	WRc Defect Score	Reduce risk of sewer collapse/blockage

All of the concepts presented in the following section should be able to address the project objectives not stated in the above table, such as evaluation of a range of technologies.

6.2 DEVELOPMENT OF I&I REDUCTION CONCEPTS

The sources of I&I can be considered in terms of both mechanisms and location. In terms of determining the best approach for the City beyond the JBIIRPP, it will be of high importance to determine the relative amount of inflow versus infiltration, and also whether this occurs primarily on private or public property. This can also be considered in terms of the infrastructure being targeted for rehabilitation – inflow reduction involves removing direct stormwater connections, while infiltration reduction focuses on buried pipes and manholes.

The City has proposed the following program for evaluating various technologies and approaches to I&I reduction:

- Area 1 (Niagara): rehabilitate publicly-owned sewer mainlines and manholes, and remove any direct connections within the public right-of-way;

- Area 2 (Superior South): reline or replace service connections from the mainline to property line, and remove all direct connections;

- Area 3 (Superior North): this area would be left alone as a control for verifying I&I reduction results; and

- Area 4 (Belleville South): reline or replace service connections on private property from the property line to the building.

This approach would allow for evaluation of a number of approaches to reducing I&I. Based on previous experience in I&I reduction programs in various jurisdictions, several improvements to the above approach can be identified:

- It has been observed that mainline/manhole-only rehabilitation creates a secondary flow path for RII to enter further upstream in the system (e.g. through defects in service connections). By devoting one catchment to removal of all but the mainline/manhole I&I more certainty of isolating this source can be achieved.

- Rehabilitation of only the private or public portions of service connections is also expected to result in a secondary flow path similar manner to that expected from mainline-only rehab. This effect is expected to be more pronounced if only the public portion is rehabilitated compared with the private portion. Further, mobilization costs comprise a significant portion of the rehabilitation of a service connection, and it is more cost-effective to rehabilitate the entire connection than a portion.

- The proposed program will not be able to address the reduction in quantity of SWI versus RII, as all areas will involve some measure of inflow reduction through elimination of direct connections in the current plan. Devoting one study area to inflow-only reduction would provide insight into this component, and allow for reallocation of budget resources to full service connection rehabilitation.

The following table describes which I&I components are affected by rehabilitation of the various portions of the sanitary sewer system.

Table 6-2: I&I Components by Source

I&I Sources	I&I Components			
	GWI	RII_{slow}	RII_{fast}	SWI
Mainline & Manholes	X	X	X	X
Public Service Connection	X	X		
Private Service Connection	X	X	X	
Public Direct Connections				X
Private Direct Connections				X

Mainlines and manholes allow I&I from each category, as noted. While mains and manholes are generally considered to allow infiltration, manhole covers and storm sewer overflows are included in the SWI component. Because it will be impossible to distinguish between SWI removal from manholes and overflows as opposed to other surface connections, it is recommended that all catchments receiving manhole/mainline R&R work also be paired with removal of all public-side SWI sources.

PROPOSED I&I REDUCTION CONCEPTS

Three base I&I reduction concepts are presented below. These concepts relate to the I&I components that will be targeted. Further to this, each concept has two alternative arrangements in which individual study areas have been identified for removal of the I&I components. This is illustrated in Figure 6-1.

Concept A (Independent Source Removal) – this concept will achieve a number of the project objectives by evaluating a range of technologies and targeting various components of the sewer system. It is not expected to produce results that will allow for isolation of individual I&I components (SWI vs. RII) or sources (public vs. private). Secondary flow pathways are expected to result from this concept, which may affect the rate of I&I reduction.

Concept B (Inflow and Mainline Isolation) - provides an approach that is more likely to definitively isolate the amount of RII entering in from mainlines and manholes by all other I&I components. It will isolate the SWI component by focusing one catchment to targeting only surface inflow.

Concept C (Inflow and Private-Side Isolation) – also provides an approach that will isolate RII vs. SWI. This concept is also intended to identify the influence of private vs. public I&I sources. Because fewer sources will be targeted, the resulting I&I reduction may be less than in other concepts.

Concept alternatives are summarized in the following table.

Table 6-3: I&I Reduction Concept Alternatives

Concept	1 Niagara	2 Superior South	3 Superior North	4 Belleville South
A1	Mainlines Manholes Pub. Inflow	Pub. SC All Inflow	Control	Priv. SC All Inflow
A2	Control	Pub. SC All Inflow	Priv. SC All Inflow	Mainlines Manholes Pub. Inflow
B1	Mainlines Manholes Pub. Inflow	All SC All Inflow	Control	All Inflow
B2	All Inflow	Mainlines Manholes Pub. Inflow	All SC All Inflow	Control
C1	Mainlines Manholes Pub. Inflow	Priv. SC Priv. Inflow	Control	All Inflow
C2	Mainlines Manholes Pub. Inflow	All Inflow	Priv. SC Priv. Inflow	Control

6.3 BUDGET ANALYSIS

Overall Program Budget

The total budget for the JBIIRPP is $3.0 million. This budget is intended cover the following tasks:

- Consulting Fees (Engineering, Construction Management, Communications) – $232,000;
- Flow Monitoring for remainder of project – $250,000 (allowance); and
- Construction (incl. contingencies) – $2,518,000.

Construction Cost Estimate

The cost estimates provided in this study are of Class 'C' detail. This means that the cost estimates have been prepared with limited site information, but all foreseeable project components have been included in the cost. The projects identified have not considered the following factors affecting construction:

- utility relocations or work around boulevard features such as trees;
- special permitting requirements (contaminated site, etc.); and/or
- critical market shortages of materials.

As the above factors have not been allowed for in estimating construction unit rates or project design, the following factors are applied to all projects:

- Mobilization/Demobilization – 6%;
- Bonding/Insurance – 2%;
- Contractor Markup/Overhead Allowance – 10%;
- Contingency – 20%; and
- Indeterminate Items – 3% to 18%.

GST has not been included in the estimated project costs.

The unit prices reflect budget pricing from trenchless contractors and KWL's recent experience with similar work, and therefore represent the best prediction of actual (2008) costs as of the date prepared. Actual tendered costs would depend on such things as market conditions generally, remoteness factor, the time of year, contractors' work loads, any perceived exposure of risk associated with the work or unknown conditions.

A summary of estimated construction and additional field inspection costs is provided in the following table. These costs represent 100% rehabilitation of each catchment.

Table 6-4: Budget-Level Cost Estimate Summary by Study Area

	1 Niagara	2 Superior South	3 Superior North	4 Belleville South	Total
I&I Reduction Cost					
Field Inspection	$90,106	$107,943	$102,620	$129,170	**$429,839**
Mains & Manholes	$1,609,830	$1,300,941	$1,152,932	$1,506,258	**$5,569,961**
Public Service Connection	$859,662	$950,468	$1,048,377	$1,334,040	**$4,192,548**
Private Service	$670,328	$792,589	$754,646	$990,737	**$3,208,300**

	1 Niagara	2 Superior South	3 Superior North	4 Belleville South	Total
Connection					
Public Direct Inflow	$91,650	$149,460	$180,480	$411,720	**$833,310**
Private Direct Inflow	$64,719	$116,325	$138,533	$361,031	**$680,607**
Total	**$3,386,295**	**$3,417,726**	**$3,377,588**	**$4,732,955**	**$14,914,564**
Mainline Length (m)	3,151	3,151	3,146	3,902	13,350
Unit I&I Reduction Cost ($ per metre of mainline)					
Field Inspection	$29	$34	$33	$33	$32
Mains & Manholes	$511	$413	$366	$386	$417
Public Service Connection	$273	$302	$333	$342	$314
Private Service Connection	$213	$252	$240	$254	$240
Public Direct Inflow	$29	$47	$57	$106	$62
Private Direct Inflow	$21	$37	$44	$93	$51
Total	**$1,075**	**$1,085**	**$1,074**	**$1,213**	**$1,117**

As indicated in the budget estimate, the total available construction budget will cover approximately 17% of the total rehabilitation cost in the study area.

Previous I&I reduction cost estimates are available through the "Inflow and Infiltration Management Plan" (UMA, 2004) and from KWL's experience in the City of White Rock. This information is summarized in the following table.

Table 6-5: Unit I&I Reduction Costs from Other Studies

	Capital Cost	Catchment Area (ha)	Mainline Length (m)	Unit Cost ($/ha)	Unit Cost ($/m)
White Rock Service Connection Replacement (2003)	$172,933.00	3.4	430	50,863	402
UMA I&I Study: Mainline (2004)	$1,000,000.00	N/a	2,500	N/a	400
UMA I&I Study: Services (2004)	$1,000,000.00	20	1,667	50,000	600

Notes:
1. White Rock study involved replacement of 32 service connections using pipe bursting.
2. Catchment area for UMA study based on replacement of 200 services, assuming 1 service per lot, and lot size of 0.1 ha.
3. Mainline length for service connections in UMA study based on spacing of 10 m per connection.

The costs estimated for the JBIIRPP program budget compare well with the costs from the previous studies. Averaged across the study area, service connections have been estimated at a total cost of $550/m of mainline, and mainlines (with manholes) estimated at $420/m.

Construction costs for each concept alternative are estimated as follows:

- A1 - $7.04 million;
- A2 - $6.31 million;
- B1 - $5.04 million;
- B2 - $4.22 million;
- C1 - $4.89 million; and
- C2 - $4.14 million.

Detailed cost estimate breakdowns are provided in the Appendix.

Each of these exceeds the estimated available construction budget by a significant margin. It is therefore recommended that the City request additional funding to complete this project as intended, or alternative scale back the extent of the program to meet budgetary limits. To meet the current budget the amount of rehabilitation that can be completed ranges between approximately 35% and 60% of the cost depending upon the concept selected.

The relative need based on the cost for rehabilitation work is a prime indicator of how the City should allocate funding from an asset management perspective. The following table ranks each cost component of the I&I reduction program for each catchment.

Table 6-6: Needs Assessment Ranking

	1 Niagara	2 Superior South	3 Superior North	4 Belleville South
Field Inspection	4	1	3	2
Mains and Manholes	1	2	4	3
Public Service Connection	4	3	2	1
Private Service Connection	4	2	3	1
Public Direct Inflow	4	3	2	1
Private Direct Inflow	4	3	2	1
Overall	**3**	**2**	**4**	**1**

The needs assessment suggests that concepts should generally include Area 1, 2, and 4, with catchment 3 showing the lowest overall need. As Area 1 has the highest need for mainline rehabilitation in terms of costs and structural condition, mainline/manhole rehabilitation has been targeted toward this catchment in most concepts.

6.4 DECISION ANALYSIS

A decision matrix has been prepared to evaluate the merits of each concept in terms of the aforementioned planning criteria. This matrix contains three calculations for each criterion:

1. Tabulation of criteria values for each concept.
2. Conversion of the criteria values to a value function, which assigns values of 0 to least favourable and 1 to the most favourable criteria within the range presented. Other values are scaled linearly between 0 and 1.
3. Application of user-defined weighting for each of the criteria.

The total unweighted and weighted scores are then tabulated for each concept, which provides the basis for selecting the 'preferred concept'. The preferred concept is proposed to be carried forward to the design and tendering stage.

Weighting has been developed on a priority basis, by ranking the evaluation criteria in terms of importance. The suggested weighting is as follows (most important to least important):

- I&I Component Isolation (7);
- Needs Assessment (6);
- Budget Allowance (5);
- Overflow Impact (4);
- I&I Reduction Potential (3);
- Sewer Condition Improvement (2); and
- CO_2 Offset (1).

The decision matrix table is presented as Table 6-7.

DISCUSSION OF DECISION CRITERIA

I&I Component Isolation

Isolation of particular I&I components is considered as the most important aspect of the JBIIRPP, as this will be the key mechanism for determining how to proceed with City-wide I&I reduction efforts in the future. Because mainline/manhole rehabilitation has the highest unit cost of the R&R components, it will be of high value to the City to determine whether this is an effective area to concentrate I&I funding. Similarly, inflow reduction appears to have the lowest unit cost, but is expected to have a significant impact on I&I reduction. Because Concept B addresses both of these issues, it is considered to be superior to the other concepts. Concept C is considered to be superior to Concept A because it will isolate inflow and private sources, whereas Concept A is not expected to isolate any individual components. These have been ranked as 3 (good) to 1 (poor).

- Weighted Effect on Outcome: 19% of total score; and
- Unweighted Effect on Outcome: 10% of total score.

Needs Assessment

The needs scoring is based on the average rank per I&I component removed, i.e. the sum of rankings for each component removed divided by the number of components. This criteria ranged from 1.8 (C1) to 2.5 (C2). In general, this indicator is inversely-related to cost. Concepts with high scores in this category will have the most-positive impact on the City's exposure to risk of overflows and/or structural failure.

- Weighted Effect on Outcome: 19% of total score; and
- Unweighted Effect on Outcome: 12% of total score.

Budget Allowance

While the established budget for the program is set at $3.0 million, the budget estimates set forth indicate that this will be difficult to adhere to with the current program format. The concepts range from $1.6 million (C2) over-budget to almost $4.5 million (A1) over-budget.

- Weighted Effect on Outcome: 19% of total score; and
- Unweighted Effect on Outcome: 14% of total score.

Overflow Impact

There are 17 suspected overflows in the study areas (indicated by MHC smoke codes). Concepts ranged from removing 2 (C2) up to 17 (A2). Elimination or reduction of these overflows is expected to have an immediate impact upon stormwater quality.

- Weighted Effect on Outcome: 16% of total score; and
- Unweighted Effect on Outcome: 15% of total score.

I&I Reduction Potential

Concepts A and B include removal of 8 components, while Concept C only includes 6. The significance of this objective is inextricably linked to the rationale for the entire program, in that if more components are to be targeted, it is likely that more I&I reduction will occur. This criteria is considered to be of lower importance than isolation of individual components, as there are no guaranteed outcomes of the I&I reduction work, while being able to isolate specific sources will provide benefit for future programs.

- Weighted Effect on Outcome: 13% of total score; and
- Unweighted Effect on Outcome: 16% of total score.

Sewer Condition Improvement

Area 1 requires the most attention in terms of the structural condition of the sewer mainlines. Most of the concepts include Area 1 (A1, B1, C1, C2), which has a total defect score of approximately 3,200. Scores for other concepts are 1,562 (A2/Area 4) and 2,168 (B2/Area 2).

- Weighted Effect on Outcome: 9% of total score; and
- Unweighted Effect on Outcome: 16% of total score.

CO_2 Offset

CO_2 offsets were estimated using NASTT-BC's Carbon Calculator, which considers traffic delays, haul distance, excavation and materials. All concepts would be expected to perform satisfactorily in this category, which is reflected in the relative weighting. CO_2 offset estimates ranged between 154 t and 173 t for mainline rehabilitation.

- Weighted Effect on Outcome: 5% of total score; and
- Unweighted Effect on Outcome: 18% of total score.

SELECTION OF RECOMMENDED CONCEPT

Concept B1 was rated most highly in both the weighted and unweighted decision analyses. Each concept's rank remained approximately the same in both analyses. Table 6-8 summarizes the overall ranking for the presented concepts.

Table 6-7: Summary of Decision Analysis

	A1	A2	B1	B2	C1	C2
Unweighted Score	4.5	2.8	**6.6**	4.4	5.0	3.5
Unweighted Rank	3	6	**1**	4	2	5
Weighted Score	13.1	11.6	**25.8**	17.8	19.4	11.5
Weighted Rank	4	5	**1**	3	2	6

Concept B1 performs well in all objective categories relative to the other concepts. As all of the concepts as presented exceed the project budget by a significant margin, changes to the extents of the program are needed to meet budgetary limits. The City has indicated that an additional $500,000 may be available in addition to the initial program budget to complete the JBIIRPP.

As noted in the above table, the lower-cost alternatives (A2, B2, C2) under each concept were rated lower than the alternatives that sought to target rehabilitation to the areas of greatest need. Selection of these lower-cost alternatives is not recommended, as the additional funding that is required to complete these will not have been utilized to the greatest effect.

The following section discusses use of Concept B1 with a modified rehabilitation extent.

I&I Reduction Concepts

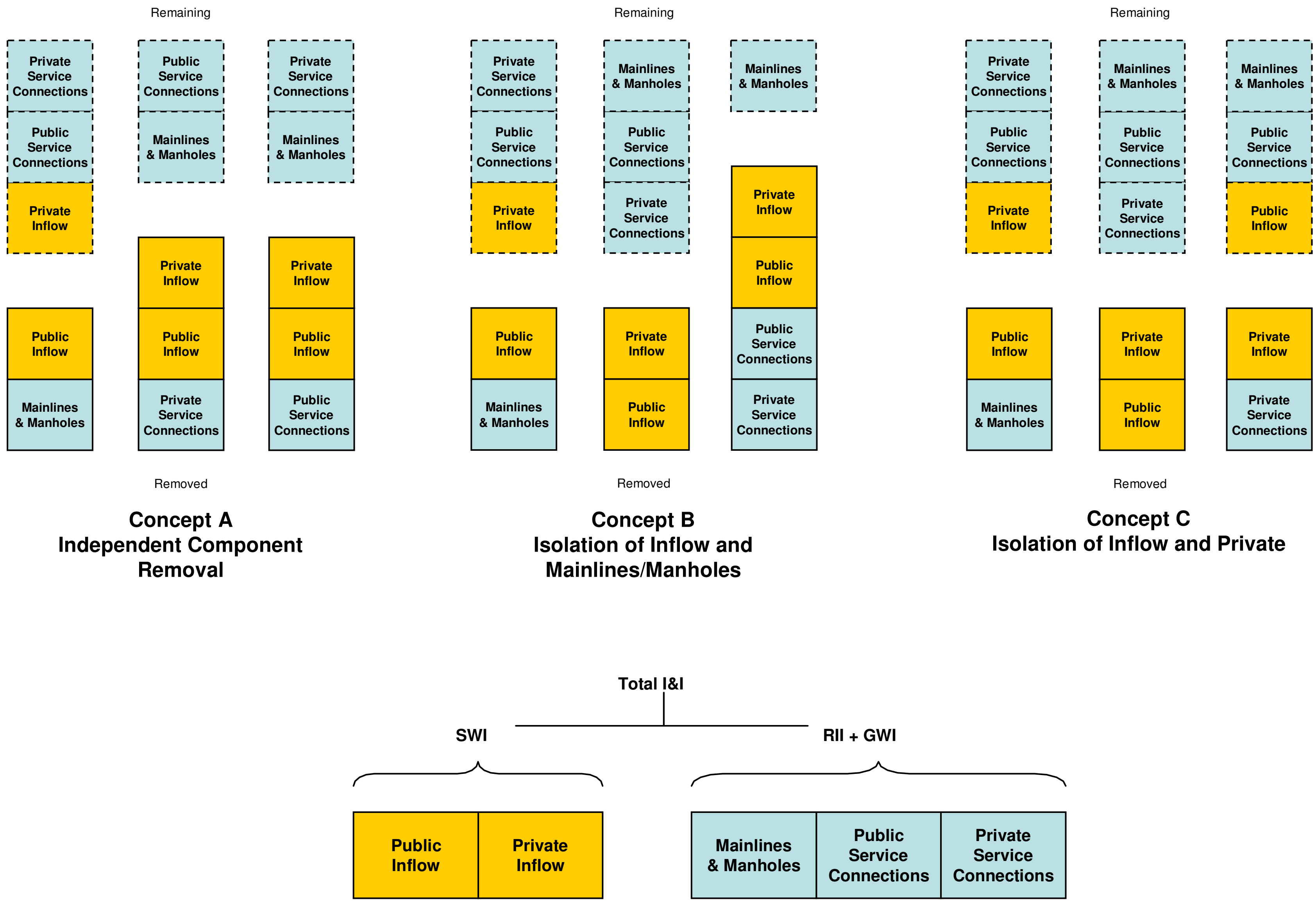
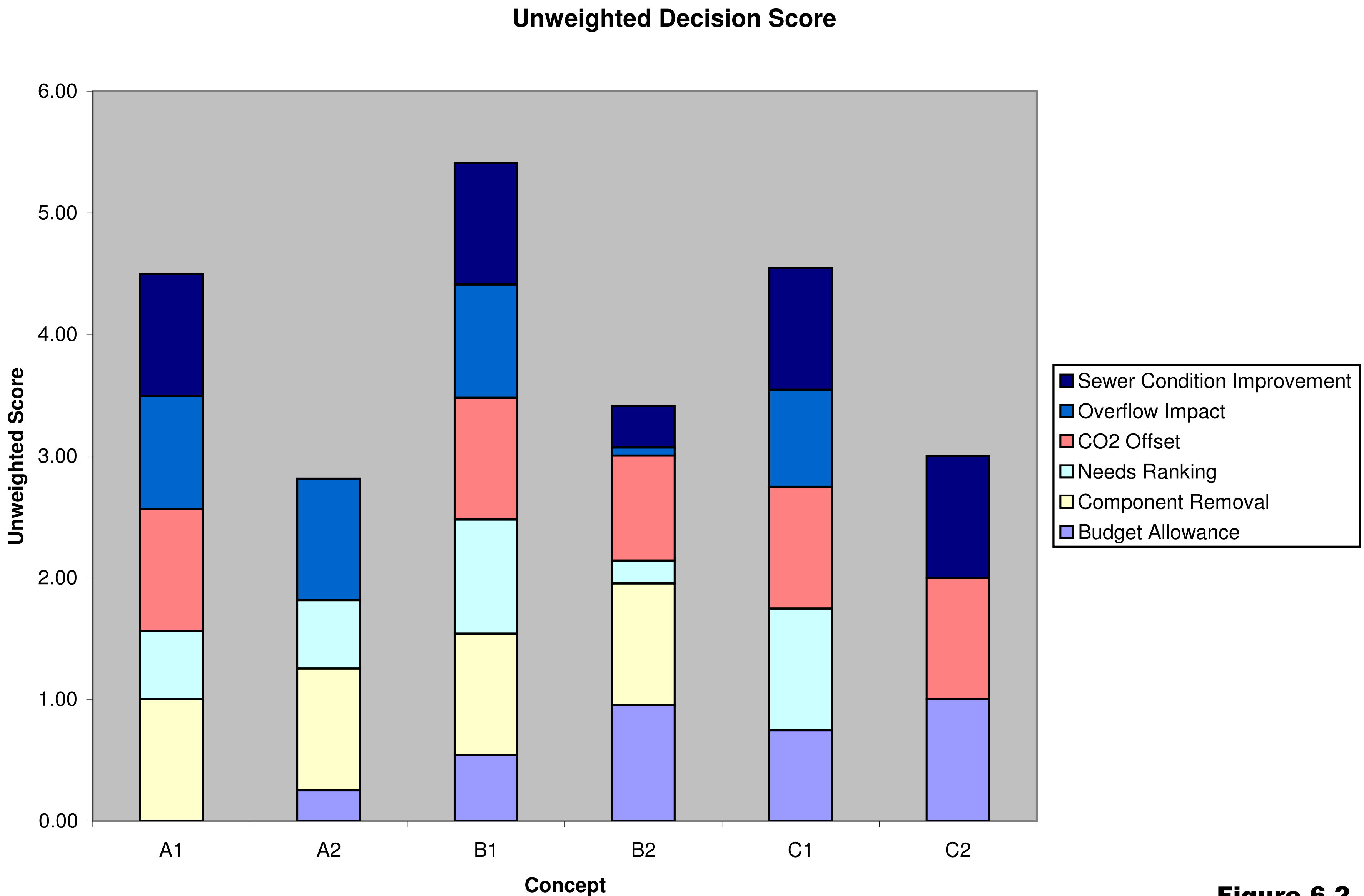


Figure 6-1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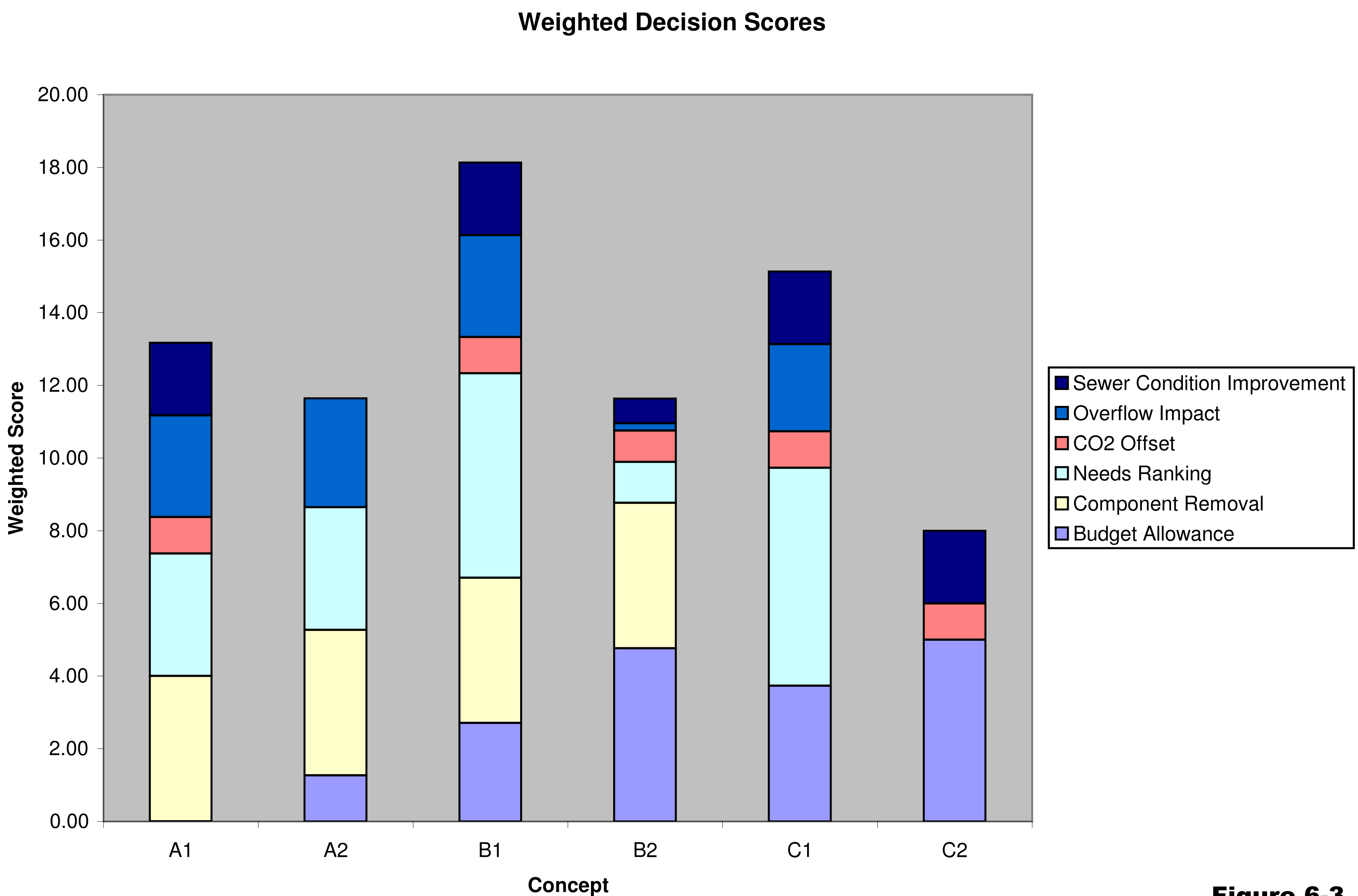
5.00
4.00
3.00
2.00
1.00
0.00
Unweighted Score
A1
A2
B1
B2
C1
C2
Concept
Sewer Condition Improvement
Overflow Impact
CO2 Offset
Needs Ranking
Component Removal
Budget Allowance

Figure 6-2


Weighted Decision Scores
Weighted Score
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18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
A1
A2
B1
B2
C1
C2
Concept
Sewer Condition Improvement
Overflow Impact
CO2 Offset
Needs Ranking
Component Removal
Budget Allowance

Figure 6-3

Table 6-8: Decision Criteria for I&I Reduction Plan Development

	Evaluation Criteria **Metric**	**Budget Allowance** $	**I&I Reduction Potential** # Components Targeted	**I&I Component Isolation** Rank of Concepts	**Needs Ranking** Average Rank of Need	**CO2 Offset** t CO2	**Overflow Impact** # Overflows	**Sewer Condition Improvement** WRc Defect Score
Concept Evaluation	A1	-$4,518,506	**8**	3	2.13	**176**	16	**3332**
	A2	-$3,795,721	**8**	3	2.13	154	**17**	1562
	B1	-$2,519,916	**8**	**1**	1.88	**176**	16	**3332**
	B2	**-$1,698,589**	**8**	**1**	2.38	173	3	2168
	C1	-$2,370,456	6	2	**1.83**	**176**	14	**3332**
	C2	**-$1,622,134**	6	2	2.50	**176**	2	**3332**
Unweighted Concept Rating	**Cost (-) or Benefit (+)**	**+**	**+**	**-**	**-**	**+**	**+**	**+**
	A1	0.0	**1.0**	0.0	0.6	**1.0**	0.9	**1.0**
	A2	0.2	**1.0**	0.0	0.6	0.0	**1.0**	0.0
	B1	0.7	**1.0**	**1.0**	0.9	**1.0**	0.9	**1.0**
	B2	1.0	**1.0**	**1.0**	0.2	0.9	0.1	0.3
	C1	0.7	0.0	0.5	**1.0**	**1.0**	0.8	**1.0**
	C2	**1.0**	0.0	0.5	0.0	**1.0**	0.0	**1.0**
	Max	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Avg	0.6	0.7	0.5	0.5	0.8	0.6	0.7
	Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weighted Concept Rating	**Weight**	**5**	**3**	**7**	**6**	**1**	**4**	**2**
	A1	0.0	**3.0**	0.0	3.4	**1.0**	3.7	**2.0**
	A2	1.2	**3.0**	0.0	3.4	0.0	**4.0**	0.0
	B1	3.5	**3.0**	**7.0**	5.6	**1.0**	3.7	**2.0**
	B2	4.9	**3.0**	**7.0**	1.1	0.9	0.3	0.7
	C1	3.7	0.0	3.5	**6.0**	**1.0**	3.2	**2.0**
	C2	**5.0**	0.0	3.5	0.0	**1.0**	0.0	**2.0**
	Max	5.0	3.0	7.0	6.0	1.0	4.0	2.0
	Avg	3.0	2.0	3.5	3.3	0.8	2.5	1.4
	Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Effective Weight	A1	0%	23%	0%	26%	8%	28%	15%
	A2	11%	26%	0%	29%	0%	34%	0%
	B1	13%	12%	27%	22%	4%	14%	8%
	B2	27%	17%	39%	6%	5%	1%	4%
	C1	19%	0%	18%	31%	5%	16%	10%
	C2	43%	0%	30%	0%	9%	0%	17%
	Max	43%	26%	39%	31%	9%	34%	17%
	Avg	19%	13%	19%	19%	5%	16%	9%
	Min	0%	0%	0%	0%	0%	0%	0%

Section 7

Development of Recommended Concept

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7. DEVELOPMENT OF RECOMMENDED CONCEPT

7.1 PROPOSED APPROACH

To meet budgetary constraints the recommended Concept B1 can be modified slightly to reduce costs while actually improving the expected outcome.

This modified alternative is called B3 for clarity. B3 takes advantage of all 6 flow monitors as shown in the following table. Figure 7-1 shows the layout of the proposed concept.

Table 7-1: Proposed Concept B3

Concept	1A Niagara (FM-10)	1B Niagara (FM-11)	2 Superior South (FM-12)	3A Superior North (FM-13)	3B Superior North (FM-14)	4 Belleville South (FM-15)
B3	Mainline	Manholes	Control	Public SC All Inflow	Abandoned SC (optional)	All Inflow

This concept does not differ significantly in approach from Concept B1, and improves upon the potential for isolation of I&I results by separating mainlines and manholes, and investigating the effect of only sealing abandoned service connections. Costs are reduced by almost 50% under this approach by splitting the mainline and manhole rehabilitation, which were the largest cost item under B1, as well as by reducing the number of service connections that will be replaced/relined. The budgetary implications of this concept are discussed in the following section.

7.2 CONCEPT B3 BUDGET ESTIMATE

A budget estimate has been prepared based on the proposed B3 concept. Specific items of note for this particular concept include:

- 100% of manholes and vents in Area 1B will be rehabilitated;
- 33% of uncapped service connections (as indicated by CCTV) are assumed to be abandoned for budgeting purposes;
- 100% of capped service connections are assumed to require sealing; and
- an indeterminate items allowance for private property inflow reduction has been included as 20% of the base price to account for properties with inconclusive smoke tests.

The following table summarizes the estimated budget for each catchment area and portion of sewer infrastructure to be rehabilitated. Detailed costs are included in Appendix B.

Table 7-2: Concept B3 Budget Estimate

Cost Item	Area 1	Area 2	Area 3	Area 4	Total Cost
Field Services	$15,679	$7,614	$91,721	$20,093	$135,106
Mains and Manholes	$869,152		$91,711		$969,323
Public Service Connection			$761,353		$761,353
Private Service Connection			$365,378		$365,378
Public Direct Inflow			$84,600	$329,940	$414,540
Private Direct Inflow			$60,519	$309,581	$370,100
Total – Core	**$893,291**	**$7,614**	**$1,455,281**	**$626,463**	**$3,015,799**
Abandoned Services (Opt.)			$185,650		$185,650
Total – Core plus Optional	**$893,291**	**$7,614**	**$1,640,931**	**$626,463**	**$3,201,449**
Mainline Length (m)	1,474 (1A)/ 1,239 (1B)	3,151	2,099 (3A)/ 890 (3B)	3,902	11,865 (Core)/ 12,755 (Optional)
Unit I&I Reduction Cost ($/m)	$506 (1A)/ $106 (1B)/ $329 (Total)	$2	$693 (3A)/ $209 (3B)/ $550 (Total)	$161	$254 (Core)/ $251 (Optional)

The budget estimate for Concept B3 differs slightly from that presented in Section 6 as more detail has been considered in preparing the above estimate. Based on the estimate, Concept B3 is expected to meet the budgetary requirements of the City.

In terms of the unit cost of rehabilitation, the approaches in Areas 1B (manholes), 3B (abandoned service connections) and 4 (SWI) are significantly less expensive than the others. Should these approaches yield positive I&I reduction results, they will be of high value to the City's I&I reduction blueprint.

7.3 DECISION ANALYSIS COMPARISON

Concept B3 was analyzed using the same methods as for the other concept alternatives. The following parameters were input to the decision matrix, assuming the optional abandoned service work is included:

- Construction Cost – $3,201,449;
- I&I Reduction Potential – 7;
- I&I Component Isolation – 1 (all other concepts demoted by 1 point);
- Needs Ranking – 1.6;
- CO2 Offet – 88 tonnes (50% of Area 1);
- Overflow Impact – 13; and

- Sewer Condition Improvement – 862.

The resulting scores for all concepts are presented below and shown as bar charts on Figures 7-2 and 7-3.

Table 7-3: Decision Analysis Results with Concept B3

	A1	A2	B1	B2	B3	C1	C2
Unweighted Score	4.4	3.6	**5.8**	4.1	4.2	4.4	3.1
Unweighted Rank	3	6	**1**	5	4	2	7
Weighted Score	12.2	11.8	21.2	14.5	**22.4**	15.5	9.1
Weighted Rank	5	6	2	4	**1**	3	7

Concept B3 ranks highly in weighted decision analysis, and in the middle of the range for the unweighted analysis. While this concept will not provide as high a level of improvement in structural condition or GHG offsets, these two categories have been identified as being least-important to completing the overall objectives of the JBIIRPP.

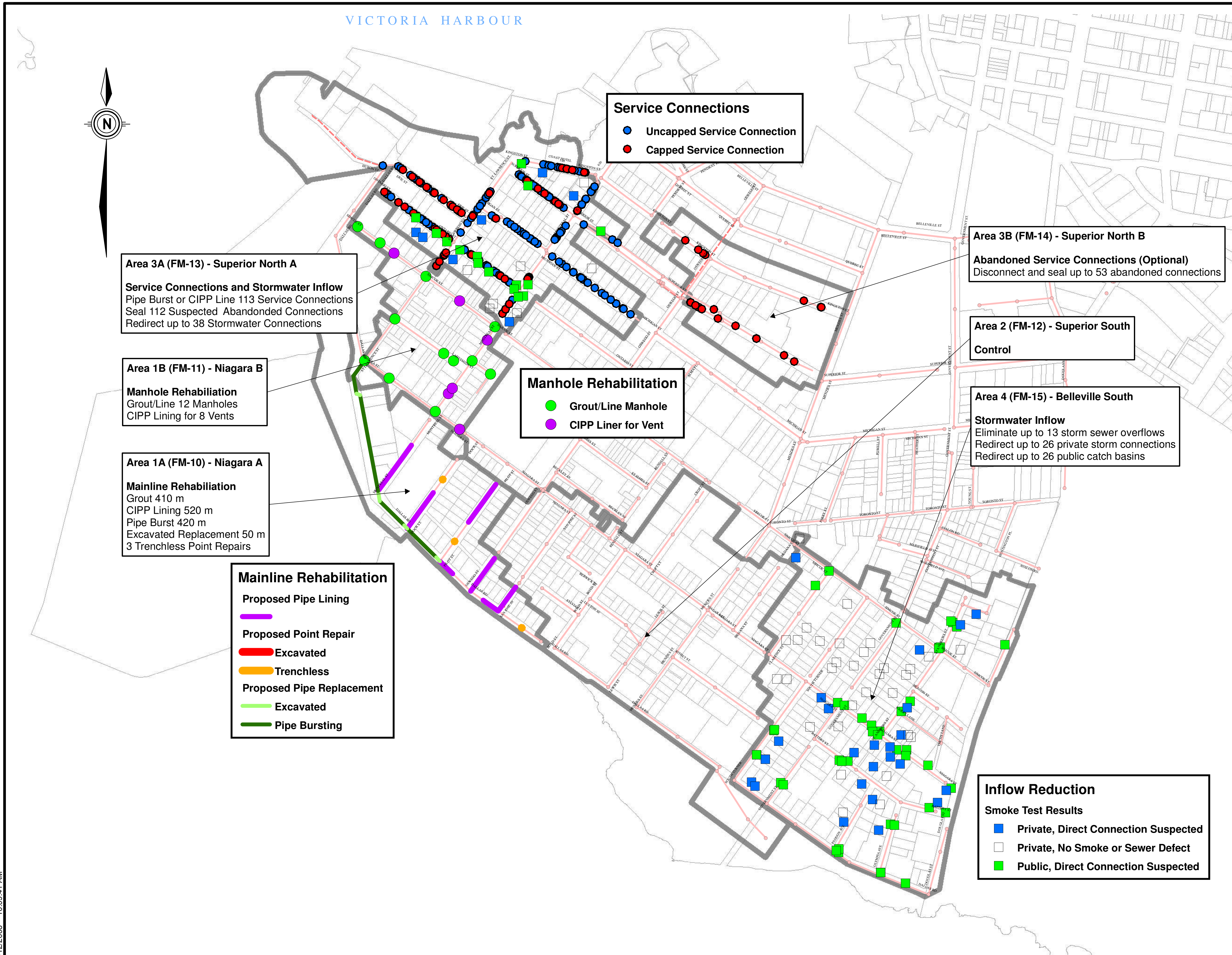
This concept is expected to provide the greatest benefits in terms of providing isolation of I&I components for determination of the cost/benefit ratios of I&I reduction methods. B3 also targets the available funding to the areas with the greatest need. As this concept is expected to meet the budgetary requirements of the City, it is recommended Concept B3 be carried forward to the design and construction phase of the JBIIRPP.

7.4 NEXT STEPS

Upon approval of the proposed approach, the JBIIRPP will move to Phase 2, Design & Construction, with the following tasks to be completed by October 2009:

- Dye Testing for Inconclusive Smoke Tests;
- Stakeholder Engagement;
- Preparation of Construction Drawings, Construction Contract and Technical Specifications;
- Tendering and Award of Construction Work; and
- Construction and Inspection.

Figure 7-4 presents the proposed schedule for Phase 2.



City of Victoria
James Bay I&I Reduction Pilot Project

Legend

- Study Areas
- Existing Sanitary Manhole
- Existing Gravity Sewer
- Existing Forcemain

KERR WOOD LEIDAL associates limited
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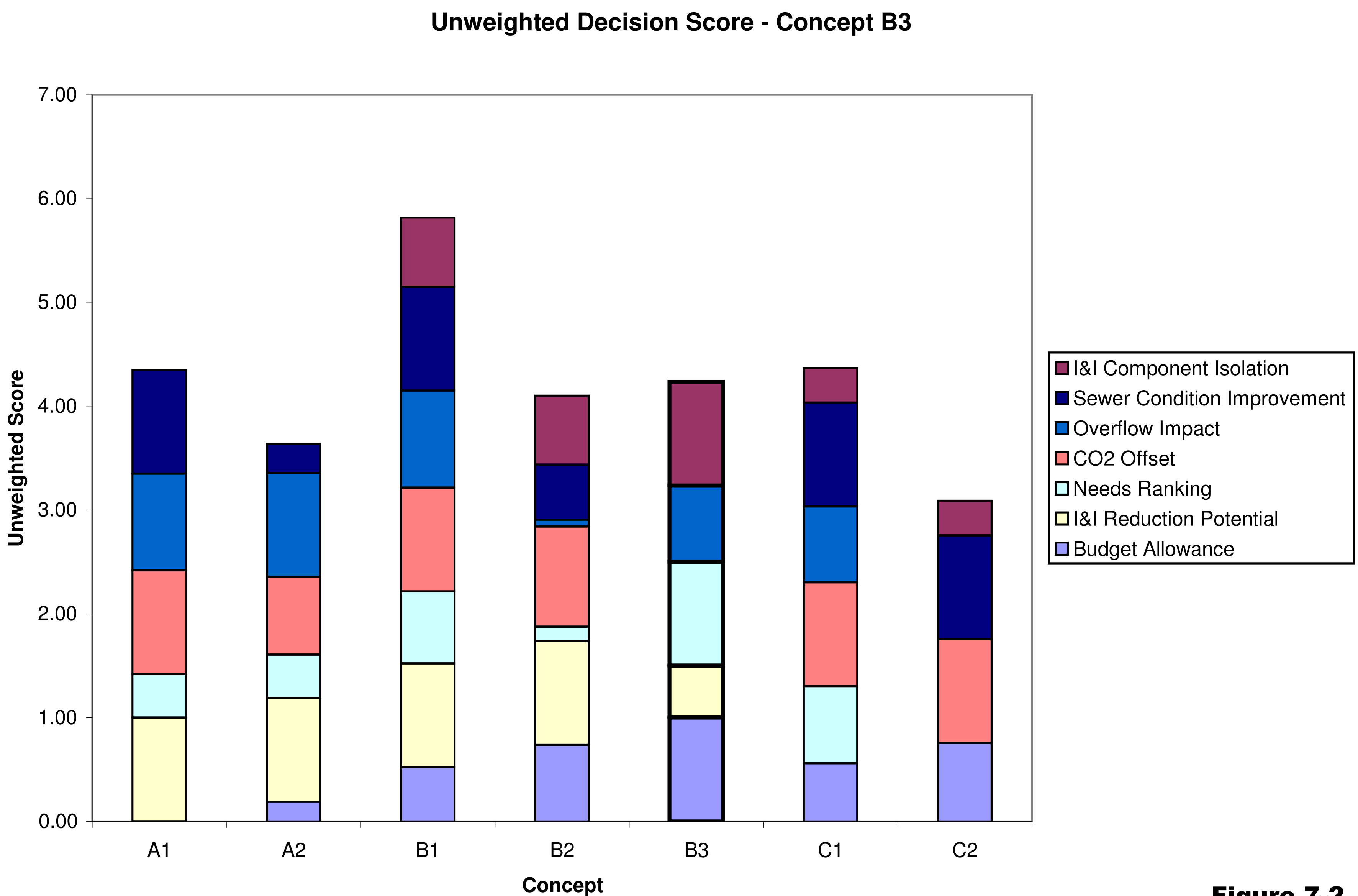
100 0 100
Scale in Metres 1:7,500

Project No.	Date
809-032	January 2009

I&I Reduction Plan for Concept B3

Figure 7-1



Unweighted Decision Score - Concept B3
Unweighted Score
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
A1
A2
B1
B2
B3
C1
C2
Concept
I&I Component Isolation
Sewer Condition Improvement
Overflow Impact
CO2 Offset
Needs Ranking
I&I Reduction Potential
Budget Allowance

Figure 7-2

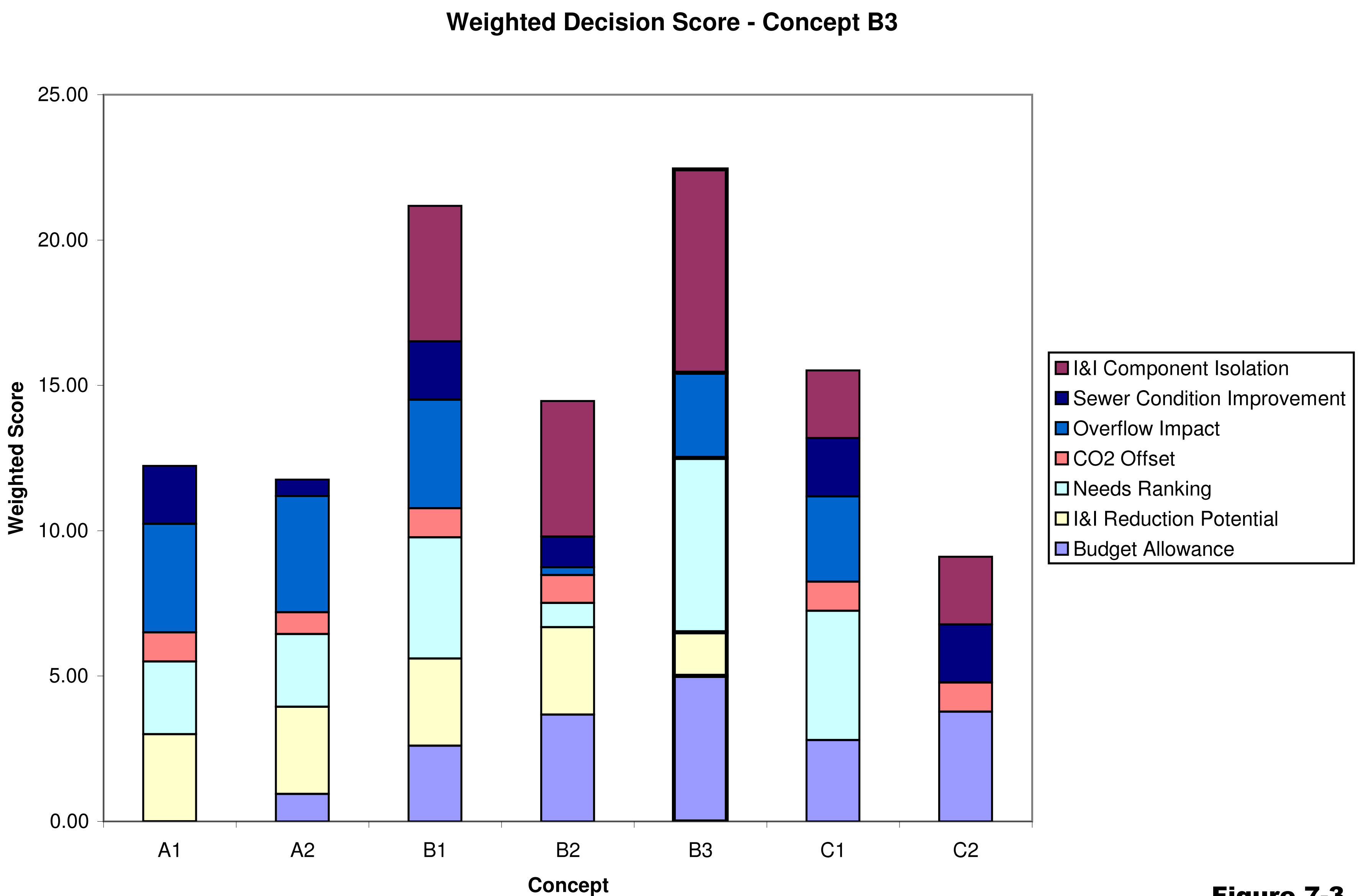

Weighted Decision Score - Concept B3
25.00
20.00
15.00
10.00
5.00
0.00
Weighted Score
A1
A2
B1
B2
B3
C1
C2
Concept
I&I Component Isolation
Sewer Condition Improvement
Overflow Impact
CO2 Offset
Needs Ranking
I&I Reduction Potential
Budget Allowance

Figure 7-3

City of Victoria
James Bay I&I Reduction Pilot Project

Figure 7-4: Proposed Phase 2 Schedule

Task	2009 Jan 1	Jan 15	Jan 29	Feb 12	Feb 26	Mar 12	Mar 26	Apr 9	Apr 23	May 7	May 21	Jun 4	Jun 18	Jul 2	Jul 16	Jul 30	Aug 13	Aug 27	Sep 10	Sep 24	Oct 8	Oct 22
Phase 1 Completion																						
Phase 1 Report Submission		M																				
City Approval of Recommended Concept			M																			
Dye Testing																						
Prepare Dye Test Contract Documents			M																			
Award Dye Test Contract				M																		
Conduct Dye Testing																						
Stakeholder Engagement																						
Prepare Communication Plan																						
Open House					M																	
Design & Procurement																						
Prepare Construction Drawings																						
Finalize Quantities																						
Class A Cost Estimate																						
Prepare Contract Documents							M															
Prepare Technical Specifications							M															
Tendering Period																						
Award Contract(s)									M													
Construction																						
Pre-Construction Meeting										M												
Construction Period																						
Substantial Completion																			M			
Deficiency Completion																						
Completion of Final Deficiencies																						M

Critical Path Tasks
M Project Milestone
Flexible Tasks

Milestone Dates

January 16, 2009	Phase 1 Report Submission
January 30, 2009	City Approval of Recommended Concept
January 30, 2009	Issue Dye Testing Tender
February 13, 2009	Dye Test Tender Closing & Award
March 5, 2009	Tentative Date for Public Open House
March 20, 2009	Complete Dye Testing
April 1, 2009	Complete Contract Documents and Specifications
April 26-29, 2009	BC Water & Waste Association Annual Conference (Presentation)
May 6, 2009	Award Construction Contract
May 13, 2009	Pre-Construction Meeting
October 1, 2009	Substantial Completion of Construction Work
October 31, 2009	Completion of Final Deficiencies

Section 8

Summary and Recommendations

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8. SUMMARY AND RECOMMENDATIONS

8.1 SUMMARY OF FINDINGS

Flow Monitoring

- Flow monitoring to date has provided two sites (Niagara PS and Superior PS) with enough reliable I&I measurements to formulate I&I Envelopes.
- Both I&I Envelope assessments for the pump stations indicate a high degree of influence from Stormwater Inflow (SWI).
- Estimated I&I rates range from 170,000 L/ha/d to 389,000 L/ha/d at the 5-year peak-hour return period and duration.
- Flow monitoring at 6 sites by GEOtivity was determined to date not to be sufficient for proceeding with I&I Envelope analyses. SFE Global will be providing additional flow monitoring over the 2008/09 winter season to augment the previous data.

Field Inspections

- Smoke testing data is considered to be complete, and indicated a large number of potential stormwater connections, especially from catch basins within the public right-of-way.
- Follow-up dye testing is recommended for all public catch basins and 'no smoke' codes prior to initiation of construction work.
- CCTV data is considered to be complete and of good quality.
- Most sewer mainlines show some level of structural deterioration. Area 1 (Niagara) has the highest level of deterioration.
- Manhole inspections have been completed by the City for approximately 95% of the study area. Most manholes show no serious deterioration issues, however some infiltration and surcharging has been noted.
- Service connection CCTV inspections will be required for areas receiving rehab on the service connections.
- Additional manhole inspections or service connection CCTV will be required at locations where potential storm sewer overflows are indicated by smoke testing.

Rehabilitation and Replacement Methods

- Mainlines may be trenchlessly rehabilitated using chemical grouting, CIPP lining (full pipe or point repair), sliplining or pipe bursting. CIPP lining and pipe bursting are considered to be the best usage of trenchless technology in this application.
- Manholes may be trenchlessly rehabilitated using chemical grouting, spray-on membrane coatings or structural liners. For budgeting purposes, coating is expected to be used on 30% of manholes, while structural liners may have limited applications in this project.
- Service connections may be trenchlessly rehabilitated using CIPP lining or pipe bursting. Abandoned service connections may be eliminated by installing a segment of CIPP lining over the connection point in the mainline.
- A preliminary rehabilitation plan has been developed for each study area for budget estimate purposes.

Hydraulic Capacity

- A SANSYS collection system model was developed by Focus for the Clover catchment area, which includes James Bay.
- The design scenario from the modelling study selected for planning purposes is the 2056 (No I&I Reduction) development scenario. This assumes an I&I rate of 130,000 L/ha/d.
- The model identified a number of sections in the study area with hydraulic capacity deficiencies.
- Pipe upgrade sections without structural deterioration (or otherwise requiring work) are proposed to be deferred to future capital programs as their rehabilitation will not reduce I&I.
- Pipe upgrade sizing has been based upon the modelling work for planning purposes.
- A 100-year peak-hour I&I rate is recommended for designing pipe upgrades in order to be consistent with CALWMP commitments, which will be reviewed at the detailed design stage.

Preliminary I&I Reduction Plan

- The design of the I&I reduction plan is to be based on the objectives specified in the RFP for the JBIIRP as well as the Innovation Funds Grant application:

- Reduction or elimination of I&I using different approaches of trenchless technology;

- Reduce impact of construction-related GHG emissions by maximizing use of trenchless technology;

- Elimination or reduction of the number of existing overflows in the system;

- Improve public safety by lowering risk of sewer collapse;

- Determining which approach to I&I reduction (i.e., mains/manholes, service connections, direct SWI connections) have the highest benefit/cost ratio; and

- Development of a "blueprint" for I&I reduction.

▪ The I&I reduction plan concepts developed in this document have been evaluated with the following criteria:

  - Budget Allowance ($);
  - I&I Component Removal (Mains, manholes, etc.);
  - Needs Assessment (Rank for each component based on rehab costs);
  - Overflow Reduction (Number of overflows eliminated);
  - Sewer Condition Improvement (total WRc score in mainline rehab catchment); and
  - CO2 Offset by Trenchless Technology (tonnes CO2, estimated with NASTT-BC Carbon Calculator).

▪ Three base I&I reduction concepts have been developed:

  - Concept A (initial City concept): Mainlines + Manholes + Public SWI; Private Service Connection + All SWI; Public Service Connection + All SWI;

  - Concept B: Mainlines + Manholes + Public SWI; All SWI + All Service Connections; SWI Only; and

  - Concept C: Mainlines + Manholes + Public SWI; Private SWI + Private Service Connections; SWI Only.

▪ Each base concept has been presented with two alternative arrangements by adjusting which study areas receive rehab work. Concepts A1, B1 and C1 focus I&I reduction toward the areas with greatest need, and Concepts A2, B2, and C2 focus on cost savings.

- An estimate of the total I&I reduction budget has been completed for each study area, with individual area costs (for 100% rehabilitation) ranging between \$3.4 million and \$4.7 million, and a total cost estimated at approximately \$14.9 million.

- The average unit I&I reduction cost ranges from \$1,070/m to \$1,200/m for full basin rehabilitation, at an average of \$1,120/m for the entire study area.

- The existing program budget will allow for approximately \$2.52 million in construction work.

- Each concept alternative has been costed at a Class 'C' level of detail, and all exceed the available construction budget:

  - A1 - \$7.04 million;
  - A2 - \$6.31 million;
  - B1 - \$5.04 million;
  - B2 - \$4.22 million;
  - C1 - \$4.89 million; and
  - C2 - \$4.14 million.

- A decision matrix was developed to rate each concept alternative in terms of the planning criteria. Evaluations were made on an unweighted and a weighted basis.

- Weighting for each criteria was determined by ranking in terms of priority, and assigning a corresponding weight between 1 and 7.

- Concept B1 was determined to have the highest rating in both the weighted and unweighted analyses by significant margins.

- Concept C2 comes closest to meeting budgetary needs, however it is not preferable in terms of effective funding allocation, isolation of I&I components or absolute I&I reduction.

Development of Recommended Concept

- In order to meet budgetary requirements the extent of the proposed rehabilitation work has been reduced.

- The general approach of Concept B1 has been retained in the development of the recommended Concept B3, with the following adjustments:

  - Area 1: split manhole and mainline rehabilitation between the two flow monitors (FM-10/FM-11), and omit public-side inflow reduction;

  - Area 2: becomes the control;

- Area 3: rehabilitate all active services, seal off all abandoned services and eliminate all sources of inflow in the FM-13 subcatchment; optionally seal off all abandoned services in the FM-14 catchment; and

- Area 4: eliminate all sources of inflow including private and public.

▪ The cost of Concept B3 is estimated to be \$3.2 million with the FM-13 optional work, and \$3.0 million without.

▪ Concept B3 ranks fourth in the unweighted decision matrix, and first in the weighted decision matrix.

8.2 RECOMMENDATIONS

Based on the foregoing, it is recommended that:

▪ a dye testing program be initiated prior to completing detailed design and program tendering;

▪ if budget is available, the City select Concept B3 with the optional abandoned services work in Area 3B (FM-14);

▪ if budget is not available, then the City select Concept B3 without the abandoned services work in Area 3B (FM-14); and

▪ the recommended concept be approved and moved to the detailed design stage.

8.3 REPORT SUBMISSION

Prepared by:

KERR WOOD LEIDAL ASSOCIATES LTD.

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Mike Homenuke, P.Eng.
Project Engineer

Reviewed by:

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Andrew Boyland, P.Eng.
Planning & Policy Manager

Appendix A

I&I Event Hydrographs

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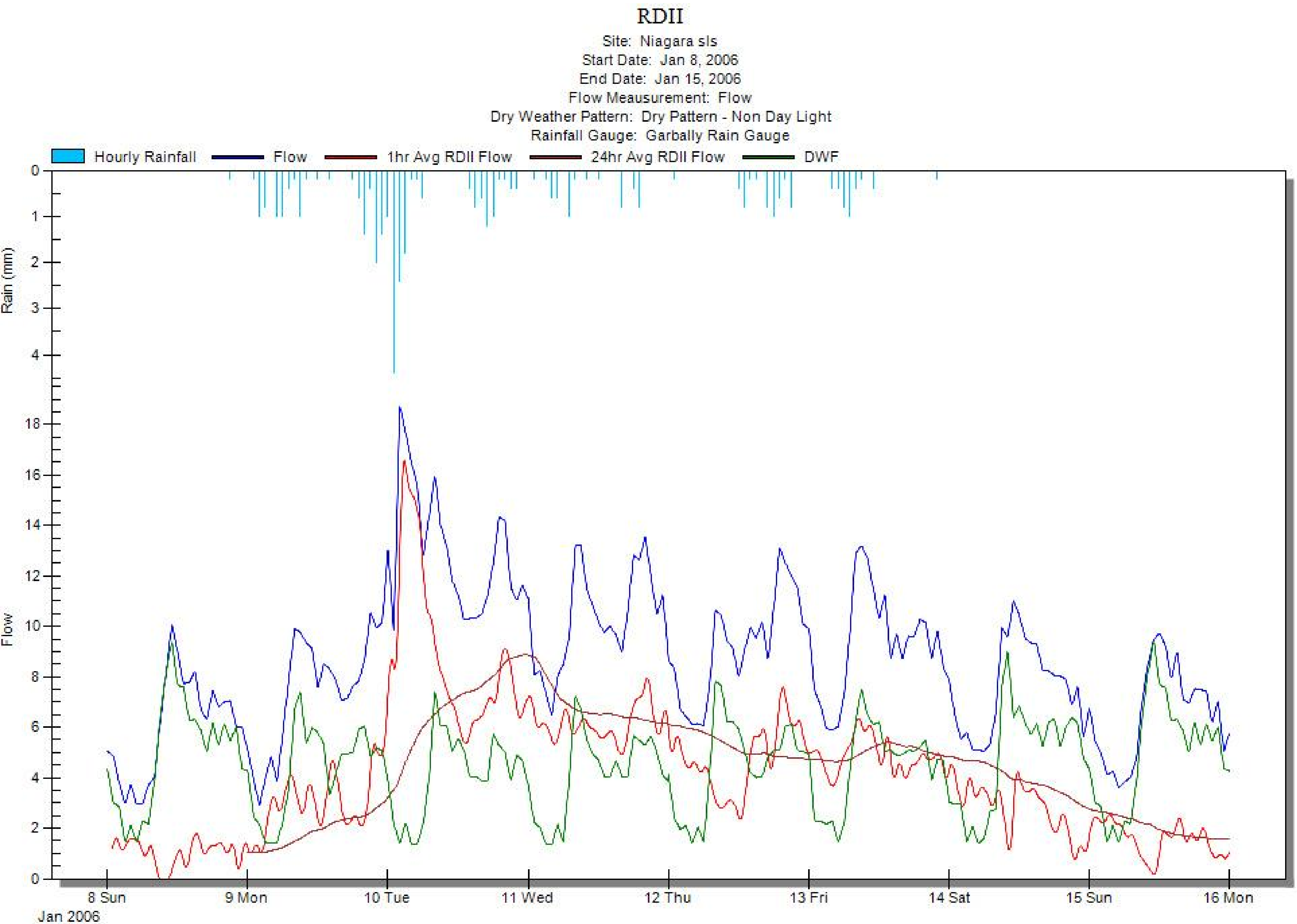

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Hourly Rainfall
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1hr Avg RDII Flow
24hr Avg RDII Flow
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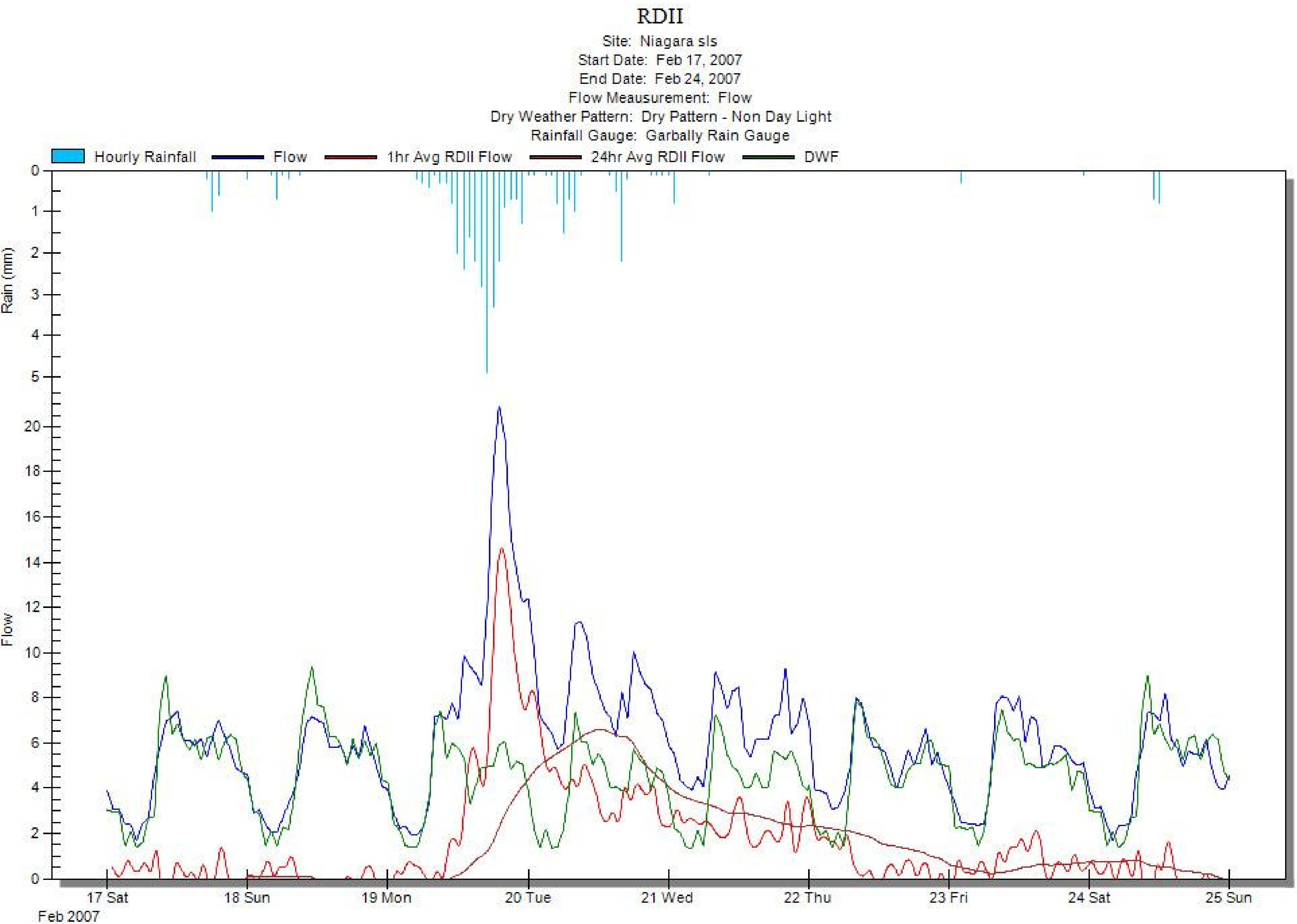

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Hourly Rainfall
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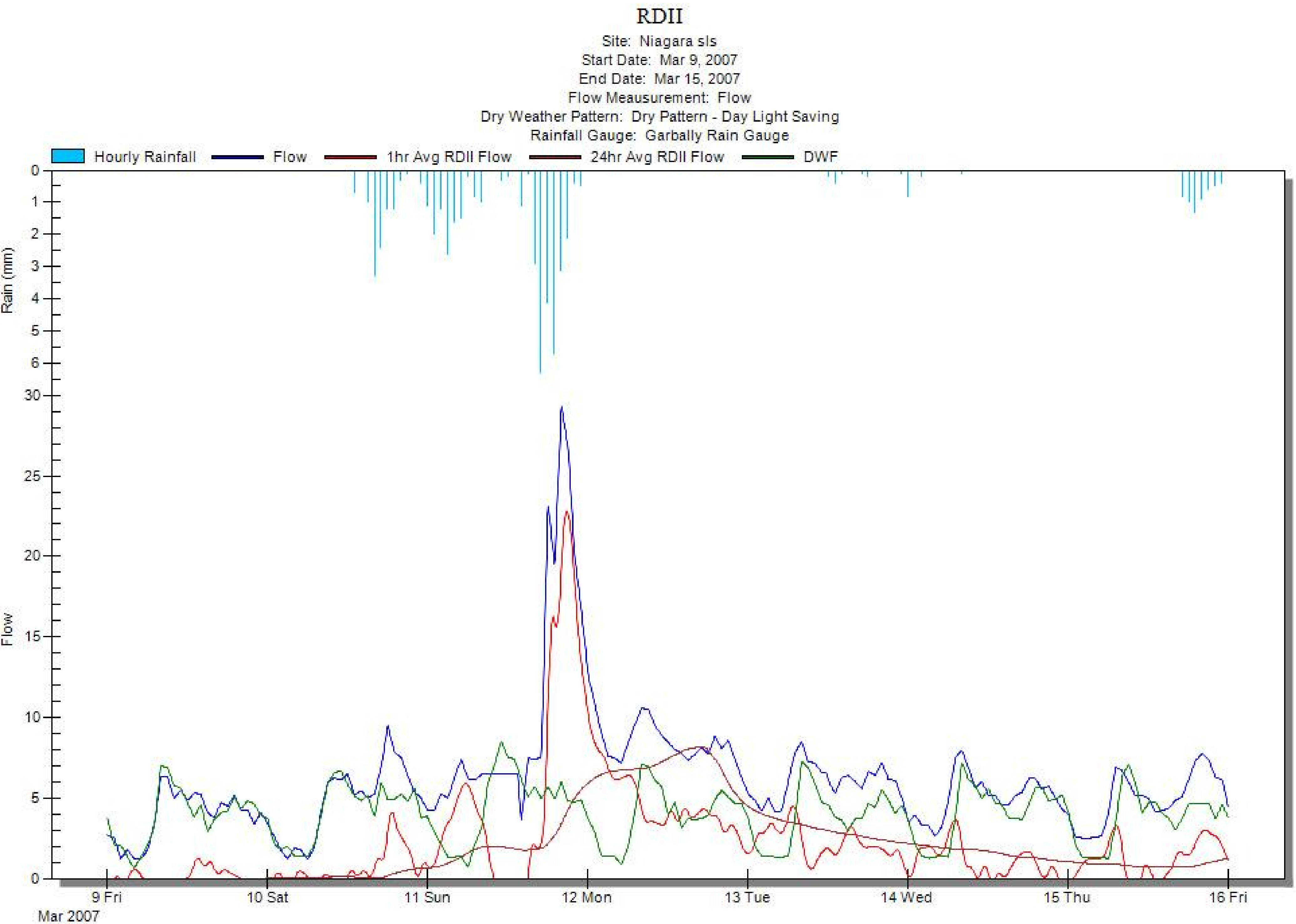
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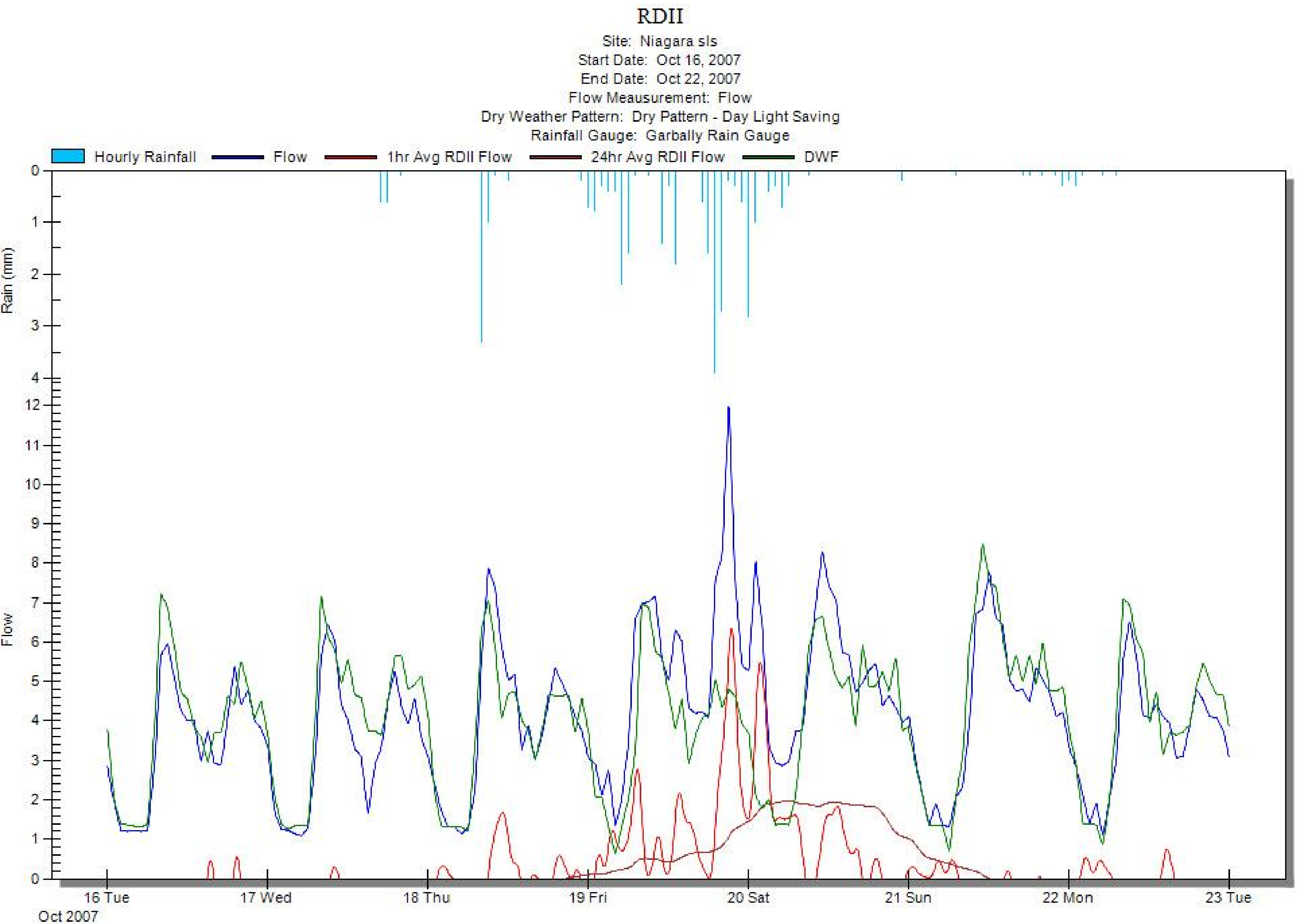

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Oct 2007

RDII

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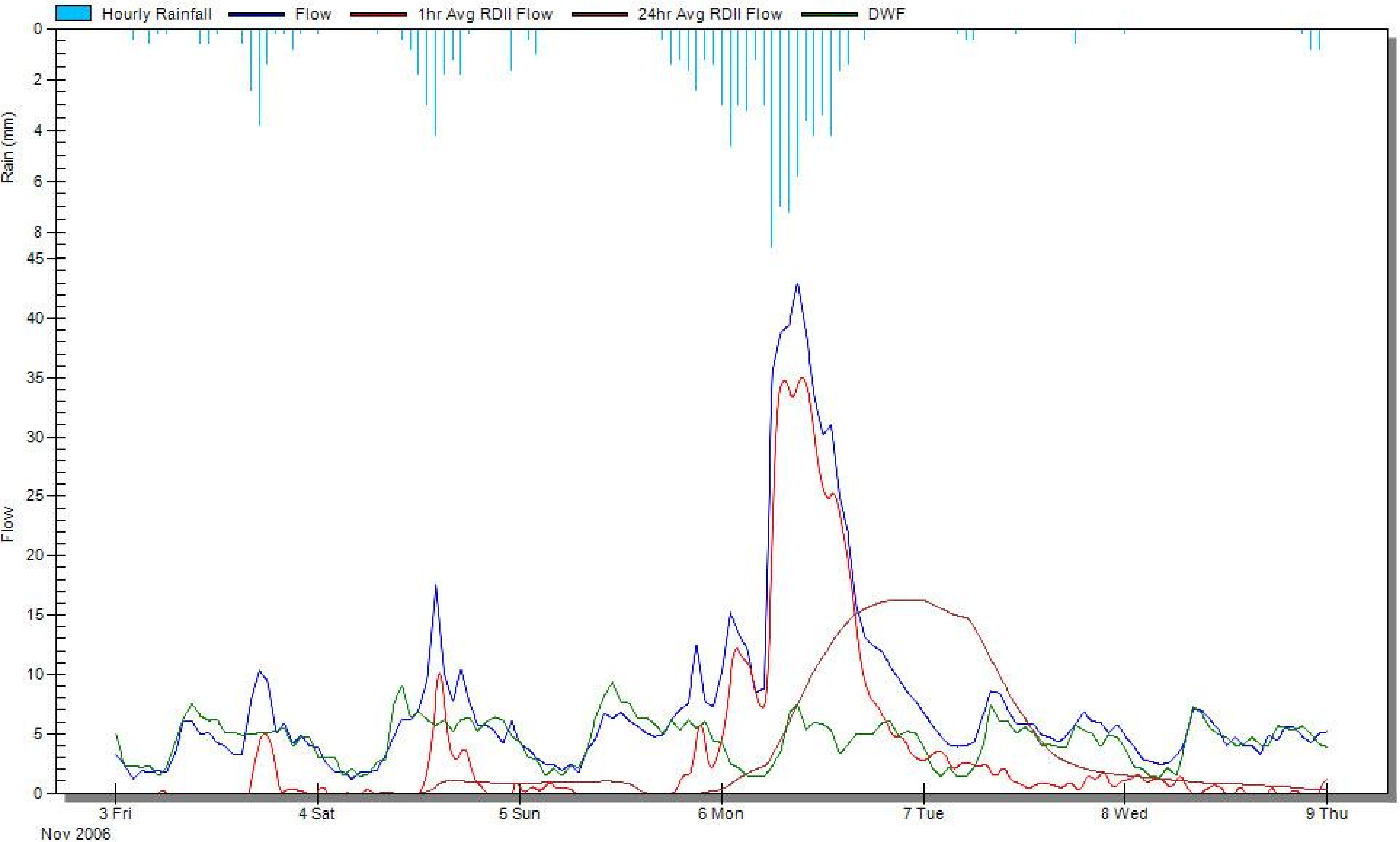

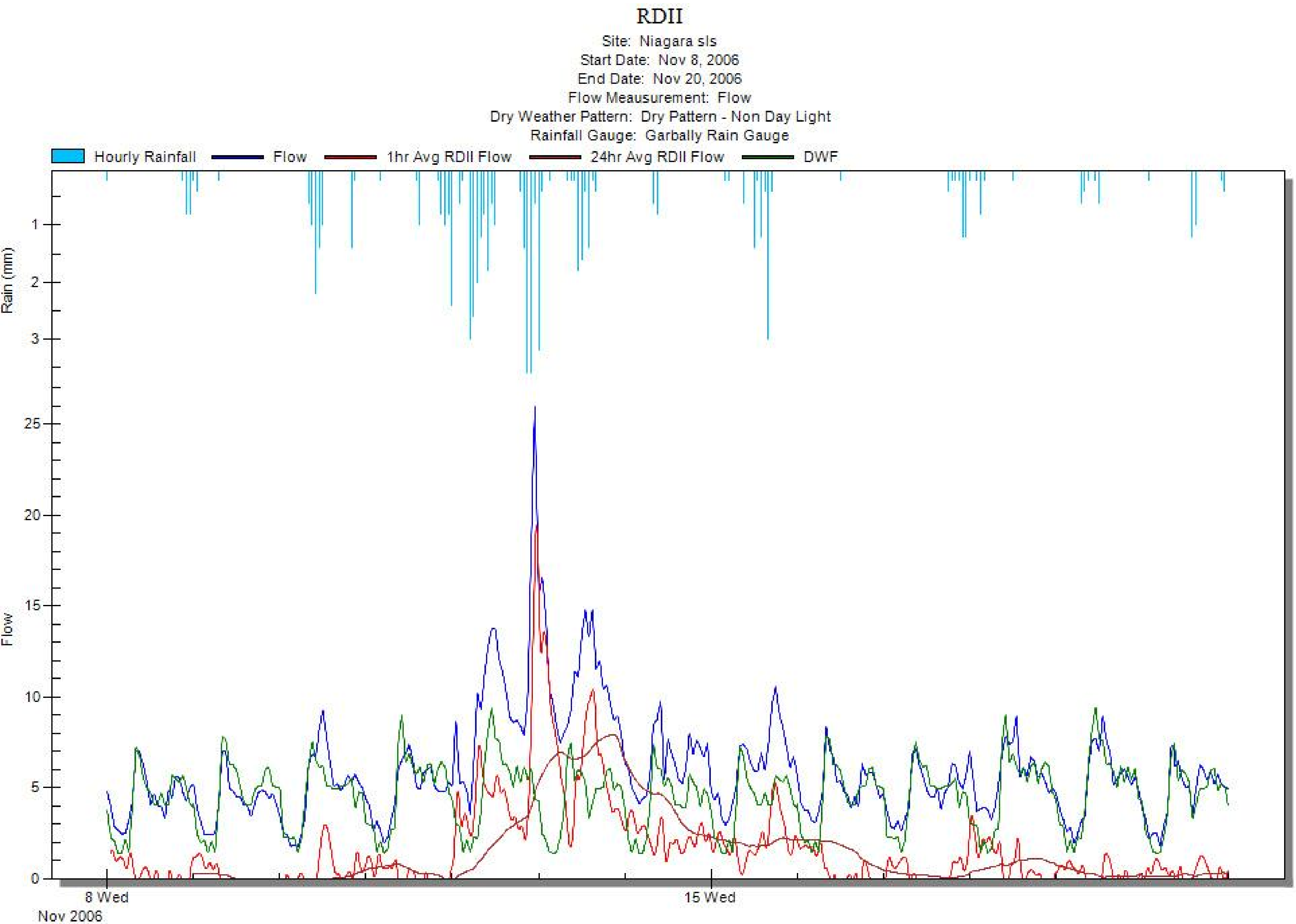
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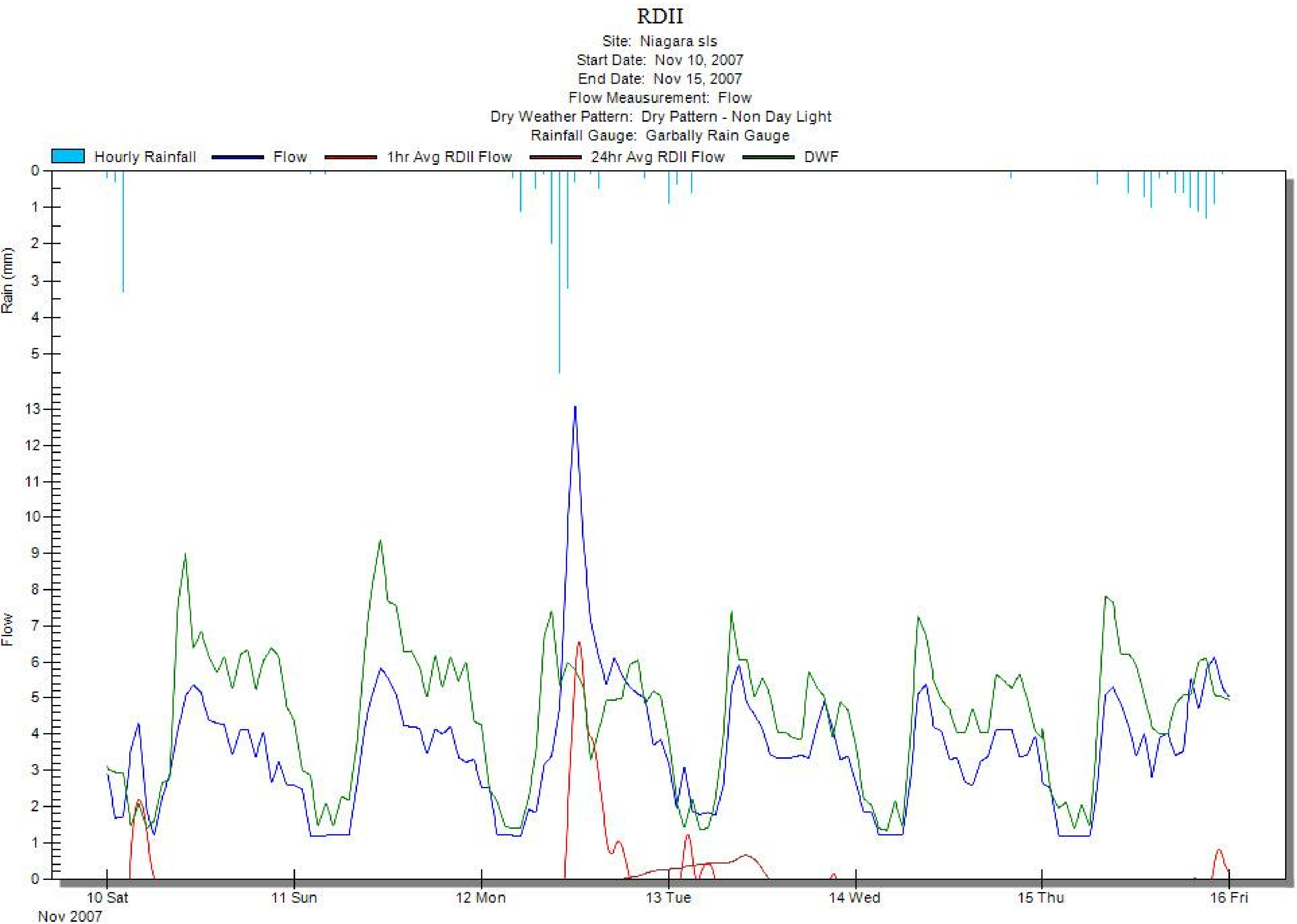

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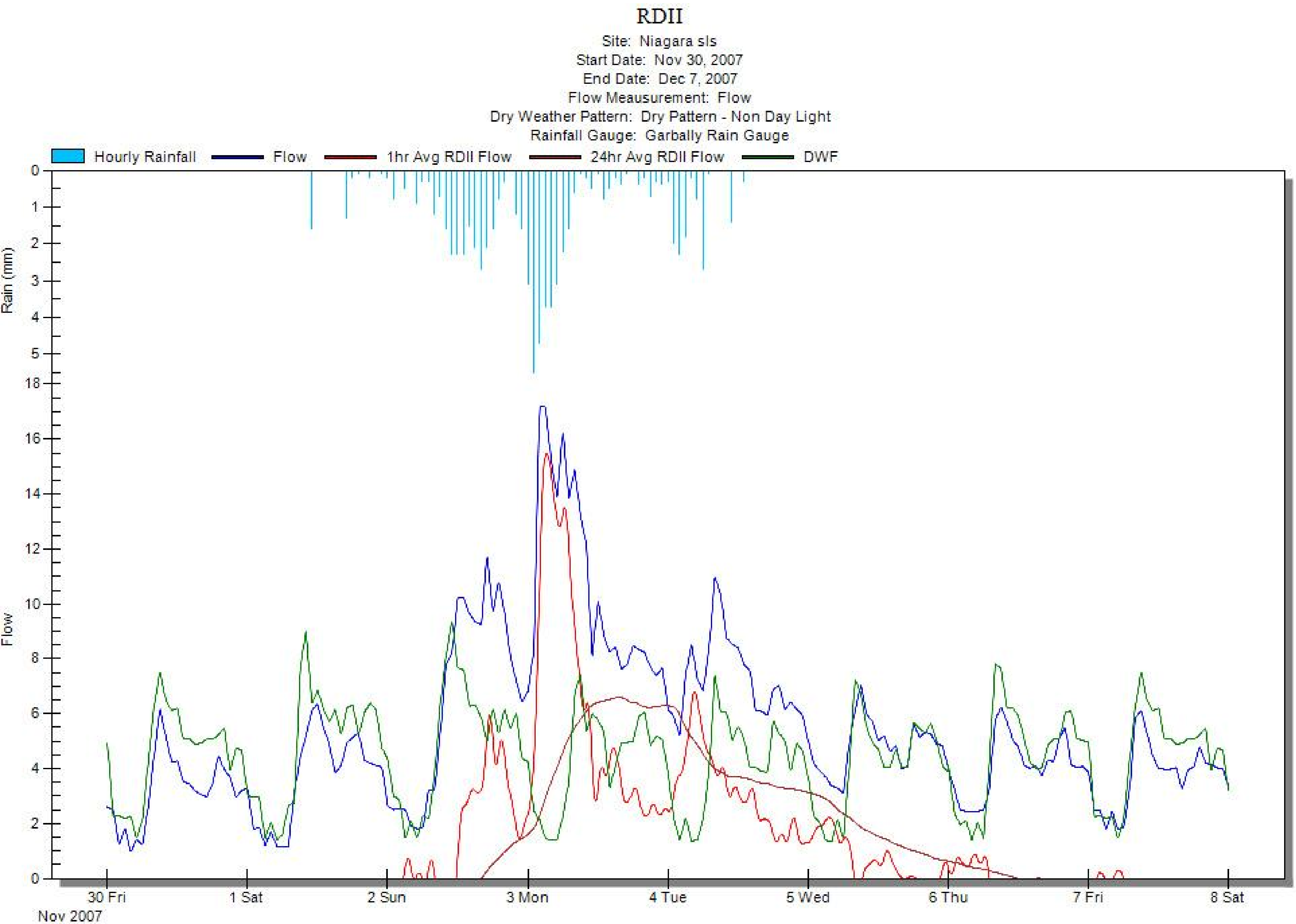
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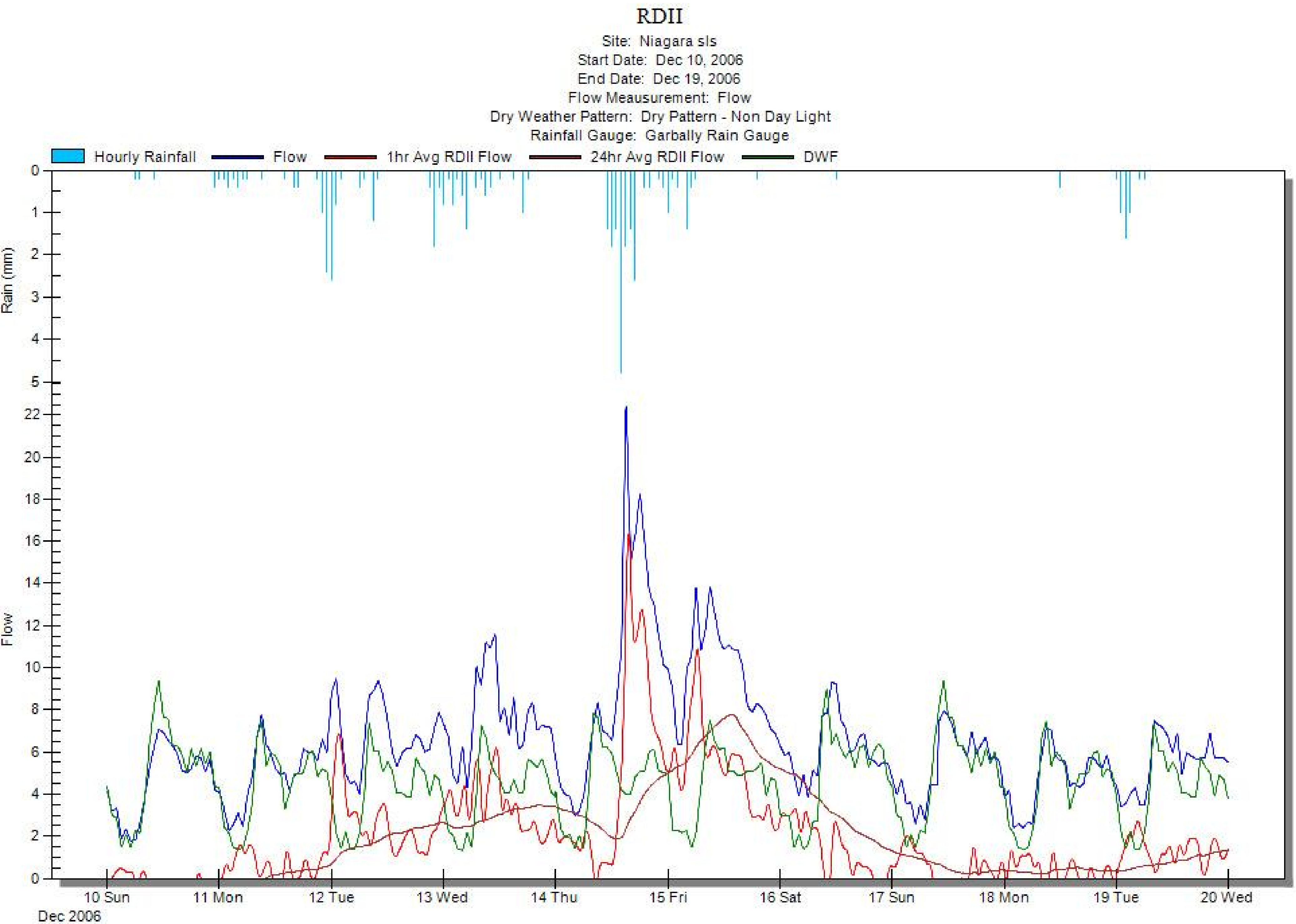
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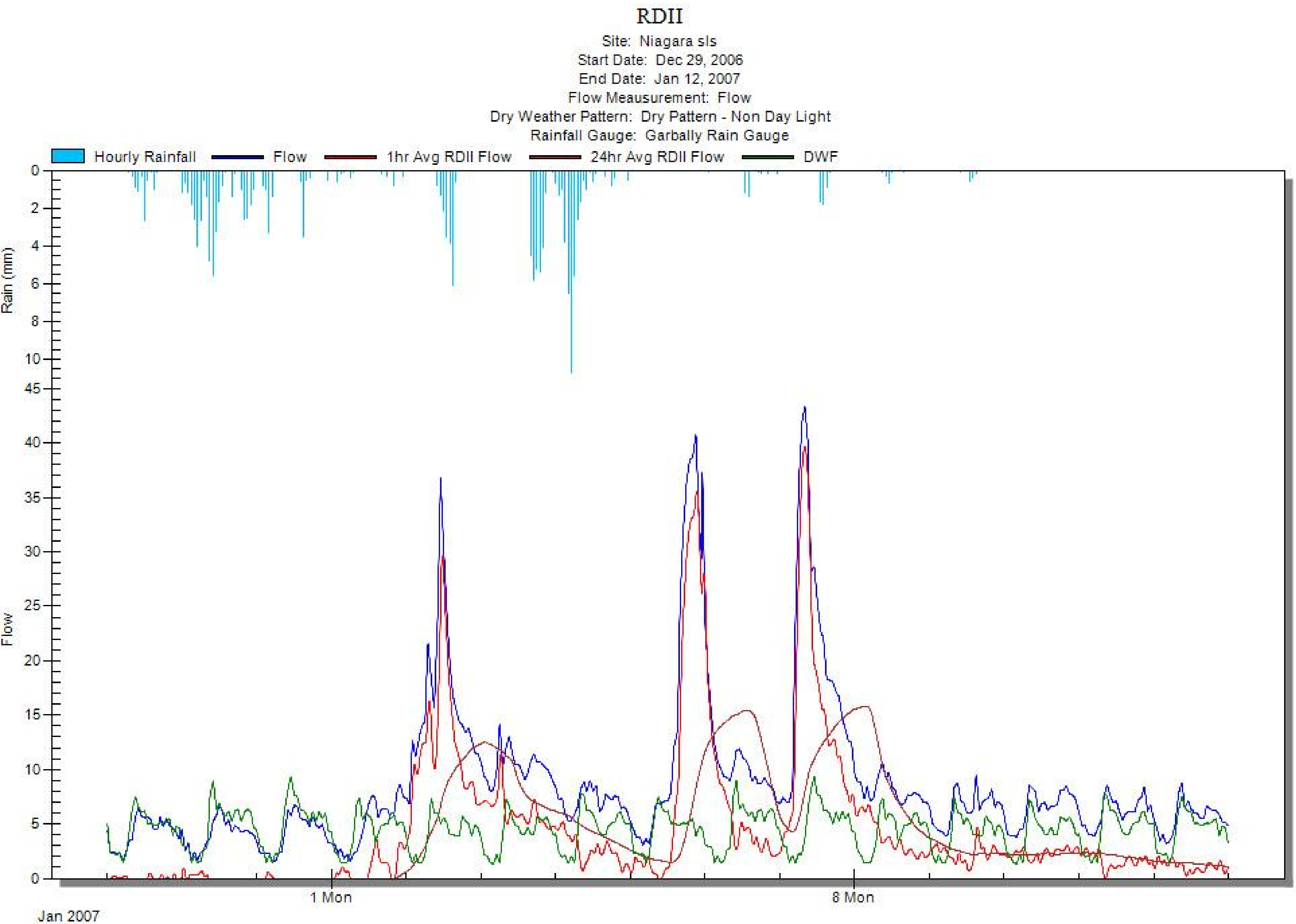
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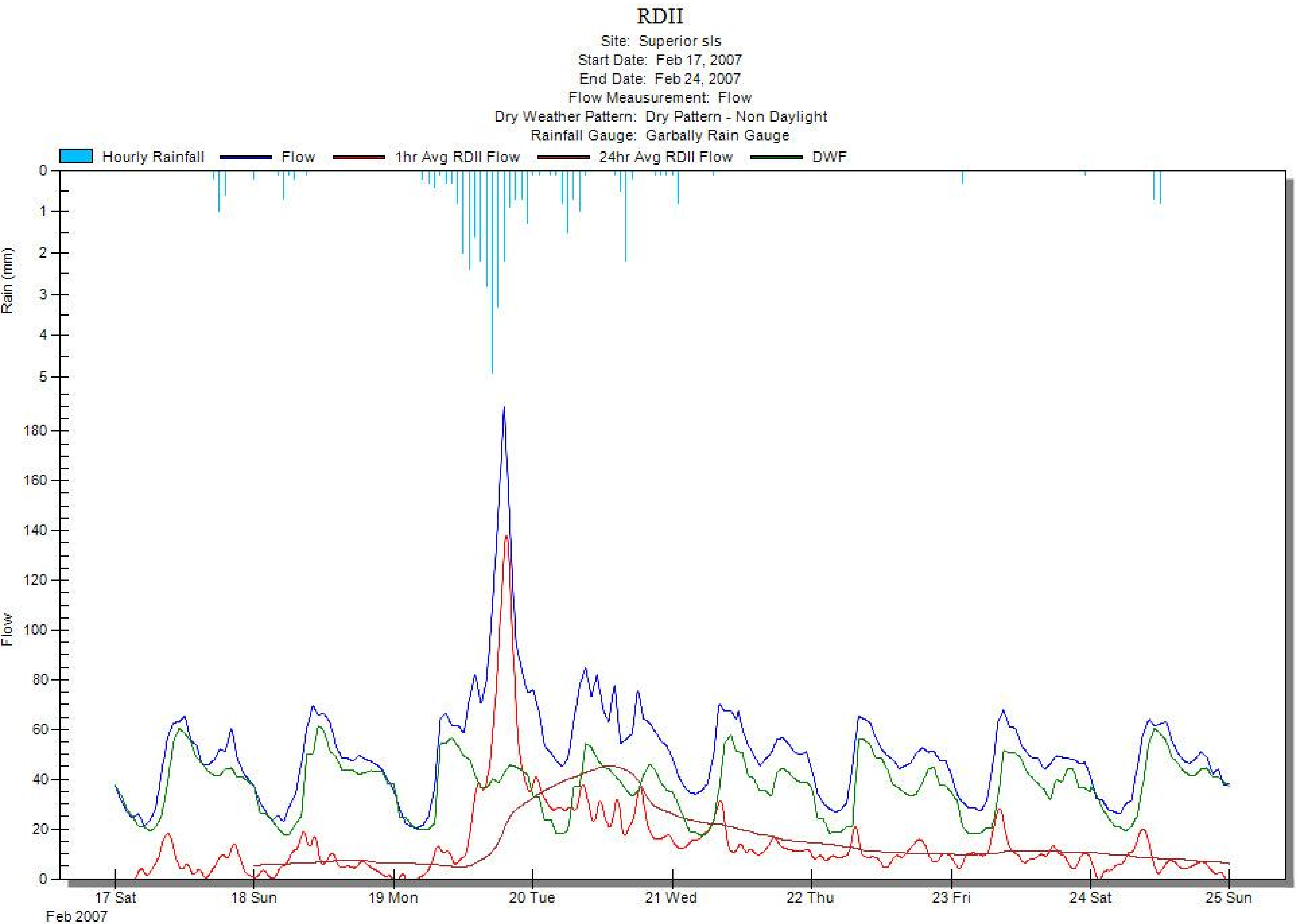
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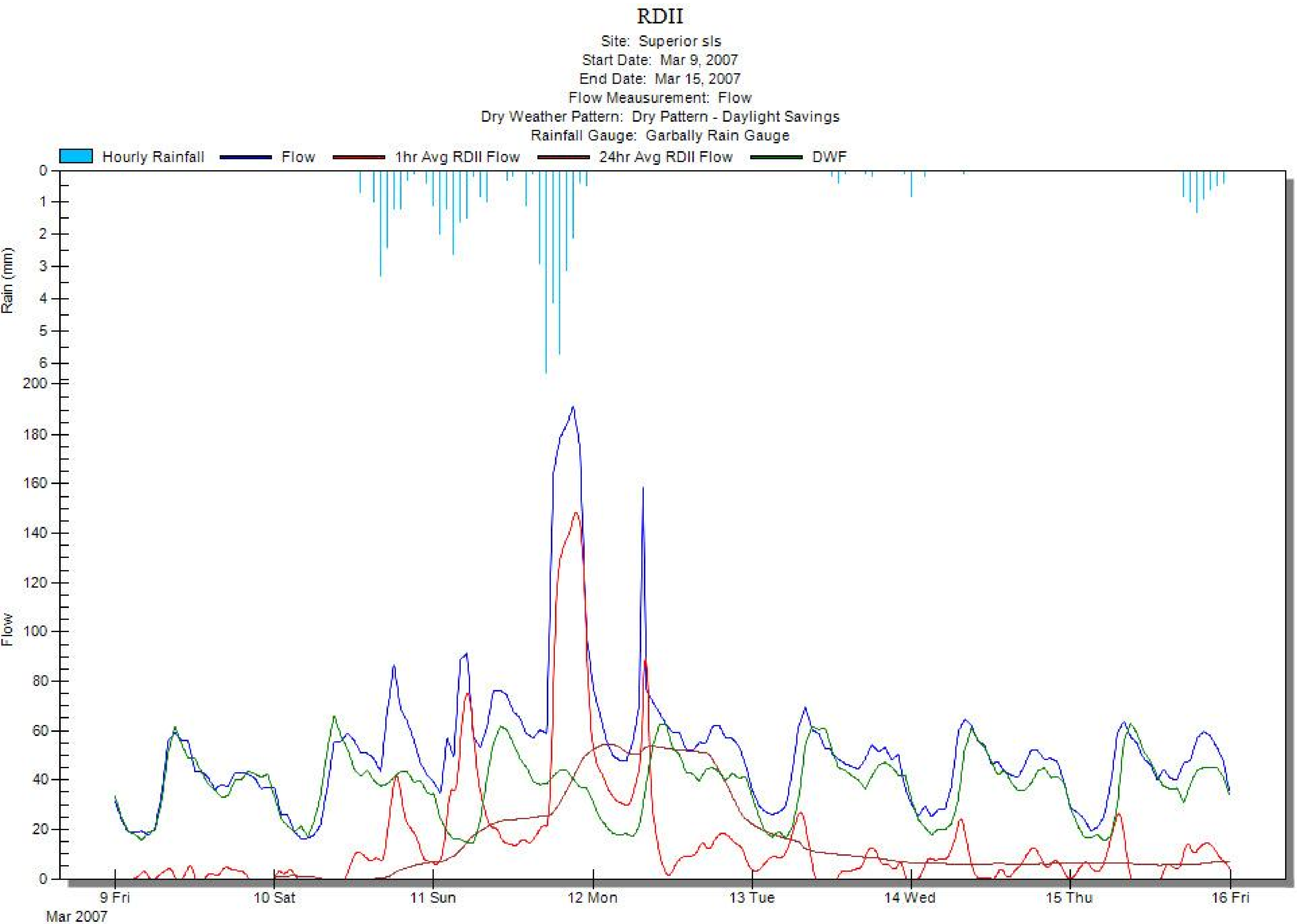
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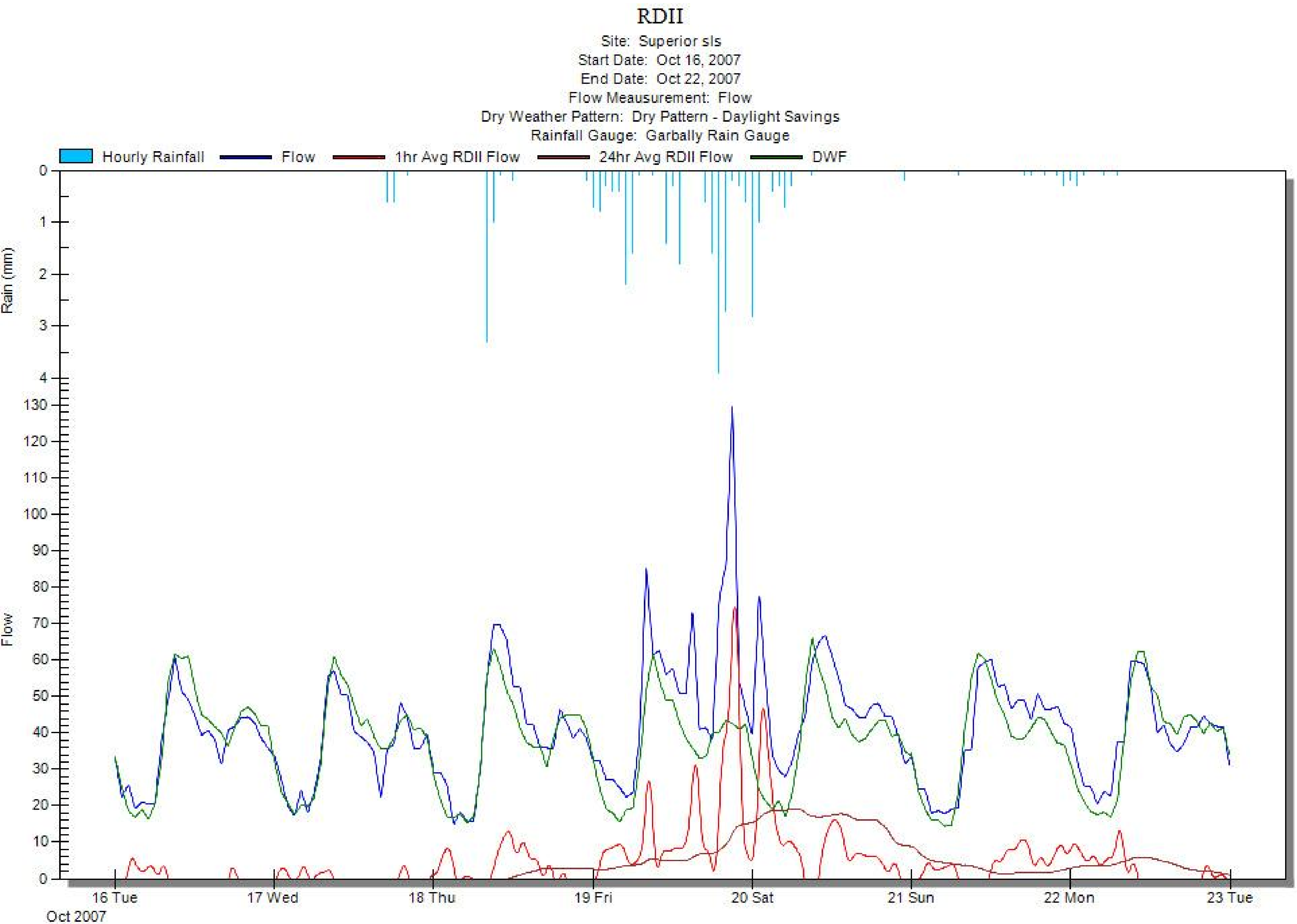
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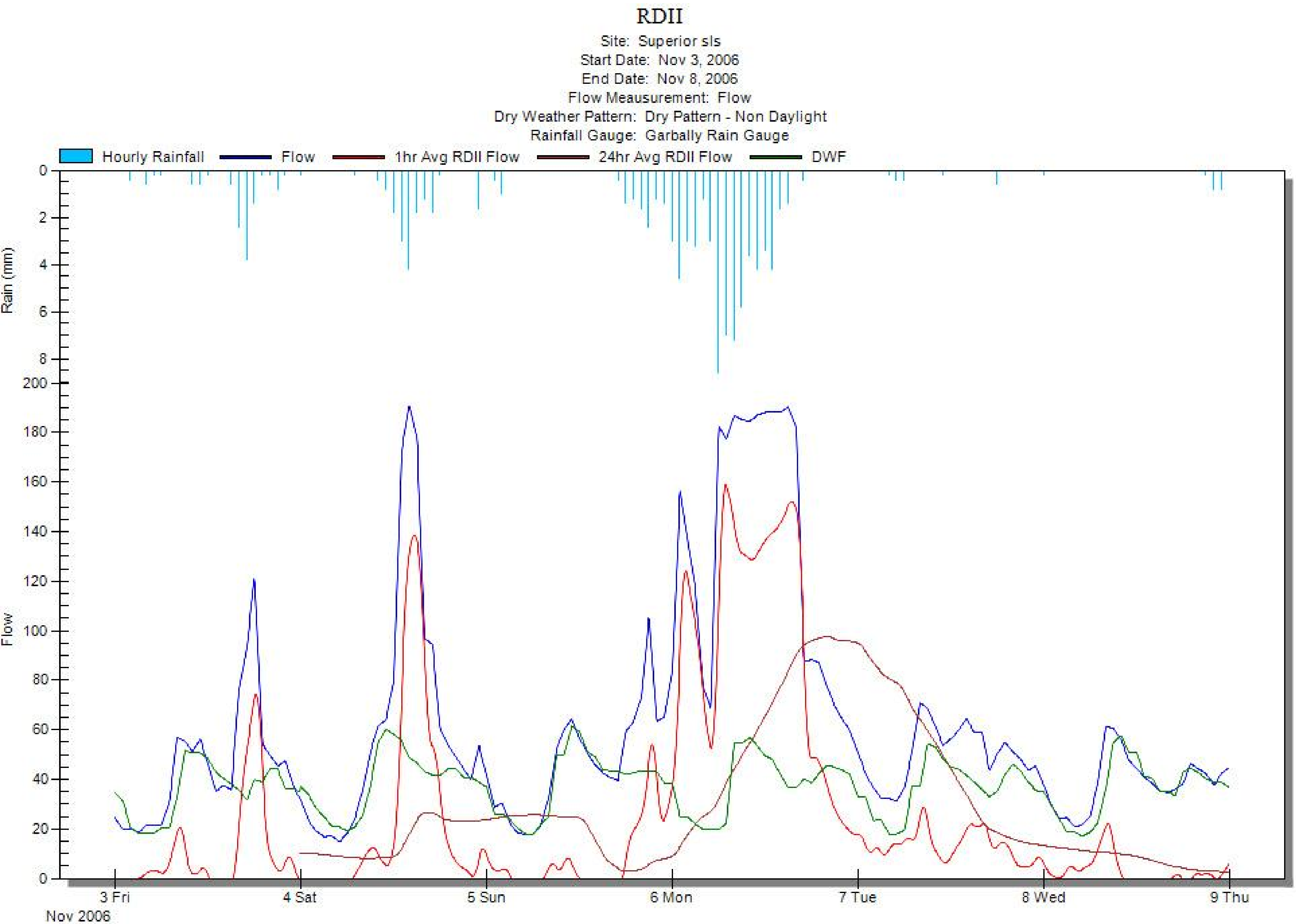

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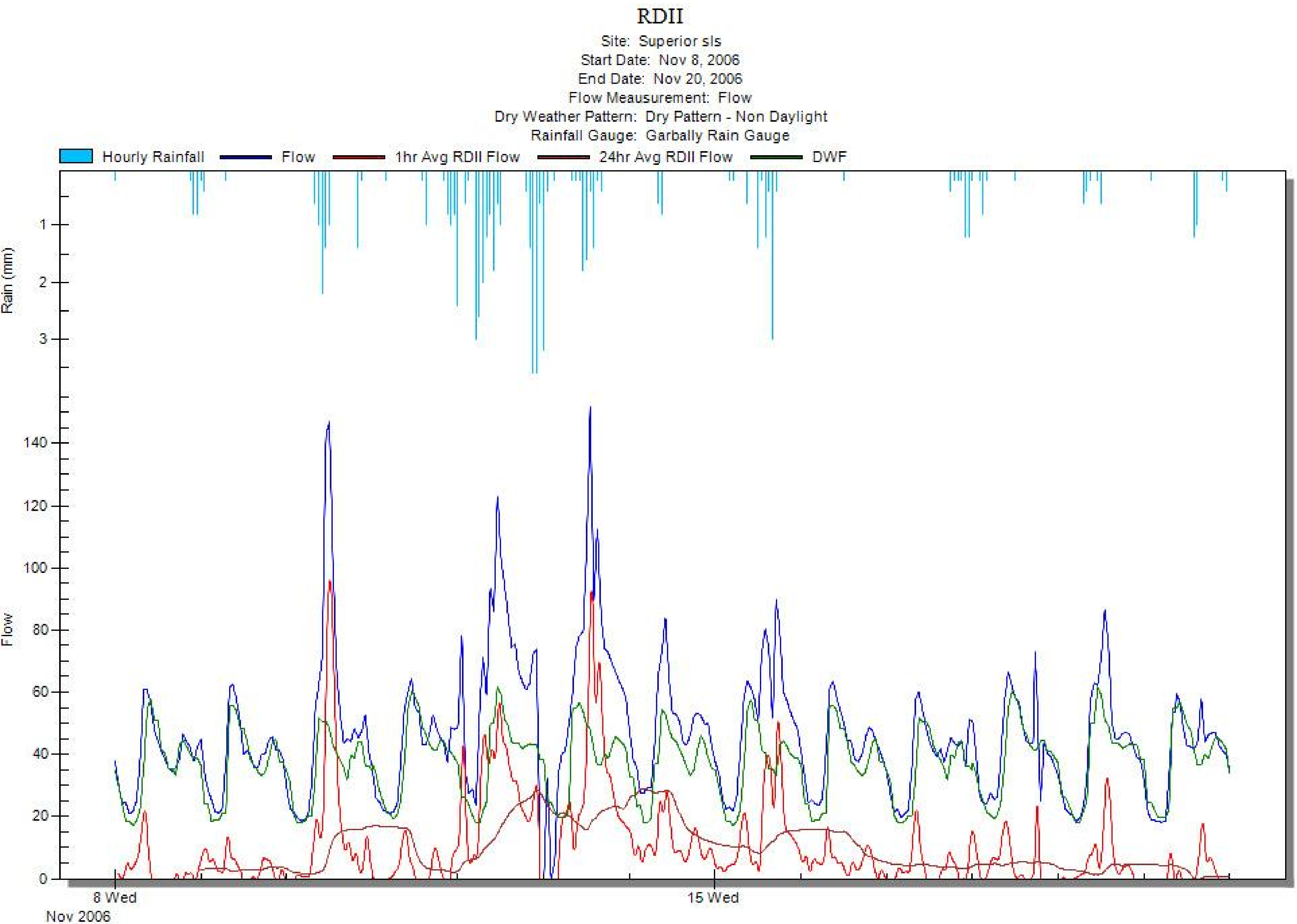
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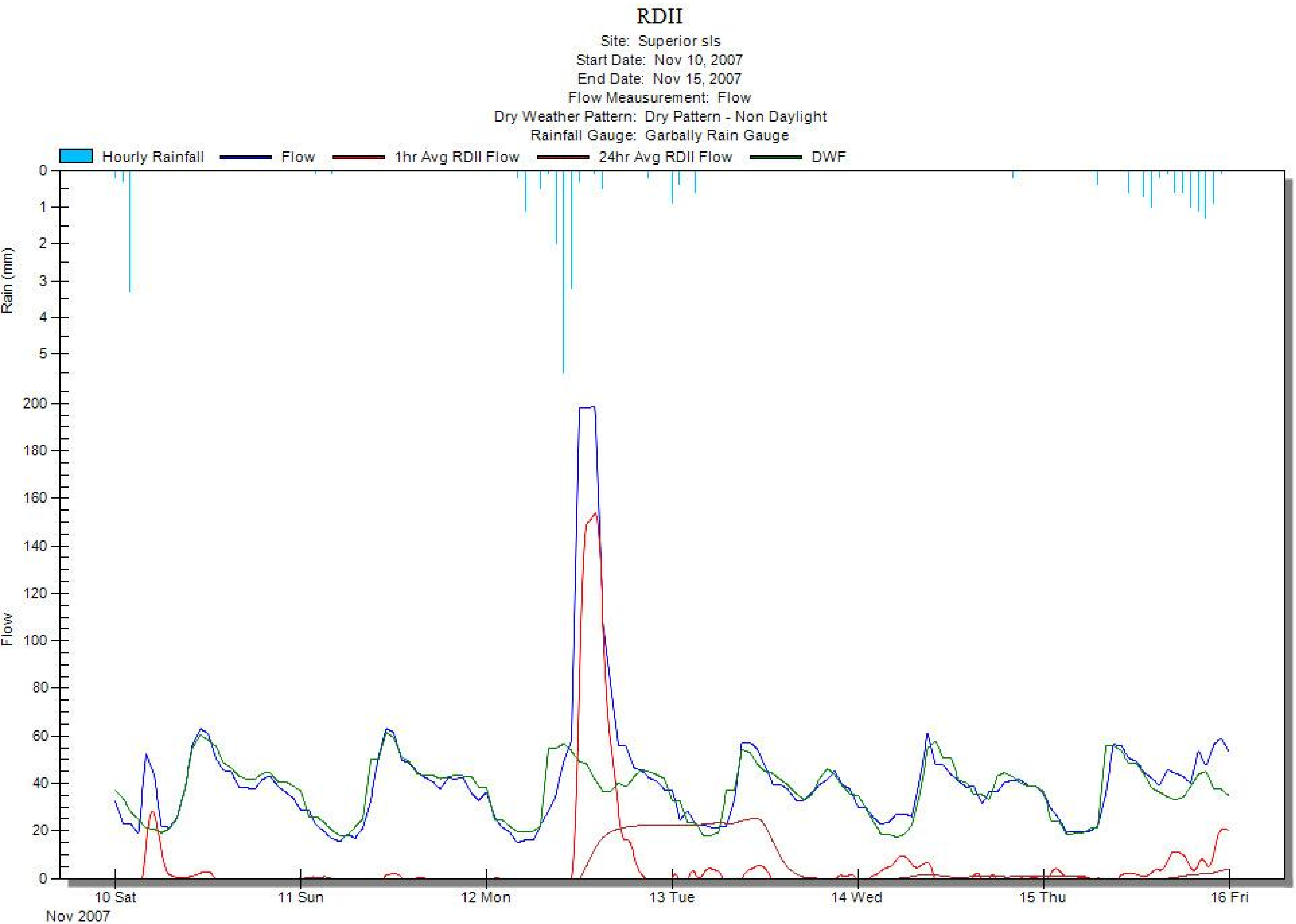

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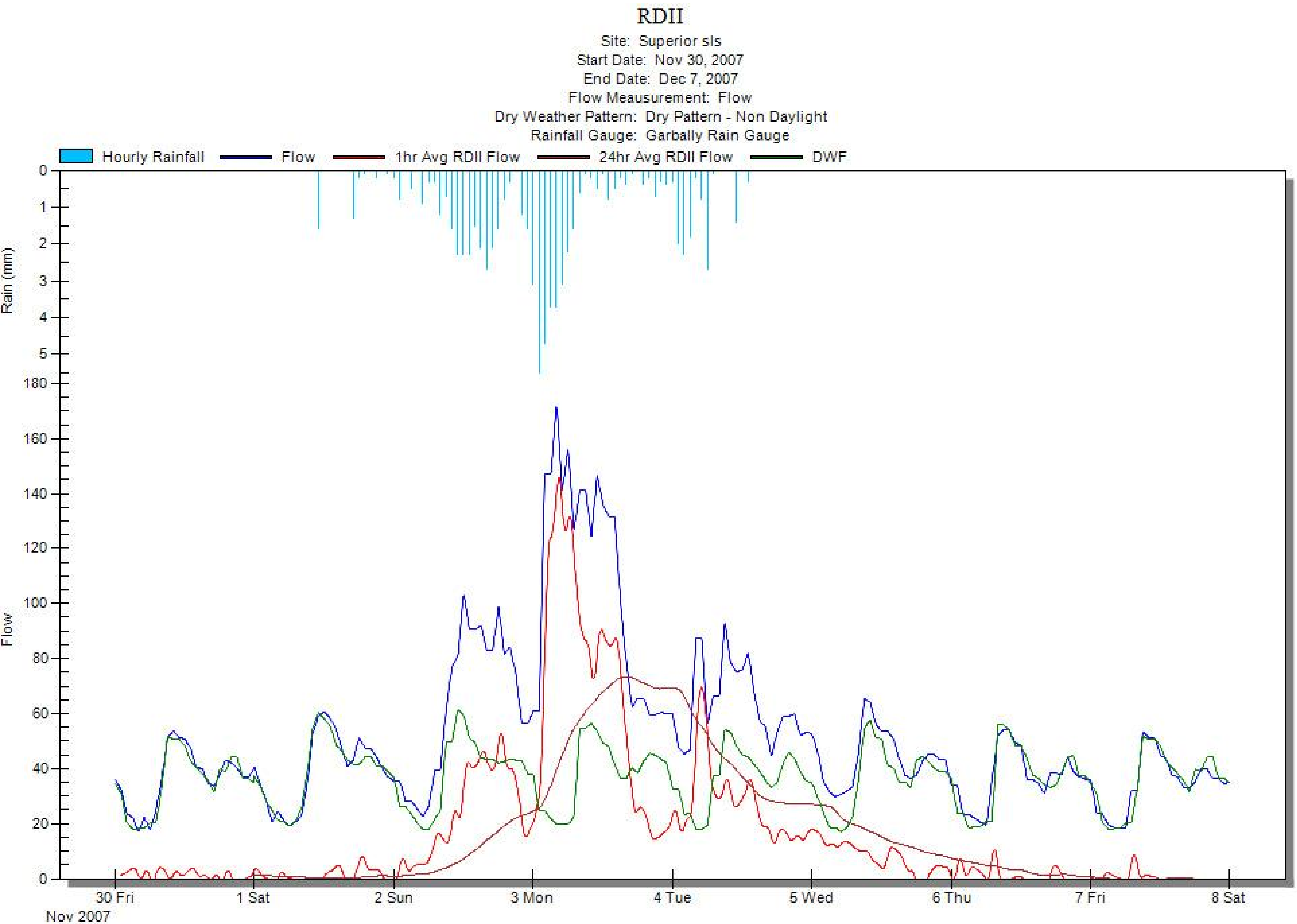
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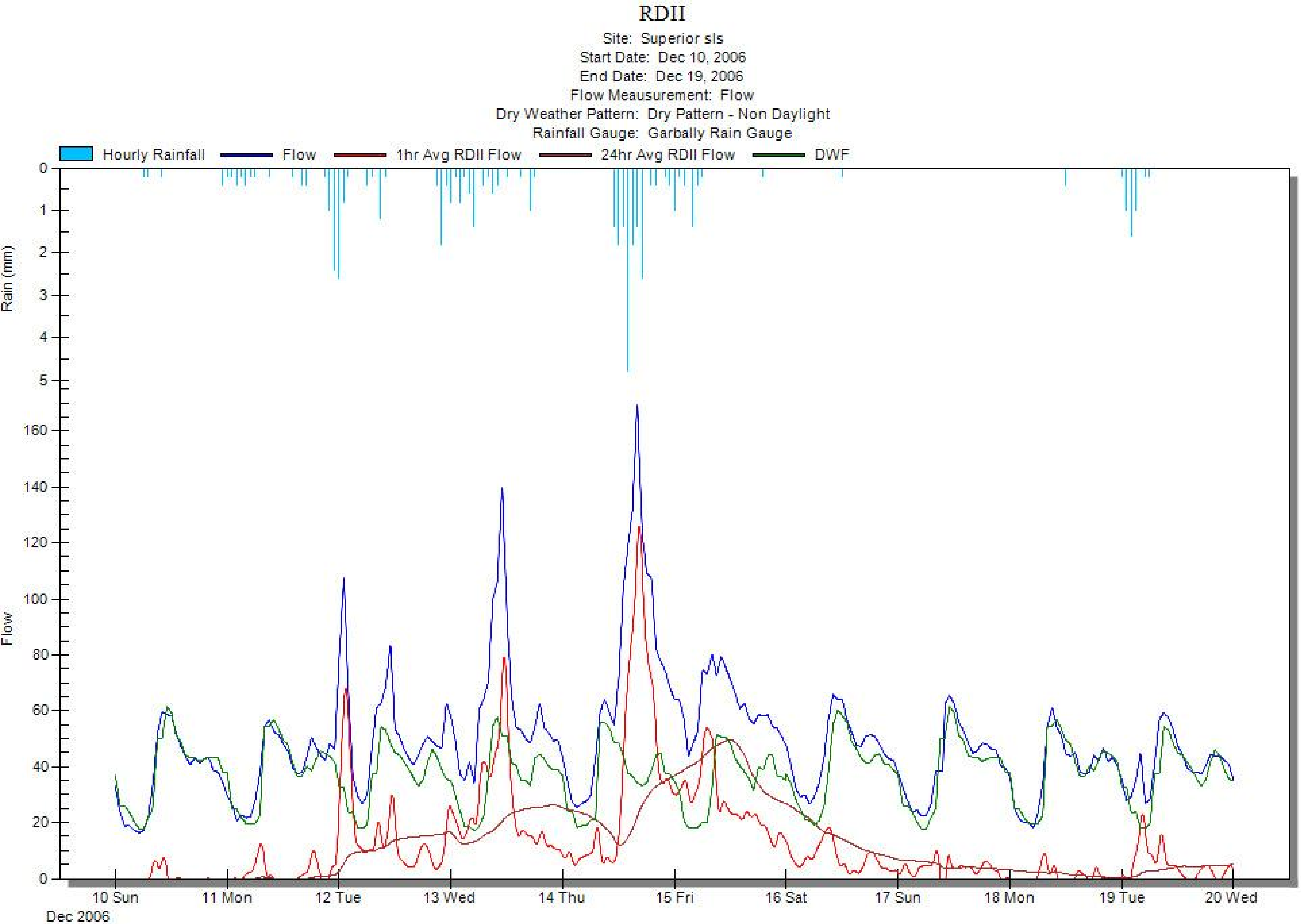
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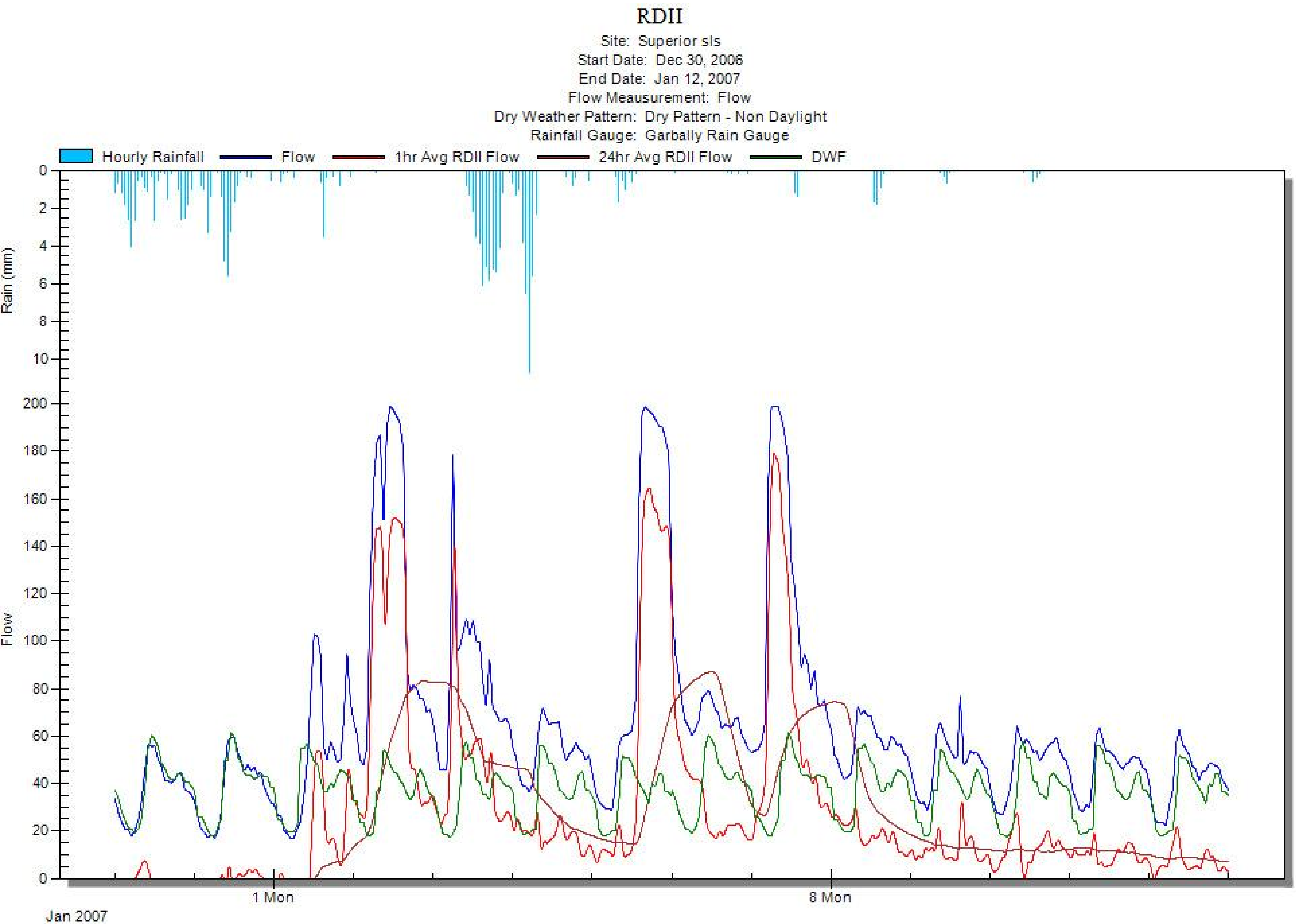
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End Date: Jan 12, 2007
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Jan 2007

Appendix B

Detailed Budget Estimates

KERR WOOD LEIDAL
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City of Victoria
James Bay I&I Reduction Pilot Project
Budget-Level Cost Estimate
O:\0800-0899\809-032\700-CostEstimate\[I&IReductionPlanner_20081211.xls]ConceptA1

Concept A1	Total Cost	
Field Services	238,086	3%
Mains & Manholes	1,970,839	28%
Public Service Connection	2,102,606	30%
Private Service Connection	1,593,794	23%
Public Direct Inflow	652,830	9%
Private Direct Inflow	478,625	7%
Total		**$7,036,779**

Task	Quantity Area 1	Area 2	Area 3	Area 4	Rehab Ratio Area 1	Area 2	Area 3	Area 4	Total Quantity	Units	Unit Cost $/unit	Subtotal $
Pre-Rehab Maintenance/Inspections												
Flush/Clean/Post-Rehab Inspection	3,151	3,151	3,146	3,902	100%				3,151	lin.m	5	15,755
Service CCTV	262	304	299	349		100%		100%	653	each	200	130,600
Dye Testing	25	36	35	54	100%	100%	100%	100%	150	each	150	22,500
Direct Inflow Connections												
Reconnect CB (Public)	13	18	24	36	100%	100%		100%	67	each	5000	335,000
Redirect Storm Drain (Private)	6	11	13	34		100%		100%	45	each	7500	337,500
Replace Cleanout Cap	6		5	7	100%	100%		100%	13	each	150	1,950
Remove Storm Overflow	0	2	1	14	100%	100%		100%	16	each	8000	128,000
Mainline Rehabilitation												
Grout Pipe Joint (assume 0.6 m pipe length)	2,397	2,524	3,858	4,072	100%				2,397	each	60	143,828
Grout Service Interface	175	203	199	233	100%	100%		100%	610	each	550	335,500
CIPP Full Lining - 200 mm	1,225	1,458	1,304	1,152	100%				1,225	lin. m	180	220,495
CIPP Full Lining - 250 mm					100%				0	lin. m	195	0
CIPP Full Lining - 300 mm			38		100%				0	lin. m	225	0
CIPP Full Lining - 375 mm					100%				0	lin. m	240	0
CIPP Full Lining - 450 mm					100%				0	lin. m	300	0
CIPP Point Repair - 200 mm	10	5	5	7	100%				10	each	2500	25,000
CIPP Point Repair - 250 mm					100%				0	each		0
CIPP Point Repair - 300 mm					100%				0	each		0
CIPP Point Repair - 375 mm					100%				0	each		0
CIPP Point Repair - 450 mm					100%				0	each		0
Pipe Burst - 200 mm	62	332			100%				62	lin. m	400	24,671
Pipe Burst - 250 mm	264	119		132	100%				264	lin. m	400	105,565
Pipe Burst - 300 mm	419			93	100%				419	lin. m	600	251,628
Pipe Burst - 375 mm				206	100%				0	lin. m	600	0
Pipe Burst - 450 mm					100%				0	lin. m	800	0
EPR < 2 m Depth					100%				0	each	4000	0
EPR 2 - 3 m Depth	2	2	2		100%				2	each	5000	10,000
EPR 3 - 4 m Depth					100%				0	each	6000	0
EPR 4 - 5 m Depth					100%				0	each	8000	0
EPR > 5 m Depth					100%				0	each	9000	0
Excavated Replacement - 200 mm					100%				0	lin. m	950	0
Excavated Replacement - 250 mm	11		8		100%				11	lin. m	1050	11,780
Excavated Replacement - 300 mm	38				100%				38	lin. m	1100	41,414
Excavated Replacement - 375 mm					100%				0	lin. m	1200	0
Excavated Replacement - 450 mm					100%				0	lin. m	1300	0
	2,031	1,916	1,357	1,590								
Manhole Rehabilitation	0.64	0.61	0.43	0.41								
Replace Cover	62	49	58	57	100%				62	each	200	12,400
Replace Frame/Ring	2	3	0	3	100%				2	each	350	700
Structural Repair	3	3	0	9	100%				3	each	2000	6,000
Manhole Grouting	62	49	58	57	30%				19	each	6500	120,900
Service Connections												
Pipe Burst Private Only	207	244	233	306				100%	306	each	3700	1,130,350
Pipe Burst Public Only	207	244	233	306		100%			244	each	3400	830,960
Pipe Burst Entire Connection	207	244	233	306					0	each	4600	0
Disconnect & Cap	143	114	145	151		100%		100%	264	each	2500	660,250
Total												**4,902,746**

Task	Markup Factors 1 - Contractor Markup	2 - Contingency	3 - Indeterminate Items	4 - Mob, Bonding, Ins.	Factor Costs 1 - Contractor Markup $	2 - Contingency $	3 - Other $	4 - Mob, Bonding, Ins.	Total Cost $
Pre-Rehab Maintenance/Inspections									
Flush/Clean/Post-Rehab Inspection	10%	20%	3%	8%	1,576	3,151	473	1,260	22,215
Service CCTV	10%	20%	3%	8%	13,060	26,120	3,918	10,448	184,146
Dye Testing	10%	20%	3%	8%	2,250	4,500	675	1,800	31,725
Direct Inflow Connections									
Reconnect CB (Public)	10%	20%	3%	8%	33,500	67,000	10,050	26,800	472,350
Redirect Storm Drain (Private)	10%	20%	3%	8%	33,750	67,500	10,125	27,000	475,875
Replace Cleanout Cap	10%	20%	3%	8%	195	390	59	156	2,750
Remove Storm Overflow	10%	20%	3%	8%	12,800	25,600	3,840	10,240	180,480
Mainline Rehabilitation									
Grout Pipe Joint (assume 0.6 m pipe length)	10%	20%	10%	8%	14,383	28,766	14,383	11,506	212,866
Grout Service Interface	10%	20%	10%	8%	33,550	67,100	33,550	26,840	496,540
CIPP Full Lining - 200 mm	10%	20%	18%	8%	22,049	44,099	39,689	17,640	343,971
CIPP Full Lining - 250 mm	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 300 mm	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 375 mm	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 450 mm	10%	20%	18%	8%	0	0	0	0	0
CIPP Point Repair - 200 mm	10%	20%	3%	8%	2,500	5,000	750	2,000	35,250
CIPP Point Repair - 250 mm	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 300 mm	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 375 mm	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 450 mm	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst - 200 mm	10%	20%	18%	8%	2,467	4,934	4,441	1,974	38,487
Pipe Burst - 250 mm	10%	20%	18%	8%	10,556	21,113	19,002	8,445	164,681
Pipe Burst - 300 mm	10%	20%	18%	8%	25,163	50,326	45,293	20,130	392,539
Pipe Burst - 375 mm	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 450 mm	10%	20%	3%	8%	0	0	0	0	0
EPR < 2 m Depth	10%	20%	3%	8%	0	0	0	0	0
EPR 2 - 3 m Depth	10%	20%	3%	8%	1,000	2,000	300	800	14,100
EPR 3 - 4 m Depth	10%	20%	3%	8%	0	0	0	0	0
EPR 4 - 5 m Depth	10%	20%	3%	8%	0	0	0	0	0
EPR > 5 m Depth	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 200 mm	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 250 mm	10%	20%	3%	8%	1,178	2,356	353	942	16,610
Excavated Replacement - 300 mm	10%	20%	3%	8%	4,141	8,283	1,242	3,313	58,394
Excavated Replacement - 375 mm	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 450 mm	10%	20%	3%	8%	0	0	0	0	0
Manhole Rehabilitation									
Replace Cover	10%	20%	3%	8%	1,240	2,480	372	992	17,484
Replace Frame/Ring	10%	20%	3%	8%	70	140	21	56	987
Structural Repair	10%	20%	3%	8%	600	1,200	180	480	8,460
Manhole Grouting	10%	20%	3%	8%	12,090	24,180	3,627	9,672	170,469
Service Connections									
Pipe Burst Private Only	10%	20%	3%	8%	113,035	226,070	33,911	90,428	1,593,794
Pipe Burst Public Only	10%	20%	3%	8%	83,096	166,192	24,929	66,477	1,171,654
Pipe Burst Entire Connection	10%	20%	3%	8%	0	0	0	0	0
Disconnect & Cap	10%	20%	3%	8%	66,025	132,050	19,808	52,820	930,953
Total					**490,275**	**980,549**	**270,989**	**392,220**	**7,036,779**

City of Victoria
James Bay I&I Reduction Pilot Project
Budget-Level Cost Estimate
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Concept A2

	Total Cost	
Field Services	229,280	4%
Mains & Manholes	1,788,444	28%
Public Service Connection	2,084,276	33%
Private Service Connection	1,213,996	19%
Public Direct Inflow	741,660	12%
Private Direct Inflow	256,338	4%
Total		**$6,313,994**

Task	Quantity Area 1	Area 2	Area 3	Area 4	Rehab Ratio Area 1	Area 2	Area 3	Area 4	Total Quantity	Units	Unit Cost $/unit	Subtotal $	Markup Factors 1 - Contractor Markup	2 - Contingency	3 - Indeterminate Items	4 - Mob, Bonding, Ins.	Factor Costs 1 - Contractor Markup $	2 - Contingency $	3 - Other $	4 - Mob, Bonding, Ins.	Total Cost $
Pre-Rehab Maintenance/Inspections																					
Flush/Clean/Post-Rehab Inspection	3,151	3,151	3,146	3,902				100%	3,902	lin.m	5	19,510	10%	20%	3%	8%	1,951	3,902	585	1,561	27,509
Service CCTV	262	304	299	349		100%	100%		603	each	200	120,600	10%	20%	3%	8%	12,060	24,120	3,618	9,648	170,046
Dye Testing	25	36	35	54	100%	100%	100%	100%	150	each	150	22,500	10%	20%	3%	8%	2,250	4,500	675	1,800	31,725
Direct Inflow Connections																					
Reconnect CB (Public)	13	18	24	36		100%	100%	100%	78	each	5000	390,000	10%	20%	3%	8%	39,000	78,000	11,700	31,200	549,900
Redirect Storm Drain (Private)	6	11	13	34		100%	100%		24	each	7500	180,000	10%	20%	3%	8%	18,000	36,000	5,400	14,400	253,800
Replace Cleanout Cap	6		5	7		100%	100%	100%	12	each	150	1,800	10%	20%	3%	8%	180	360	54	144	2,538
Remove Storm Overflow	0	2	1	14		100%	100%	100%	17	each	8000	136,000	10%	20%	3%	8%	13,600	27,200	4,080	10,880	191,760
Mainline Rehabilitation																					
Grout Pipe Joint (assume 0.6 m pipe length)	2,397	2,524	3,858	4,072				100%	4,072	each	60	244,341	10%	20%	10%	8%	24,434	48,868	24,434	19,547	361,625
Grout Service Interface	175	203	199	233		100%	100%	100%	635	each	550	349,067	10%	20%	10%	8%	34,907	69,813	34,907	27,925	516,619
CIPP Full Lining - 200 mm	1,225	1,458	1,304	1,152				100%	1,152	lin. m	180	207,321	10%	20%	18%	8%	20,732	41,464	37,318	16,586	323,421
CIPP Full Lining - 250 mm								100%	0	lin. m	195	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 300 mm			38					100%	0	lin. m	225	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 375 mm								100%	0	lin. m	240	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 450 mm								100%	0	lin. m	300	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Point Repair - 200 mm	10	5	5	7				100%	7	each	2500	17,500	10%	20%	3%	8%	1,750	3,500	525	1,400	24,675
CIPP Point Repair - 250 mm								100%	0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 300 mm								100%	0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 375 mm								100%	0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 450 mm								100%	0	each		0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst - 200 mm	62	332						100%	0	lin. m	400	0	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 250 mm	264	119		132				100%	132	lin. m	400	52,755	10%	20%	18%	8%	5,276	10,551	9,496	4,220	82,299
Pipe Burst - 300 mm	419			93				100%	93	lin. m	600	55,966	10%	20%	18%	8%	5,597	11,193	10,074	4,477	87,308
Pipe Burst - 375 mm				206				100%	206	lin. m	600	123,617	10%	20%	18%	8%	12,362	24,723	22,251	9,889	192,843
Pipe Burst - 450 mm								100%	0	lin. m	800	0	10%	20%	3%	8%	0	0	0	0	0
EPR < 2 m Depth								100%	0	each	4000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 2 - 3 m Depth	2	2	2					100%	0	each	5000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 3 - 4 m Depth								100%	0	each	6000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 4 - 5 m Depth								100%	0	each	8000	0	10%	20%	3%	8%	0	0	0	0	0
EPR > 5 m Depth								100%	0	each	9000	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 200 mm								100%	0	lin. m	950	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 250 mm	11		8					100%	0	lin. m	1050	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 300 mm	38							100%	0	lin. m	1100	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 375 mm								100%	0	lin. m	1200	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 450 mm								100%	0	lin. m	1300	0	10%	20%	3%	8%	0	0	0	0	0
	2,031	1,916	1,357	1,590																	
Manhole Rehabilitation	0.64	0.61	0.43	0.41																	
Replace Cover	62	49	58	57				100%	57	each	200	11,400	10%	20%	3%	8%	1,140	2,280	342	912	16,074
Replace Frame/Ring	2	3	0	3				100%	3	each	350	1,050	10%	20%	3%	8%	105	210	32	84	1,481
Structural Repair	3	3	0	9				100%	9	each	2000	18,000	10%	20%	3%	8%	1,800	3,600	540	1,440	25,380
Manhole Grouting	62	49	58	57				30%	17	each	6500	111,150	10%	20%	3%	8%	11,115	22,230	3,335	8,892	156,722
Service Connections																					
Pipe Burst Private Only	207	244	233	306			100%		233	each	3700	860,990	10%	20%	3%	8%	86,099	172,198	25,830	68,879	1,213,996
Pipe Burst Public Only	207	244	233	306		100%			244	each	3400	830,960	10%	20%	3%	8%	83,096	166,192	24,929	66,477	1,171,654
Pipe Burst Entire Connection	207	244	233	306					0	each	4600	0	10%	20%	3%	8%	0	0	0	0	0
Disconnect & Cap	143	114	145	151		100%	100%		259	each	2500	647,250	10%	20%	3%	8%	64,725	129,450	19,418	51,780	912,623
Total												**4,401,778**					**440,178**	**880,356**	**239,541**	**352,142**	**6,313,994**

City of Victoria
James Bay I&I Reduction Pilot Project
Budget-Level Cost Estimate
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Concept B1	Total Cost	
Field Services	139,668	3%
Mains & Manholes	1,781,448	36%
Public Service Connection	1,193,029	24%
Private Service Connection	792,589	16%
Public Direct Inflow	582,330	12%
Private Direct Inflow	478,625	10%
Total	**$4,967,689**	

Task	Quantity Area 1	Area 2	Area 3	Area 4	Rehab Ratio Area 1	Area 2	Area 3	Area 4	Total Quantity	Units	Unit Cost $/unit	Subtotal $	Markup Factors 1 - Contractor Markup	2 - Contingency	3 - Indeterminate Items	4 - Mob, Bonding, Ins.	Factor Costs 1 - Contractor Markup $	2 - Contingency $	3 - Other $	4 - Mob, Bonding, Ins.	Total Cost $
Pre-Rehab Maintenance/Inspections																					
Flush/Clean/Post-Rehab Inspection	3,151	3,151	3,146	3,902	100%				3,151	lin.m	5	15,755	10%	20%	3%	8%	1,576	3,151	473	1,260	22,215
Service CCTV	262	304	299	349		100%			304	each	200	60,800	10%	20%	3%	8%	6,080	12,160	1,824	4,864	85,728
Dye Testing	25	36	35	54	100%	100%	100%	100%	150	each	150	22,500	10%	20%	3%	8%	2,250	4,500	675	1,800	31,725
Direct Inflow Connections																					
Reconnect CB (Public)	13	18	24	26	100%	100%		100%	57	each	5000	285,000	10%	20%	3%	8%	28,500	57,000	8,550	22,800	401,850
Redirect Storm Drain (Private)	6	11	13	34		100%		100%	45	each	7500	337,500	10%	20%	3%	8%	33,750	67,500	10,125	27,000	475,875
Replace Cleanout Cap	6		5	7	100%	100%		100%	13	each	150	1,950	10%	20%	3%	8%	195	390	59	156	2,750
Remove Storm Overflow	0	2	1	14	100%	100%		100%	16	each	8000	128,000	10%	20%	3%	8%	12,800	25,600	3,840	10,240	180,480
Mainline Rehabilitation																					
Grout Pipe Joint (assume 0.6 m pipe length)	2,397	2,524	3,858	4,072	100%				2,397	each	60	143,828	10%	20%	10%	8%	14,383	28,766	14,383	11,506	212,866
Grout Service Interface	175	203	199	233	100%	100%			377	each	550	207,533	10%	20%	10%	8%	20,753	41,507	20,753	16,603	307,149
CIPP Full Lining - 200 mm	1,225	1,458	1,304	1,152	100%				1,225	lin. m	180	220,495	10%	20%	18%	8%	22,049	44,099	39,689	17,640	343,971
CIPP Full Lining - 250 mm					100%				0	lin. m	195	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 300 mm			38		100%				0	lin. m	225	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 375 mm					100%				0	lin. m	240	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 450 mm					100%				0	lin. m	300	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Point Repair - 200 mm	10	5	5	7	100%				10	each	2500	25,000	10%	20%	3%	8%	2,500	5,000	750	2,000	35,250
CIPP Point Repair - 250 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 300 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 375 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 450 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst - 200 mm	62	332			100%				62	lin. m	400	24,671	10%	20%	18%	8%	2,467	4,934	4,441	1,974	38,487
Pipe Burst - 250 mm	264	119		132	100%				264	lin. m	400	105,565	10%	20%	18%	8%	10,556	21,113	19,002	8,445	164,681
Pipe Burst - 300 mm	419			93	100%				419	lin. m	600	251,628	10%	20%	18%	8%	25,163	50,326	45,293	20,130	392,539
Pipe Burst - 375 mm				206	100%				0	lin. m	600	0	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 450 mm					100%				0	lin. m	800	0	10%	20%	3%	8%	0	0	0	0	0
EPR < 2 m Depth					100%				0	each	4000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 2 - 3 m Depth	2	2	2		100%				2	each	5000	10,000	10%	20%	3%	8%	1,000	2,000	300	800	14,100
EPR 3 - 4 m Depth					100%				0	each	6000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 4 - 5 m Depth					100%				0	each	8000	0	10%	20%	3%	8%	0	0	0	0	0
EPR > 5 m Depth					100%				0	each	9000	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 200 mm					100%				0	lin. m	950	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 250 mm	11		8		100%				11	lin. m	1050	11,780	10%	20%	3%	8%	1,178	2,356	353	942	16,610
Excavated Replacement - 300 mm	38				100%				38	lin. m	1100	41,414	10%	20%	3%	8%	4,141	8,283	1,242	3,313	58,394
Excavated Replacement - 375 mm					100%				0	lin. m	1200	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 450 mm					100%				0	lin. m	1300	0	10%	20%	3%	8%	0	0	0	0	0
	2,031	1,916	1,357	1,590																	
Manhole Rehabilitation	0.64	0.61	0.43	0.41																	
Replace Cover	62	49	58	57	100%				62	each	200	12,400	10%	20%	3%	8%	1,240	2,480	372	992	17,484
Replace Frame/Ring	2	3	0	3	100%				2	each	350	700	10%	20%	3%	8%	70	140	21	56	987
Structural Repair	3	3	0	9	100%				3	each	2000	6,000	10%	20%	3%	8%	600	1,200	180	480	8,460
Manhole Grouting	62	49	58	57	30%				19	each	6500	120,900	10%	20%	3%	8%	12,090	24,180	3,627	9,672	170,469
Service Connections																					
Pipe Burst Private Only	207	244	233	306					0	each	3700	0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst Public Only	207	244	233	306					0	each	3400	0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst Entire Connection	207	244	233	306		100%			244	each	4600	1,124,240	10%	20%	3%	8%	112,424	224,848	33,727	89,939	1,585,178
Disconnect & Cap	143	114	145	151		100%			114	each	2500	284,000	10%	20%	3%	8%	28,400	56,800	8,520	22,720	400,440
Total												**3,441,659**					**344,166**	**688,332**	**218,199**	**275,333**	**4,967,689**

City of Victoria
James Bay I&I Reduction Pilot Project
Budget-Level Cost Estimate
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Concept B2	Total Cost	
Field Services	138,258	3%
Mains & Manholes	1,432,289	34%
Public Service Connection	1,266,829	30%
Private Service Connection	754,646	18%
Public Direct Inflow	421,590	10%
Private Direct Inflow	203,252	5%
Total		**$4,216,862**

Task	**Quantity Area 1**	**Area 2**	**Area 3**	**Area 4**	**Rehab Ratio Area 1**	**Area 2**	**Area 3**	**Area 4**	**Total Quantity**	**Units**	**Unit Cost $/unit**	**Subtotal $**	**Markup Factors 1 - Contractor Markup**	**2 - Contingency**	**3 - Indeterminate Items**	**4 - Mob, Bonding, Ins.**	**Factor Costs 1 - Contractor Markup $**	**2 - Contingency $**	**3 - Other $**	**4 - Mob, Bonding, Ins.**	**Total Cost $**
Pre-Rehab Maintenance/Inspections																					
Flush/Clean/Post-Rehab Inspection	3,151	3,151	3,146	3,902		100%			3,151	lin.m	5	15,755	10%	20%	3%	8%	1,576	3,151	473	1,260	22,215
Service CCTV	262	304	299	349			100%		299	each	200	59,800	10%	20%	3%	8%	5,980	11,960	1,794	4,784	84,318
Dye Testing	25	36	35	54	100%	100%	100%	100%	150	each	150	22,500	10%	20%	3%	8%	2,250	4,500	675	1,800	31,725
Direct Inflow Connections																					
Reconnect CB (Public)	13	18	24	36	100%	100%	100%		55	each	5000	275,000	10%	20%	3%	8%	27,500	55,000	8,250	22,000	387,750
Redirect Storm Drain (Private)	6	11	13	34	100%		100%		19	each	7500	142,500	10%	20%	3%	8%	14,250	28,500	4,275	11,400	200,925
Replace Cleanout Cap	6		5	7	100%	100%	100%		11	each	150	1,650	10%	20%	3%	8%	165	330	50	132	2,327
Remove Storm Overflow	0	2	1	14	100%	100%	100%		3	each	8000	24,000	10%	20%	3%	8%	2,400	4,800	720	1,920	33,840
Mainline Rehabilitation																					
Grout Pipe Joint (assume 0.6 m pipe length)	2,397	2,524	3,858	4,072		100%			2,524	each	60	151,433	10%	20%	10%	8%	15,143	30,287	15,143	12,115	224,121
Grout Service Interface	175	203	199	233		100%	100%		402	each	550	221,100	10%	20%	10%	8%	22,110	44,220	22,110	17,688	327,228
CIPP Full Lining - 200 mm	1,225	1,458	1,304	1,152		100%			1,458	lin. m	180	262,386	10%	20%	18%	8%	26,239	52,477	47,229	20,991	409,322
CIPP Full Lining - 250 mm						100%			0	lin. m	195	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 300 mm			38			100%			0	lin. m	225	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 375 mm						100%			0	lin. m	240	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 450 mm						100%			0	lin. m	300	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Point Repair - 200 mm	10	5	5	7		100%			5	each	2500	12,500	10%	20%	3%	8%	1,250	2,500	375	1,000	17,625
CIPP Point Repair - 250 mm						100%			0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 300 mm						100%			0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 375 mm						100%			0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 450 mm						100%			0	each		0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst - 200 mm	62	332				100%			332	lin. m	400	132,774	10%	20%	18%	8%	13,277	26,555	23,899	10,622	207,127
Pipe Burst - 250 mm	264	119		132		100%			119	lin. m	400	47,617	10%	20%	18%	8%	4,762	9,523	8,571	3,809	74,283
Pipe Burst - 300 mm	419			93		100%			0	lin. m	600	0	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 375 mm				206		100%			0	lin. m	600	0	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 450 mm						100%			0	lin. m	800	0	10%	20%	3%	8%	0	0	0	0	0
EPR < 2 m Depth						100%			0	each	4000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 2 - 3 m Depth	2	2	2			100%			2	each	5000	10,000	10%	20%	3%	8%	1,000	2,000	300	800	14,100
EPR 3 - 4 m Depth						100%			0	each	6000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 4 - 5 m Depth						100%			0	each	8000	0	10%	20%	3%	8%	0	0	0	0	0
EPR > 5 m Depth						100%			0	each	9000	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 200 mm						100%			0	lin. m	950	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 250 mm	11		8			100%			0	lin. m	1050	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 300 mm	38					100%			0	lin. m	1100	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 375 mm						100%			0	lin. m	1200	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 450 mm						100%			0	lin. m	1300	0	10%	20%	3%	8%	0	0	0	0	0
	2,031	1,916	1,357	1,590																	
Manhole Rehabilitation	0.64	0.61	0.43	0.41																	
Replace Cover	62	49	58	57		100%			49	each	200	9,800	10%	20%	3%	8%	980	1,960	294	784	13,818
Replace Frame/Ring	2	3	0	3		100%			3	each	350	1,050	10%	20%	3%	8%	105	210	32	84	1,481
Structural Repair	3	3	0	9		100%			3	each	2000	6,000	10%	20%	3%	8%	600	1,200	180	480	8,460
Manhole Grouting	62	49	58	57		30%			15	each	6500	95,550	10%	20%	3%	8%	9,555	19,110	2,867	7,644	134,726
Service Connections																					
Pipe Burst Private Only	207	244	233	306					0	each	3700	0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst Public Only	207	244	233	306					0	each	3400	0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst Entire Connection	207	244	233	306			100%		233	each	4600	1,070,420	10%	20%	3%	8%	107,042	214,084	32,113	85,634	1,509,292
Disconnect & Cap	143	114	145	151			100%		145	each	2500	363,250	10%	20%	3%	8%	36,325	72,650	10,898	29,060	512,183
Total												**2,925,084**					**292,508**	**585,017**	**180,246**	**234,007**	**4,216,862**

City of Victoria
James Bay I&I Reduction Pilot Project
Budget-Level Cost Estimate
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Concept C1	Total Cost	
Field Services	139,668	3%
Mains & Manholes	1,781,448	36%
Public Service Connection	1,193,029	24%
Private Service Connection	792,589	16%
Public Direct Inflow	503,370	10%
Private Direct Inflow	478,625	10%
Total		**$4,888,729**

Task	**Quantity Area 1**	**Area 2**	**Area 3**	**Area 4**	**Rehab Ratio Area 1**	**Area 2**	**Area 3**	**Area 4**	**Total Quantity**	**Units**	**Unit Cost $/unit**	**Subtotal $**	**Markup Factors 1 - Contractor Markup**	**2 - Contingency**	**3 - Indeterminate Items**	**4 - Mob, Bonding, Ins.**	**Factor Costs 1 - Contractor Markup $**	**2 - Contingency $**	**3 - Other $**	**4 - Mob, Bonding, Ins.**	**Total Cost $**
Pre-Rehab Maintenance/Inspections																					
Flush/Clean/Post-Rehab Inspection	3,151	3,151	3,146	3,902	100%				3,151	lin.m	5	15,755	10%	20%	3%	8%	1,576	3,151	473	1,260	22,215
Service CCTV	262	304	299	349		100%			304	each	200	60,800	10%	20%	3%	8%	6,080	12,160	1,824	4,864	85,728
Dye Testing	25	36	35	54	100%	100%	100%	100%	150	each	150	22,500	10%	20%	3%	8%	2,250	4,500	675	1,800	31,725
Direct Inflow Connections																					
Reconnect CB (Public)	13	18	24	36	100%			100%	49	each	5000	245,000	10%	20%	3%	8%	24,500	49,000	7,350	19,600	345,450
Redirect Storm Drain (Private)	6	11	13	34		100%		100%	45	each	7500	337,500	10%	20%	3%	8%	33,750	67,500	10,125	27,000	475,875
Replace Cleanout Cap	6		5	7	100%	100%		100%	13	each	150	1,950	10%	20%	3%	8%	195	390	59	156	2,750
Remove Storm Overflow	0	2	1	14	100%			100%	14	each	8000	112,000	10%	20%	3%	8%	11,200	22,400	3,360	8,960	157,920
Mainline Rehabilitation																					
Grout Pipe Joint (assume 0.6 m pipe length)	2,397	2,524	3,858	4,072	100%				2,397	each	60	143,828	10%	20%	10%	8%	14,383	28,766	14,383	11,506	212,866
Grout Service Interface	175	203	199	233	100%	100%			377	each	550	207,533	10%	20%	10%	8%	20,753	41,507	20,753	16,603	307,149
CIPP Full Lining - 200 mm	1,225	1,458	1,304	1,152	100%				1,225	lin. m	180	220,495	10%	20%	18%	8%	22,049	44,099	39,689	17,640	343,971
CIPP Full Lining - 250 mm					100%				0	lin. m	195	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 300 mm			38		100%				0	lin. m	225	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 375 mm					100%				0	lin. m	240	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 450 mm					100%				0	lin. m	300	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Point Repair - 200 mm	10	5	5	7	100%				10	each	2500	25,000	10%	20%	3%	8%	2,500	5,000	750	2,000	35,250
CIPP Point Repair - 250 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 300 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 375 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 450 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst - 200 mm	62	332			100%				62	lin. m	400	24,671	10%	20%	18%	8%	2,467	4,934	4,441	1,974	38,487
Pipe Burst - 250 mm	264	119		132	100%				264	lin. m	400	105,565	10%	20%	18%	8%	10,556	21,113	19,002	8,445	164,681
Pipe Burst - 300 mm	419			93	100%				419	lin. m	600	251,628	10%	20%	18%	8%	25,163	50,326	45,293	20,130	392,539
Pipe Burst - 375 mm				206	100%				0	lin. m	600	0	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 450 mm					100%				0	lin. m	800	0	10%	20%	3%	8%	0	0	0	0	0
EPR < 2 m Depth					100%				0	each	4000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 2 - 3 m Depth	2	2	2		100%				2	each	5000	10,000	10%	20%	3%	8%	1,000	2,000	300	800	14,100
EPR 3 - 4 m Depth					100%				0	each	6000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 4 - 5 m Depth					100%				0	each	8000	0	10%	20%	3%	8%	0	0	0	0	0
EPR > 5 m Depth					100%				0	each	9000	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 200 mm					100%				0	lin. m	950	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 250 mm	11		8		100%				11	lin. m	1050	11,780	10%	20%	3%	8%	1,178	2,356	353	942	16,610
Excavated Replacement - 300 mm	38				100%				38	lin. m	1100	41,414	10%	20%	3%	8%	4,141	8,283	1,242	3,313	58,394
Excavated Replacement - 375 mm					100%				0	lin. m	1200	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 450 mm					100%				0	lin. m	1300	0	10%	20%	3%	8%	0	0	0	0	0
	2,031	1,916	1,357	1,590																	
Manhole Rehabilitation	0.64	0.61	0.43	0.41																	
Replace Cover	62	49	58	57	100%				62	each	200	12,400	10%	20%	3%	8%	1,240	2,480	372	992	17,484
Replace Frame/Ring	2	3	0	3	100%				2	each	350	700	10%	20%	3%	8%	70	140	21	56	987
Structural Repair	3	3	0	9	100%				3	each	2000	6,000	10%	20%	3%	8%	600	1,200	180	480	8,460
Manhole Grouting	62	49	58	57	30%				19	each	6500	120,900	10%	20%	3%	8%	12,090	24,180	3,627	9,672	170,469
Service Connections																					
Pipe Burst Private Only	207	244	233	306					0	each	3700	0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst Public Only	207	244	233	306					0	each	3400	0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst Entire Connection	207	244	233	306		100%			244	each	4600	1,124,240	10%	20%	3%	8%	112,424	224,848	33,727	89,939	1,585,178
Disconnect & Cap	143	114	145	151		100%			114	each	2500	284,000	10%	20%	3%	8%	28,400	56,800	8,520	22,720	400,440
Total												**3,385,659**					**338,566**	**677,132**	**216,519**	**270,853**	**4,888,729**

City of Victoria
James Bay I&I Reduction Pilot Project
Budget-Level Cost Estimate
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Concept C2	Total Cost	
Field Services	138,258	3%
Mains & Manholes	1,778,735	43%
Public Service Connection	512,183	12%
Private Service Connection	1,213,996	29%
Public Direct Inflow	241,110	6%
Private Direct Inflow	256,127	6%
Total		**$4,140,407**

Task	**Quantity Area 1**	**Area 2**	**Area 3**	**Area 4**	**Rehab Ratio Area 1**	**Area 2**	**Area 3**	**Area 4**	**Total Quantity**	**Units**	**Unit Cost $/unit**	**Subtotal $**	**Markup Factors 1 - Contractor Markup**	**2 - Contingency**	**3 - Indeterminate Items**	**4 - Mob, Bonding, Ins.**	**Factor Costs 1 - Contractor Markup $**	**2 - Contingency $**	**3 - Other $**	**4 - Mob, Bonding, Ins.**	**Total Cost $**
Pre-Rehab Maintenance/Inspections																					
Flush/Clean/Post-Rehab Inspection	3,151	3,151	3,146	3,902	100%				3,151	lin.m	5	15,755	10%	20%	3%	8%	1,576	3,151	473	1,260	22,215
Service CCTV	262	304	299	349			100%		299	each	200	59,800	10%	20%	3%	8%	5,980	11,960	1,794	4,784	84,318
Dye Testing	25	36	35	54	100%	100%	100%	100%	150	each	150	22,500	10%	20%	3%	8%	2,250	4,500	675	1,800	31,725
Direct Inflow Connections																					
Reconnect CB (Public)	13	18	24	36	100%	100%			31	each	5000	155,000	10%	20%	3%	8%	15,500	31,000	4,650	12,400	218,550
Redirect Storm Drain (Private)	6	11	13	34		100%	100%		24	each	7500	180,000	10%	20%	3%	8%	18,000	36,000	5,400	14,400	253,800
Replace Cleanout Cap	6		5	7	100%	100%	100%		11	each	150	1,650	10%	20%	3%	8%	165	330	50	132	2,327
Remove Storm Overflow	0	2	1	14	100%	100%			2	each	8000	16,000	10%	20%	3%	8%	1,600	3,200	480	1,280	22,560
Mainline Rehabilitation																					
Grout Pipe Joint (assume 0.6 m pipe length)	2,397	2,524	3,858	4,072	100%				2,397	each	60	143,828	10%	20%	10%	8%	14,383	28,766	14,383	11,506	212,866
Grout Service Interface	175	203	199	233	100%		100%		374	each	550	205,700	10%	20%	10%	8%	20,570	41,140	20,570	16,456	304,436
CIPP Full Lining - 200 mm	1,225	1,458	1,304	1,152	100%				1,225	lin. m	180	220,495	10%	20%	18%	8%	22,049	44,099	39,689	17,640	343,971
CIPP Full Lining - 250 mm					100%				0	lin. m	195	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 300 mm			38		100%				0	lin. m	225	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 375 mm					100%				0	lin. m	240	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 450 mm					100%				0	lin. m	300	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Point Repair - 200 mm	10	5	5	7	100%				10	each	2500	25,000	10%	20%	3%	8%	2,500	5,000	750	2,000	35,250
CIPP Point Repair - 250 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 300 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 375 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 450 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst - 200 mm	62	332			100%				62	lin. m	400	24,671	10%	20%	18%	8%	2,467	4,934	4,441	1,974	38,487
Pipe Burst - 250 mm	264	119		132	100%				264	lin. m	400	105,565	10%	20%	18%	8%	10,556	21,113	19,002	8,445	164,681
Pipe Burst - 300 mm	419			93	100%				419	lin. m	600	251,628	10%	20%	18%	8%	25,163	50,326	45,293	20,130	392,539
Pipe Burst - 375 mm				206	100%				0	lin. m	600	0	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 450 mm					100%				0	lin. m	800	0	10%	20%	3%	8%	0	0	0	0	0
EPR < 2 m Depth					100%				0	each	4000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 2 - 3 m Depth	2	2	2		100%				2	each	5000	10,000	10%	20%	3%	8%	1,000	2,000	300	800	14,100
EPR 3 - 4 m Depth					100%				0	each	6000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 4 - 5 m Depth					100%				0	each	8000	0	10%	20%	3%	8%	0	0	0	0	0
EPR > 5 m Depth					100%				0	each	9000	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 200 mm					100%				0	lin. m	950	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 250 mm	11		8		100%				11	lin. m	1050	11,780	10%	20%	3%	8%	1,178	2,356	353	942	16,610
Excavated Replacement - 300 mm	38				100%				38	lin. m	1100	41,414	10%	20%	3%	8%	4,141	8,283	1,242	3,313	58,394
Excavated Replacement - 375 mm					100%				0	lin. m	1200	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 450 mm					100%				0	lin. m	1300	0	10%	20%	3%	8%	0	0	0	0	0
	2,031	1,916	1,357	1,590																	
Manhole Rehabilitation	0.64	0.61	0.43	0.41																	
Replace Cover	62	49	58	57	100%				62	each	200	12,400	10%	20%	3%	8%	1,240	2,480	372	992	17,484
Replace Frame/Ring	2	3	0	3	100%				2	each	350	700	10%	20%	3%	8%	70	140	21	56	987
Structural Repair	3	3	0	9	100%				3	each	2000	6,000	10%	20%	3%	8%	600	1,200	180	480	8,460
Manhole Grouting	62	49	58	57	30%				19	each	6500	120,900	10%	20%	3%	8%	12,090	24,180	3,627	9,672	170,469
Service Connections																					
Pipe Burst Private Only	207	244	233	306			100%		233	each	3700	860,990	10%	20%	3%	8%	86,099	172,198	25,830	68,879	1,213,996
Pipe Burst Public Only	207	244	233	306					0	each	3400	0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst Entire Connection	207	244	233	306					0	each	4600	0	10%	20%	3%	8%	0	0	0	0	0
Disconnect & Cap	143	114	145	151			100%		145	each	2500	363,250	10%	20%	3%	8%	36,325	72,650	10,898	29,060	512,183
Total												**2,855,026**					**285,503**	**571,005**	**200,472**	**228,402**	**4,140,407**

City of Victoria
James Bay I&I Reduction Pilot Project
Budget-Level Cost Estimate
O:\0800-0899\809-032\700-CostEstimate\[I&IReductionPlanner_20081211.xls]ConceptB3

Concept B3 - With Optional Abd. Services	Total Cost	
Field Services	135,106	4%
Mains & Manholes	969,323	30%
Public Service Connection	947,003	30%
Private Service Connection	365,378	11%
Public Direct Inflow	414,540	13%
Private Direct Inflow	370,100	12%
Total		**$3,201,449**

Task	Quantity Area 1	Area 2	Area 3	Area 4	Rehab Ratio Area 1	Area 2	Area 3	Area 4	Total Quantity	Units	Unit Cost $/unit	Subtotal $	Markup Factors 1 - Contractor Markup	2 - Contingency	3 - Indeterminate Items	4 - Mob, Bonding, Ins.	Factor Costs 1 - Contractor Markup $	2 - Contingency $	3 - Other $	4 - Mob, Bonding, Ins.	Total Cost $
Pre-Rehab Maintenance/Inspections																					
Flush/Clean/Post-Rehab Inspection	1,474	3,151	3,146	3,902	100%				1,474	lin.m	5	7,370	10%	20%	3%	8%	737	1,474	221	590	10,392
Service CCTV	262	304	299	349			100%		299	each	200	59,800	10%	20%	3%	8%	5,980	11,960	1,794	4,784	84,318
Dye Testing	25	36	35	95	100%	100%	100%	100%	191	each	150	28,650	10%	20%	3%	8%	2,865	5,730	860	2,292	40,397
Direct Inflow Connections																					
Reconnect CB (Public)	13	18	12	26			100%	100%	38	each	5000	190,000	10%	20%	3%	8%	19,000	38,000	5,700	15,200	267,900
Redirect Storm Drain (Private)	6	11	5	26			100%	100%	31	each	7500	232,500	10%	20%	20%	8%	23,250	46,500	46,500	18,600	367,350
Replace Cleanout Cap	6		6	7			100%	100%	13	each	150	1,950	10%	20%	3%	8%	195	390	59	156	2,750
Remove Storm Overflow	0	2	0	13			100%	100%	13	each	8000	104,000	10%	20%	3%	8%	10,400	20,800	3,120	8,320	146,640
Mainline Rehabilitation																					
Grout Pipe Joint (assume 0.6 m pipe length)	684				100%				684	each	60	41,030	10%	20%	10%	8%	4,103	8,206	4,103	3,282	60,724
Grout Service Interface	74		113		100%		100%		186	each	550	102,502	10%	20%	10%	8%	10,250	20,500	10,250	8,200	151,702
CIPP Full Lining - 200 mm	516				100%				516	lin. m	180	92,880	10%	20%	18%	8%	9,288	18,576	16,718	7,430	144,893
CIPP Full Lining - 250 mm					100%				0	lin. m	195	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 300 mm					100%				0	lin. m	225	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 375 mm					100%				0	lin. m	240	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 450 mm					100%				0	lin. m	300	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Point Repair - 200 mm	3				100%				3	each	2500	7,500	10%	20%	3%	8%	750	1,500	225	600	10,575
CIPP Point Repair - 250 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 300 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 375 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 450 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst - 200 mm					100%				0	lin. m	400	0	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 250 mm					100%				0	lin. m	400	0	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 300 mm	419				100%				419	lin. m	600	251,400	10%	20%	18%	8%	25,140	50,280	45,252	20,112	392,184
Pipe Burst - 375 mm					100%				0	lin. m	600	0	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 450 mm					100%				0	lin. m	800	0	10%	20%	3%	8%	0	0	0	0	0
EPR < 2 m Depth					100%				0	each	4000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 2 - 3 m Depth					100%				0	each	5000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 3 - 4 m Depth					100%				0	each	6000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 4 - 5 m Depth					100%				0	each	8000	0	10%	20%	3%	8%	0	0	0	0	0
EPR > 5 m Depth					100%				0	each	9000	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 200 mm	12				100%				12	lin. m	950	11,400	10%	20%	3%	8%	1,140	2,280	342	912	16,074
Excavated Replacement - 250 mm					100%				0	lin. m	1050	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 300 mm	40				100%				40	lin. m	1100	44,000	10%	20%	3%	8%	4,400	8,800	1,320	3,520	62,040
Excavated Replacement - 375 mm					100%				0	lin. m	1200	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 450 mm					100%				0	lin. m	1300	0	10%	20%	3%	8%	0	0	0	0	0
	990	0	0	0																	
Manhole Rehabilitation	0.67	0.00	0.00	0.00																	
Vent Liner	10				100%				10	each	1500	15,000	10%	20%	3%	8%	1,500	3,000	450	1,200	21,150
Replace Frame/Ring									0	each	350	0	10%	20%	3%	8%	0	0	0	0	0
Structural Repair									0	each	2000	0	10%	20%	3%	8%	0	0	0	0	0
Manhole Coating	12				100%				12	each	6500	78,000	10%	20%	3%	8%	7,800	15,600	2,340	6,240	109,980
Service Connections																					
Pipe Burst Private Only									0	each	3700	0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst Public Only									0	each	3400	0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst Entire Connection			113				100%		113	each	4600	518,267	10%	20%	3%	8%	51,827	103,653	15,548	41,461	730,756
Disconnect & Cap			165				100%		165	each	2500	412,500	10%	20%	3%	8%	41,250	82,500	12,375	33,000	581,625
Total												**2,198,748**					**219,875**	**439,750**	**167,177**	**175,900**	**3,201,449**

City of Victoria
James Bay I&I Reduction Pilot Project
Budget-Level Cost Estimate
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Concept B3 - Without Optional Abd. Services

	Total Cost	
Field Services	135,106	4%
Mains & Manholes	969,323	32%
Public Service Connection	761,353	25%
Private Service Connection	365,378	12%
Public Direct Inflow	414,540	14%
Private Direct Inflow	370,100	12%
Total	**$3,015,799**	

Task	Quantity Area 1	Area 2	Area 3	Area 4	Rehab Ratio Area 1	Area 2	Area 3	Area 4	Total Quantity	Units	Unit Cost $/unit	Subtotal $	Markup Factors 1 - Contractor Markup	2 - Contingency	3 - Indeterminate Items	4 - Mob, Bonding, Ins.	Factor Costs 1 - Contractor Markup $	2 - Contingency $	3 - Other $	4 - Mob, Bonding, Ins.	Total Cost $
Pre-Rehab Maintenance/Inspections																					
Flush/Clean/Post-Rehab Inspection	1,474	3,151	3,146	3,902	100%				1,474	lin.m	5	7,370	10%	20%	3%	8%	737	1,474	221	590	10,392
Service CCTV	262	304	299	349			100%		299	each	200	59,800	10%	20%	3%	8%	5,980	11,960	1,794	4,784	84,318
Dye Testing	25	36	35	95	100%	100%	100%	100%	191	each	150	28,650	10%	20%	3%	8%	2,865	5,730	860	2,292	40,397
Direct Inflow Connections																					
Reconnect CB (Public)	13	18	12	26			100%	100%	38	each	5000	190,000	10%	20%	3%	8%	19,000	38,000	5,700	15,200	267,900
Redirect Storm Drain (Private)	6	11	5	26			100%	100%	31	each	7500	232,500	10%	20%	20%	8%	23,250	46,500	46,500	18,600	367,350
Replace Cleanout Cap	6		6	7			100%	100%	13	each	150	1,950	10%	20%	3%	8%	195	390	59	156	2,750
Remove Storm Overflow	0	2	0	13			100%	100%	13	each	8000	104,000	10%	20%	3%	8%	10,400	20,800	3,120	8,320	146,640
Mainline Rehabilitation																					
Grout Pipe Joint (assume 0.6 m pipe length)	684				100%				684	each	60	41,030	10%	20%	10%	8%	4,103	8,206	4,103	3,282	60,724
Grout Service Interface	74		113		100%		100%		186	each	550	102,502	10%	20%	10%	8%	10,250	20,500	10,250	8,200	151,702
CIPP Full Lining - 200 mm	516				100%				516	lin. m	180	92,880	10%	20%	18%	8%	9,288	18,576	16,718	7,430	144,893
CIPP Full Lining - 250 mm					100%				0	lin. m	195	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 300 mm					100%				0	lin. m	225	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 375 mm					100%				0	lin. m	240	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Full Lining - 450 mm					100%				0	lin. m	300	0	10%	20%	18%	8%	0	0	0	0	0
CIPP Point Repair - 200 mm	3				100%				3	each	2500	7,500	10%	20%	3%	8%	750	1,500	225	600	10,575
CIPP Point Repair - 250 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 300 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 375 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
CIPP Point Repair - 450 mm					100%				0	each		0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst - 200 mm					100%				0	lin. m	400	0	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 250 mm					100%				0	lin. m	400	0	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 300 mm	419				100%				419	lin. m	600	251,400	10%	20%	18%	8%	25,140	50,280	45,252	20,112	392,184
Pipe Burst - 375 mm					100%				0	lin. m	600	0	10%	20%	18%	8%	0	0	0	0	0
Pipe Burst - 450 mm					100%				0	lin. m	800	0	10%	20%	3%	8%	0	0	0	0	0
EPR < 2 m Depth					100%				0	each	4000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 2 - 3 m Depth					100%				0	each	5000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 3 - 4 m Depth					100%				0	each	6000	0	10%	20%	3%	8%	0	0	0	0	0
EPR 4 - 5 m Depth					100%				0	each	8000	0	10%	20%	3%	8%	0	0	0	0	0
EPR > 5 m Depth					100%				0	each	9000	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 200 mm	12				100%				12	lin. m	950	11,400	10%	20%	3%	8%	1,140	2,280	342	912	16,074
Excavated Replacement - 250 mm					100%				0	lin. m	1050	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 300 mm	40				100%				40	lin. m	1100	44,000	10%	20%	3%	8%	4,400	8,800	1,320	3,520	62,040
Excavated Replacement - 375 mm					100%				0	lin. m	1200	0	10%	20%	3%	8%	0	0	0	0	0
Excavated Replacement - 450 mm					100%				0	lin. m	1300	0	10%	20%	3%	8%	0	0	0	0	0
	990	0	0	0																	
Manhole Rehabilitation	0.67	0.00	0.00	0.00																	
Vent Liner	10				100%				10	each	1500	15,000	10%	20%	3%	8%	1,500	3,000	450	1,200	21,150
Replace Frame/Ring									0	each	350	0	10%	20%	3%	8%	0	0	0	0	0
Structural Repair									0	each	2000	0	10%	20%	3%	8%	0	0	0	0	0
Manhole Coating	12				100%				12	each	6500	78,000	10%	20%	3%	8%	7,800	15,600	2,340	6,240	109,980
Service Connections																					
Pipe Burst Private Only									0	each	3700	0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst Public Only									0	each	3400	0	10%	20%	3%	8%	0	0	0	0	0
Pipe Burst Entire Connection			113				100%		113	each	4600	518,267	10%	20%	3%	8%	51,827	103,653	15,548	41,461	730,756
Disconnect & Cap			112				100%		112	each	2500	280,833	10%	20%	3%	8%	28,083	56,167	8,425	22,467	395,975
Total												**2,067,082**					**206,708**	**413,416**	**163,227**	**165,367**	**3,015,799**

APPENDIX F

DISCUSSION PAPER: COSTS VERSES BENEFITS OF REDUCING INFLOW AND INFILTRATION

Making a difference...together

DISCUSSION PAPER

Capital Regional District
Core Area
Wastewater Management Program

Cost versus Benefit
of Reducing Inflow and Infiltration

Prepared by:
Engineering Design Services
Environmental Services

March 2009

Capital Regional District
Core Area Wastewater Management Program

Cost vs. Benefit of Reducing Inflow and Infiltration

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1.0 INTRODUCTION AND OVERVIEW

1.1 Background

The Core Area of the Capital Regional District (CRD) is a partnership of seven local governments and two First Nation areas with a total land area of about 215 square kilometers that makeup the majority of Greater Victoria, located at the southern tip of Vancouver Island. The CRD provides services that are regional in nature including the sewage system which serves some 320,000 people in the core area.

The Core Area sewerage system is primarily serviced by the northwest trunk (NWT) sewer (northern and western legs) and the northeast trunk/east coast interceptor (NET/ECI).

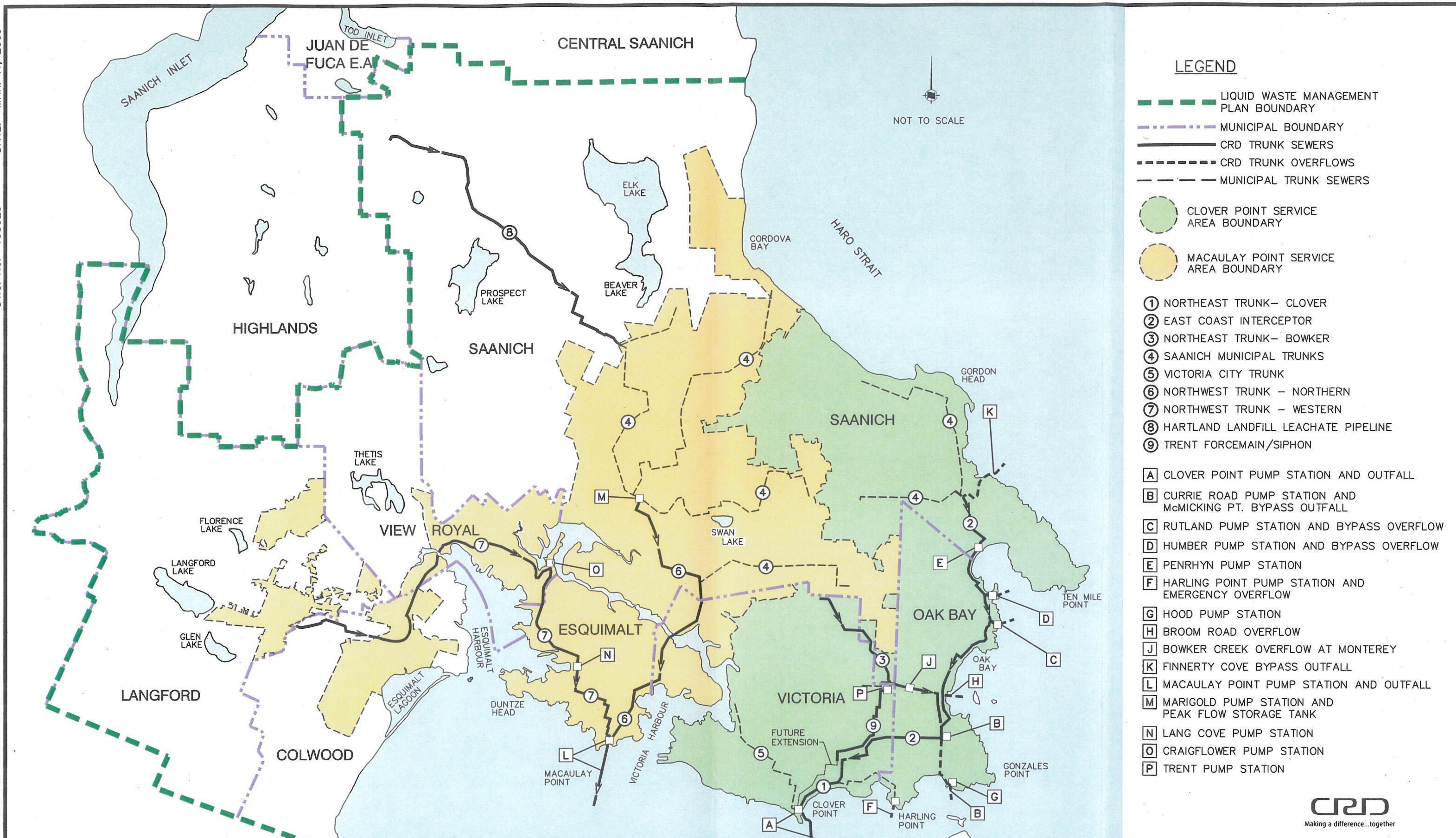
These trunk sewer systems have a total approximate length of 55 km, and are mostly reinforced concrete with some brick, high density polyethylene (HDPE), polyvinyl chloride (PVC), steel, and ductile iron mains (some of which are pressurized forcemains or inverted siphons). Pipe diameters range from 400mm to 1200mm. Due to undulating topography and subsurface conditions, 12 pump stations (including Macaulay Point and Clover Point pump stations/deep sea outfalls) provide service to the Macaulay and Clover Point service areas as shown on Figure 1.1.

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

The Core Area Liquid Waste Management Plan (LWMP), submitted to and approved by the Province in 2000 and 2003, respectively, triggered new design criteria for the sewage system to reduce and eventually eliminate sanitary sewer overflows that occur during 5-year storm events, consistent with the Municipal Sewage Regulation.

Therefore, in addition to meeting the commitments outlined in Chapter 13, Management of Wastewater Overflows, the CRD is also working towards its Inflow and Infiltration commitments in Chapter 8 of the LWMP, which will greatly assist in meeting the overflow requirements.

DWG. No. 13S023 DATE: MAR. 11, 2009



CORE AREA I&I PROGRAM

FIGURE 1.1

EXISTING CORE AREA WASTEWATER INFRASTRUCTURE

Capital Regional District | Environmental Services

1.2 Sanitary Sewer System

Sanitary sewer collection systems receive wastewater from buildings (i.e., from sinks, toilets, showers, washing machines, etc.) and convey it to sewage facilities. Sanitary sewers play a critical role in protecting human health and the environment in developed areas. Within the Core Area of the CRD, the collection system is generally defined and operated as follows:

- Sewer laterals convey wastewater from buildings to the municipal sewers. These "connections" are commonly constructed of vitrified clay, concrete, asbestos cement (no longer acceptable), and polyvinyl chloride (PVC) plastic pipe. Building connections are usually made on about 2% grade with 100mm or larger pipe.

  Individual private property owners are 100% responsible for the portion of the lateral that is located on their property and, with the exception of Oak Bay, the remainder of the lateral from the property line to the public sewer is owned and maintained by the municipality. In Oak Bay's case, the entire lateral from the building to the public sewer main is the private property owner's responsibility.

- Collection sewers gather flows from individual buildings and transport the sewage to a larger trunk sewer, municipal pump station or regional sewer. Collection sewers are usually located under the street on one side of the storm drain. They should be capable of conveying the peak domestic, commercial, industrial, and institutional flows plus an allowance for inflow and infiltration (I&I) of the area they are intended to serve. Manholes are normally located at changes in direction, grade, pipe size, or at intersections of collecting sewers. Generally, manholes should not be spaced farther than 120m apart to permit inspection and cleaning when necessary. Similar to sewer laterals, the pipe materials for these sewers are vitrified clay, concrete, asbestos cement and PVC plastic pipe.

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

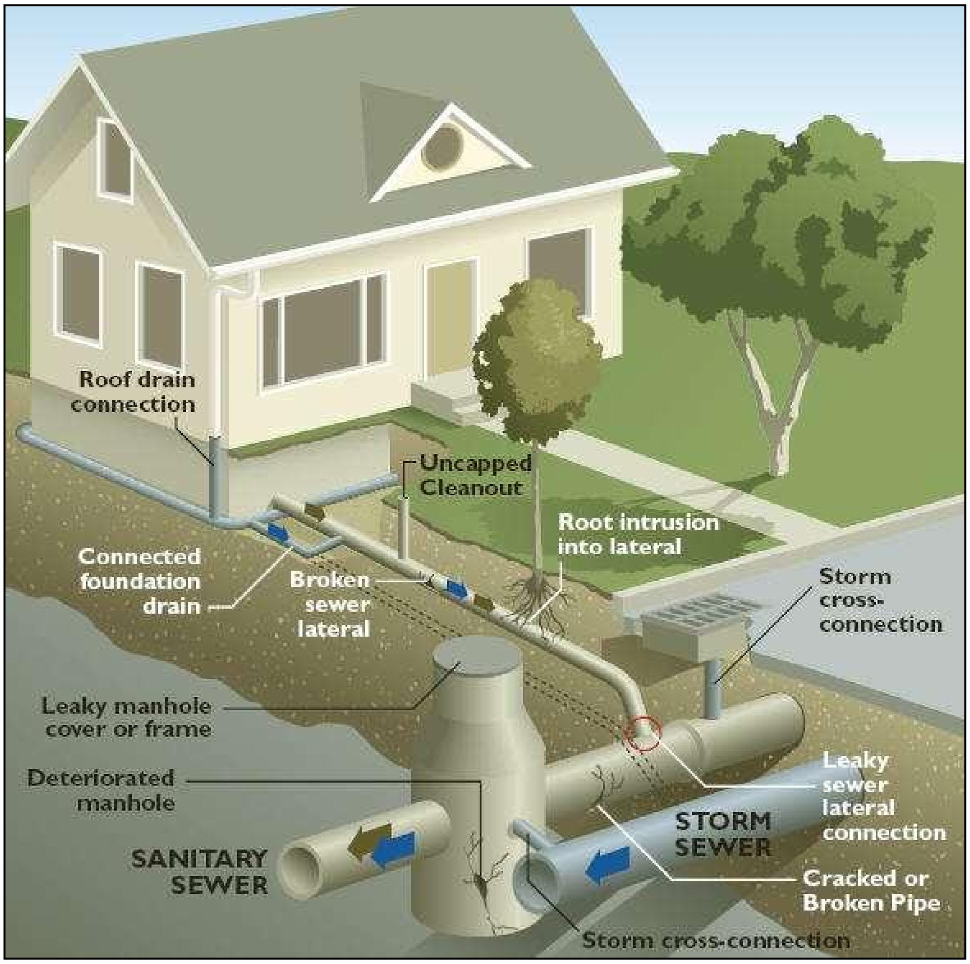
- Regional sewers are generally pipelines that convey sewage across municipal boundaries and are expected to carry flows from the collector sewers to the point of treatment and/or disposal. These sewers are obviously larger, deeper and generally installed on flatter grades. Typical pipe materials used are brick, concrete, PVC, or high density polyethylene (HDPE), and ductile iron for pressure pipe applications. These regional conveyance systems are owned and operated by the CRD.

  As shown in Figure 1.1, the regional trunk sewers currently convey wastewater to the Clover Point and Macaulay Point pump stations where it is screened to remove solids, plastic and floatable materials larger than 6mm, prior to discharge to deep sea outfalls.

1.3 Inflow and Infiltration

Inflow and Infiltration refers to rainwater and groundwater that enters the sanitary sewer collection system. A certain amount of I&I is unavoidable and is accounted for in routine sewer design. However, when I&I exceeds design allowances, sewer capacity is consumed and usually results in overflows and increased conveyance costs or a reduction in the future population service capacity. Experience has shown that the I&I allowance used in the original design of older systems is significantly below the wet-weather flows these systems experience. It is not uncommon for wet-weather peak flows to be an order of magnitude larger than the average daily flow of wastewater. Such large peak flows are primarily due to the numerous defects in the collection system caused by system deterioration and illegal connections over the years. The following figure illustrates common sources (defects) of where I&I enters the sanitary sewer system.

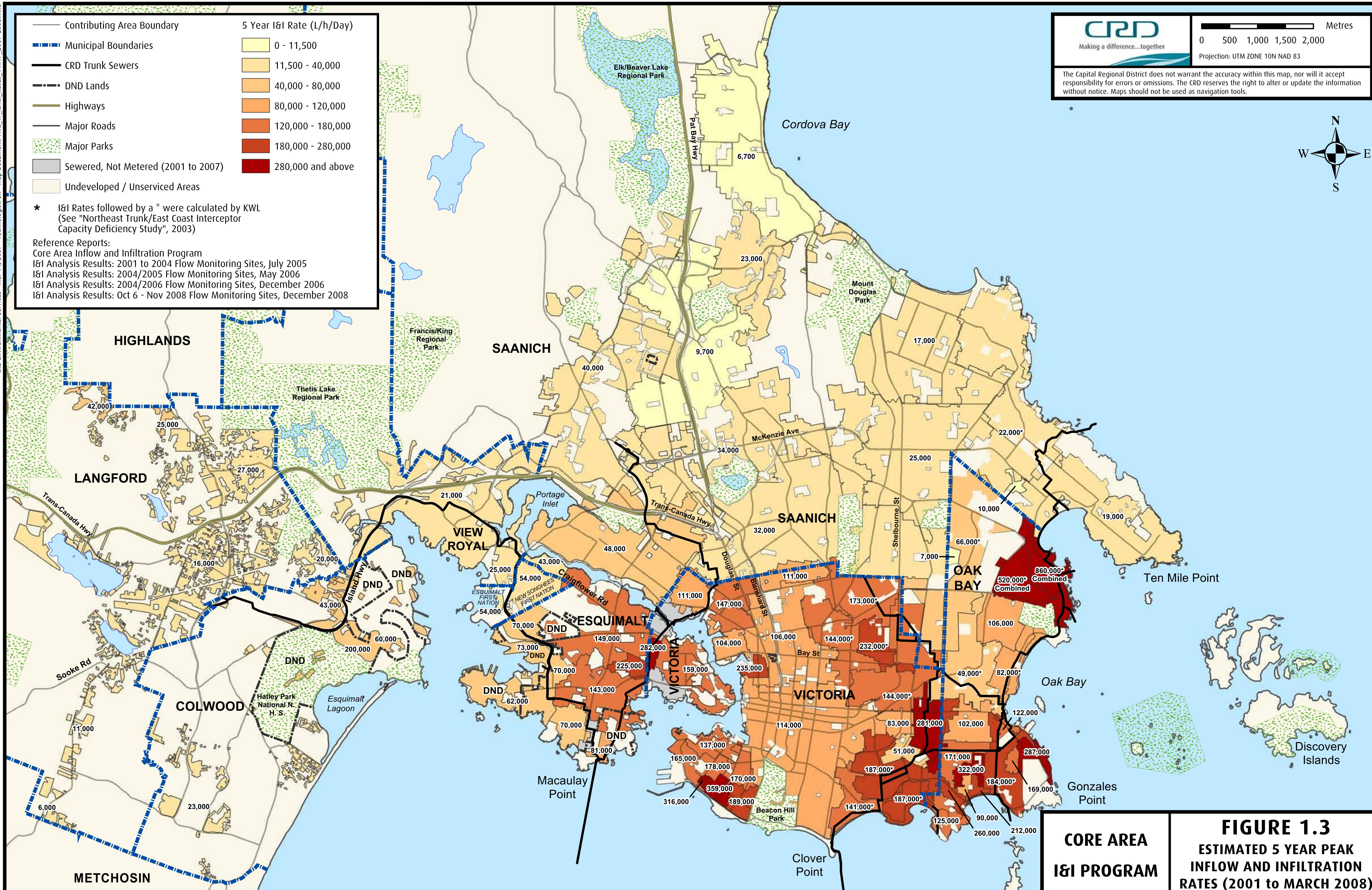
Figure 1.2 Common Sources of Inflow and Infiltration



I&I rates can be quantified by collecting sewer flow data. Typically, during dry weather periods, sewer flows follow a diurnal pattern where the flows are lowest in the middle of the night and highest during morning and evening peaks. During some rainfall events, the flow pattern will shift upward as rainwater / groundwater enters the sewer system. The amount that the flows shift upward can be quantified as I&I.

Figure 1.3 graphically displays the I&I rates that have been calculated for various catchments over the entire Core Area.

CRD Environmental Services - Mar 11, 2009 - Technologist: SR - Map Document: Five_Yr_IandI_Rates_11x17_2007-2008.mxd



CORE AREA I&I PROGRAM

FIGURE 1.3
ESTIMATED 5 YEAR PEAK INFLOW AND INFILTRATION RATES (2001 to MARCH 2008)

1.4 Typical Flow, Inflow and Infiltration Terminology

There are a variety of terms that are used to define the various flow components within a sanitary sewer system. An understanding of the more common terms will help to appreciate the design criteria used to size collections systems and treatment plants.

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

“Average Dry Weather Flow” is the average daily flow rate during dry weather periods and includes a small allowance for groundwater infiltration that is present year-round.

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

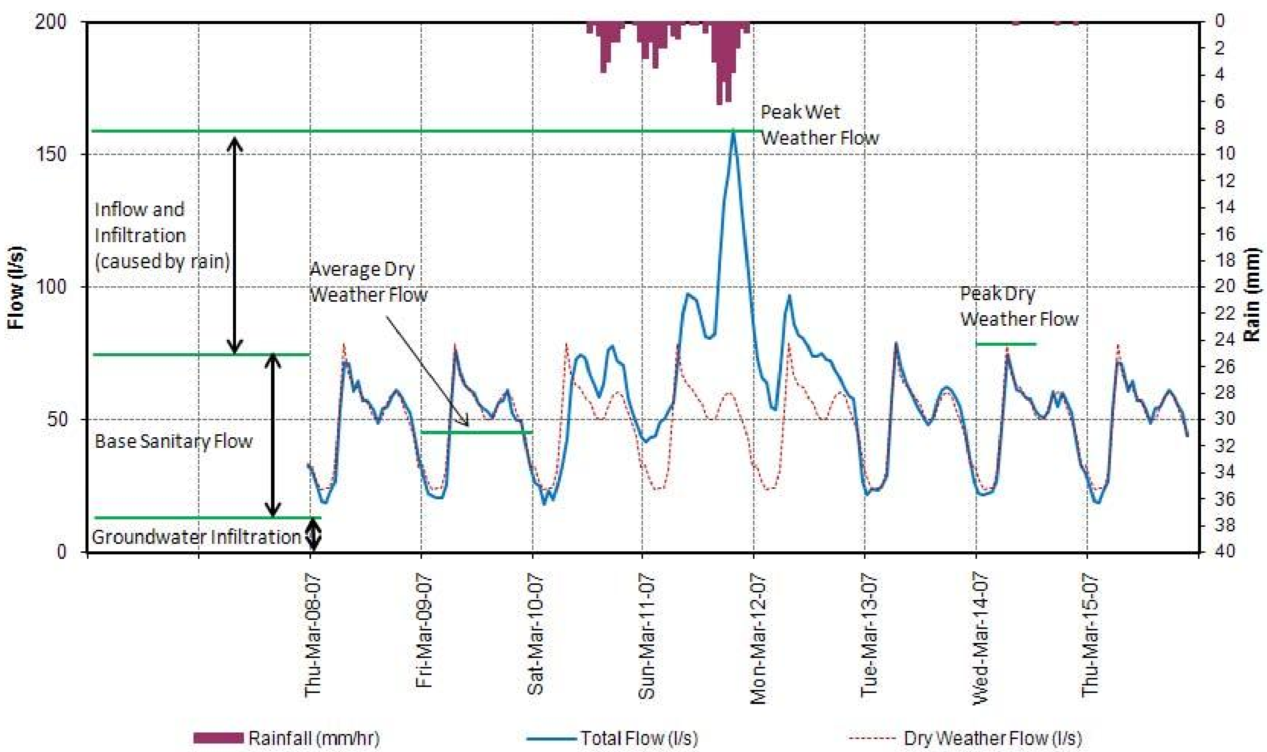
“Inflow” refers to rainwater or snowmelt water that enters the sanitary sewer through a direct (non-soil) connection. Examples of inflow include cross-connected catch basins and roof drains.

“Infiltration” is water that flows through the ground and drains into the sanitary sewer system via cracked pipes, deteriorated manholes, leaky joints, root intrusion, etc. During periods of rain and/or snowmelt, the ground becomes more saturated causing the water table to rise and leak into the sanitary sewer at a much greater rate.

“Peak Wet Weather Flow” is the peak flow rate that occurs at the height a rainfall or snowmelt event.

To help clarify the various flow terms, Figure 1.4 shows a typical hydrograph illustrating flow components.

Figure 1.4 Typical Hydrograph Showing Flow Definitions



1.5 LWMP Goals and Commitments

The goal of the CRD and its municipal partners is to reduce inflow and infiltration that minimizes total conveyance, treatment and disposal system costs, coincident with reduction of I&I induced overflows to acceptable levels.

The joint commitments made by the CRD and participating municipalities to reach the goal, as noted in the LWMP, are as follows:

The **Capital Regional District** and the **participating municipalities** commit:

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

A complete copy of Chapter 8 of the Core Area LWMP and the March 26, 2003 approval letter is included in Appendix A.

The CRD and the participating municipalities have been measuring flows, documenting expenditures and achievements, and submitting this information to the Ministry every two years. The partners are currently preparing a long-term inflow and infiltration management plan.

1.6 Regulatory Requirements

The Municipal Sewage Regulation (MSR) states that no person allows inflow and infiltration so that the maximum average daily flow exceeds 2.0 times average dry weather flow (ADWF) to occur during a storm or snowmelt with less than a 5-year return period, unless a liquid waste management plan is developed to address inflow and infiltration.

The above noted LWMP goal and commitments are being met and with respect to the future Core Area treatment plants, the following philosophy has been submitted to the Ministry for their approval.

Provide secondary treatment for all flows up to 2 times ADWF.

Provide primary treatment for flows between 2 times and 4 times ADWF with the ability to blend the primary and secondary effluent.

Provide 6-mm screening for flows that exceed 4 times ADWF.

2.0 CURRENT FLOW DATA AT CLOVER AND MACAULAY POINT OUTFALLS

Figures 2.1 and 2.2 (on the following two pages) display the entire year (2008) of flow data at Clover and Macaulay Point pump stations and deep sea outfalls.

As expected, these figures graphically show that the flow varies by season in direct correlation to rainfall, but that the flow remains below 2 times ADWF a majority of the time.

Some interesting data to note about these two pump stations and outfalls include:

	Clover	Macaulay
o Maximum daily flow (2008) =	118,600 m^3/day	81,700 m^3/day
o Minimum daily flow (2008) =	40,700 m^3/day	37,400 m^3/day
o Average dry weather flow =	52,000 m^3/day	45,000 m^3/day
o Maximum pumping capacity =	216,000 m^3/day	151,200 m^3/day

It is clear that both pump stations can screen and discharge about 3 - 4 times their average dry weather flow. Even so, there can be times when the flow exceeds their maximum pumping capacity. When this occurs, the excess quantity is discharged out through an emergency bypass outfall.

To get a better understanding of how frequent the flow rate varies at each of these pump stations, the following Tables 2.1 and 2.2 document the number of times in the past three years that the flow:

- did not exceed 2 times ADWF,
- exceeded 2 times but was less than 4 times ADWF, and
- exceeded 4 times ADWF.

Table 2.1 Statistical Flow Data from Clover Point Pump Station

Flow Range	2006	2007	2008
Number of days flow did not exceed 2xADWF	345	349	362
Number of days flow was between 2xADWF and 4xADWF	20	16	3
Number of days flow exceeded 4xADWF [1]	0	0	0
TOTAL	365	365	365

1. Not all of the flow reaches Clover Point during times of excessive flow due to the upstream system being throttled back. If all the flow was permitted to reach Clover pump station it could exceed 4xADWF.

Table 2.2 Statistical Flow Data from Macaulay Point Pump Station

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

Figure 2.2: Macaulay Pump Station Daily Flows - 2008

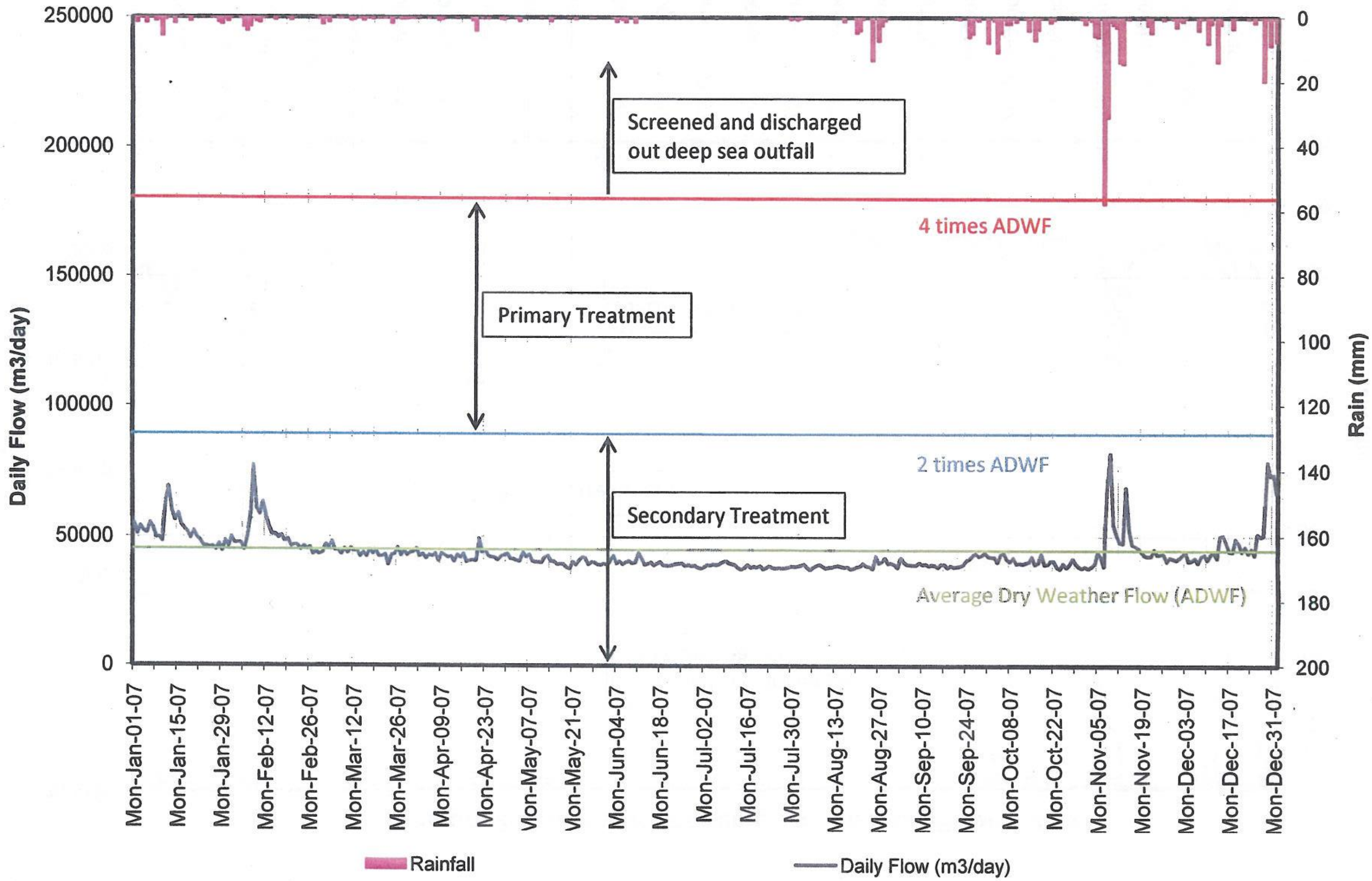
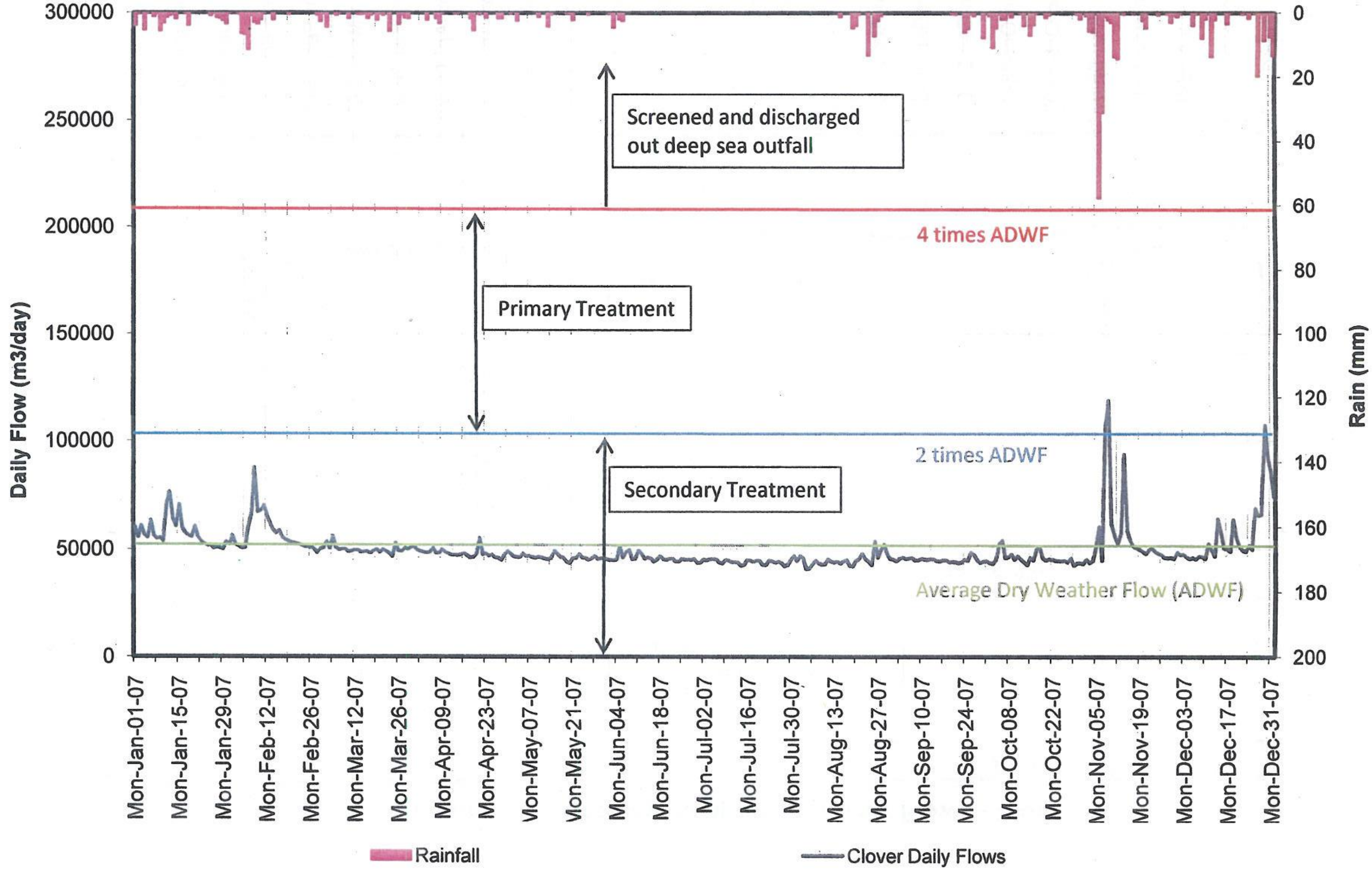


Figure 2.1: Clover Point Pump Station Daily Flows - 2008



Based on the data in the tables and graphs, it is apparent that the flow remains under 2xADWF for about 95-99% of the time. Therefore, based on the proposed wastewater treatment strategy, the flow would receive secondary treatment 95-99% of the time.

When the flow starts to exceed 2xADWF it is proposed that it would receive primary treatment up to 4xADWF and the effluent would be blended with the secondary effluent. It is estimated that this wet weather primary treatment plant would only be used about 90 hours (on average) for the whole year.

If the flow starts to exceed 4xADWF, which might only be for a few hours each year, it would be screened and discharged out the deep sea outfalls as has been the previously approved practice for many decades.

The data in the previous tables has occurred with the given amount of inflow and infiltration that is currently draining into the system. Given that the proposed wastewater treatment plants would be designed for secondary treatment for flows up to 2xADWF and primary treatment up to 4xADWF, it is apparent that the only way to reduce the size and capital cost of the plants would be to reduce inflow and infiltration to at least to 2xADWF.

3.0 COST TO REDUCE INFLOW AND INFILTRATION

To determine the cost of reducing inflow and infiltration down to where there could be some benefit in reducing the treatment plant sizes, one has to first determine what areas would need to be rehabilitated to reduce inflow and infiltration down to 4xADWF and/or 2xADWF.

A simple methodology to determine the approximate rehabilitation areas can be done as follows:

- Convert 4 and 2xADWF in to an equivalent allowable inflow and infiltration rate in litres/hectare /day.
- Compare the allowable I&I rate versus the known I&I rates determined by flow monitoring.
- Any areas that exceed the allowable I&I rate would need to be rehabilitated.

To determine the equivalent allowable I&I rates to reduce flows down to 4 and 2xADWF, the following calculation was performed.

The total ADWF for the Clover and Macaulay areas are 52,000 + 45,000 = 97,000 m^3/day (which equals 97,000,000 L/day). The total sewered catchment area for Clover and Macaulay are about 8,000 hectares.

Therefore, the maximum allowable I&I rate for 2xADWF would equal 97,000,000/8,000 = 12,500 L/ha/day. However, taking into account that not all catchments peak and respond at the same time, and to be conservative, it is recommended to double the rate to 25,000 L/ha/day.

This same methodology was completed for 4xADWF and is summarized in Table 3.1.

Table 3.1 Maximum I&I Rates to Reduce Flow to 4xADWF and 2xADWF

	Maximum I&I Rate (L/ha/day)
Maximum I&I rate needed to maintain a flow of 4xADWF	65,000 L/ha/day
Maximum I&I rate required to reach a flow of 2xADWF	25,000 L/ha/day

Note: Typical I&I design allowance for a brand new sewer is 11,200 L/ha/day.

Numerous studies now confirm that the text book design allowance of 11,200 L/ha/day is set too low. Other studies indicate that a completely rehabilitated sewer catchment on both public and private land may reduce I&I down to about 25,000 L/ha/day.

Therefore, by comparing the maximum allowable I&I rates in the above table with actual I&I rates measured over the Clover and Macaulay catchments, the rehabilitation areas were identified to maintain a flow of 4xADWF and 2xADWF,as shown in Figures 3.1 and 3.2.

It is not too surprising that the proposed rehabilitation areas coincide with the same areas of where the oldest sewer infrastructure is located.

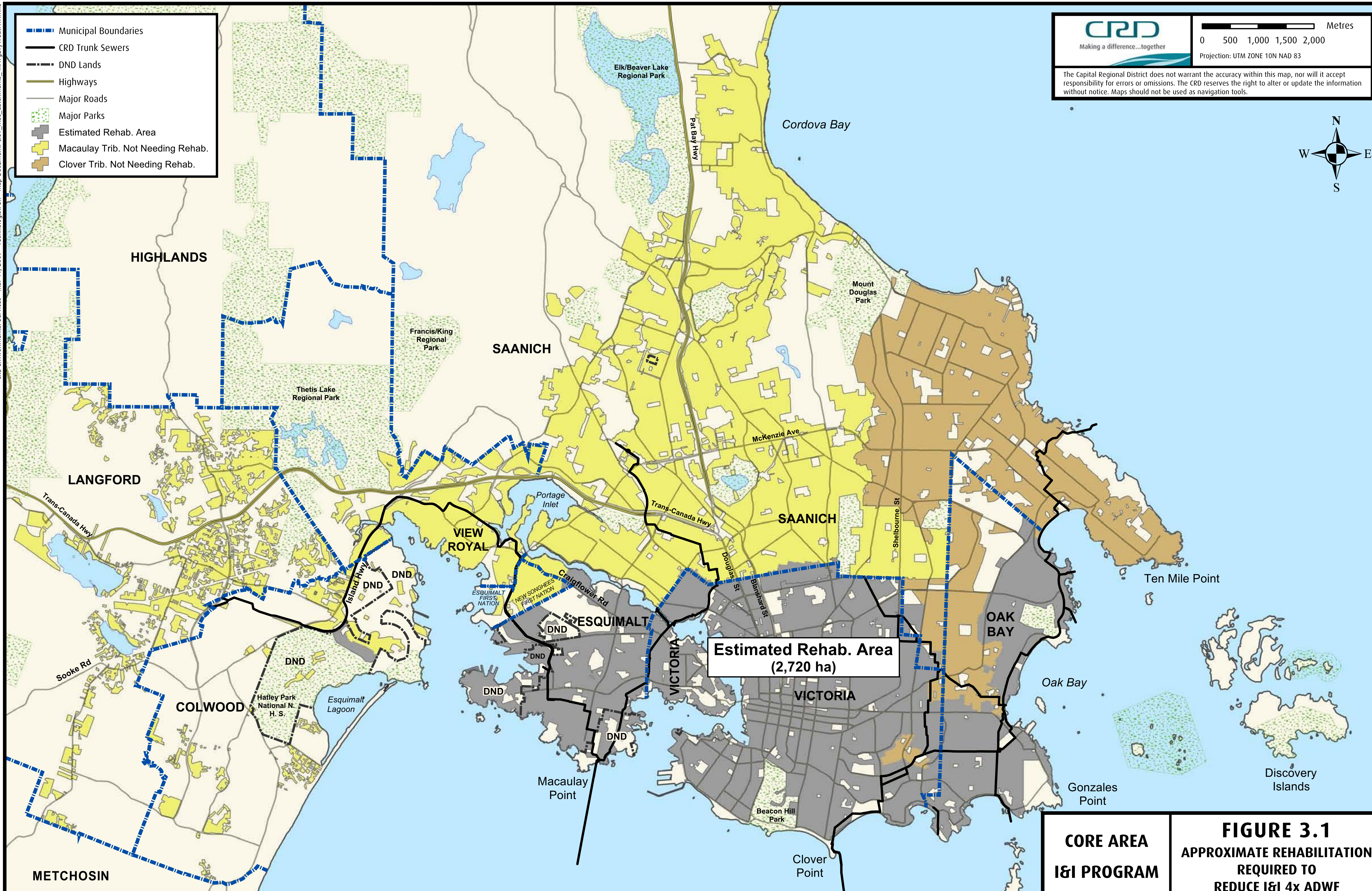
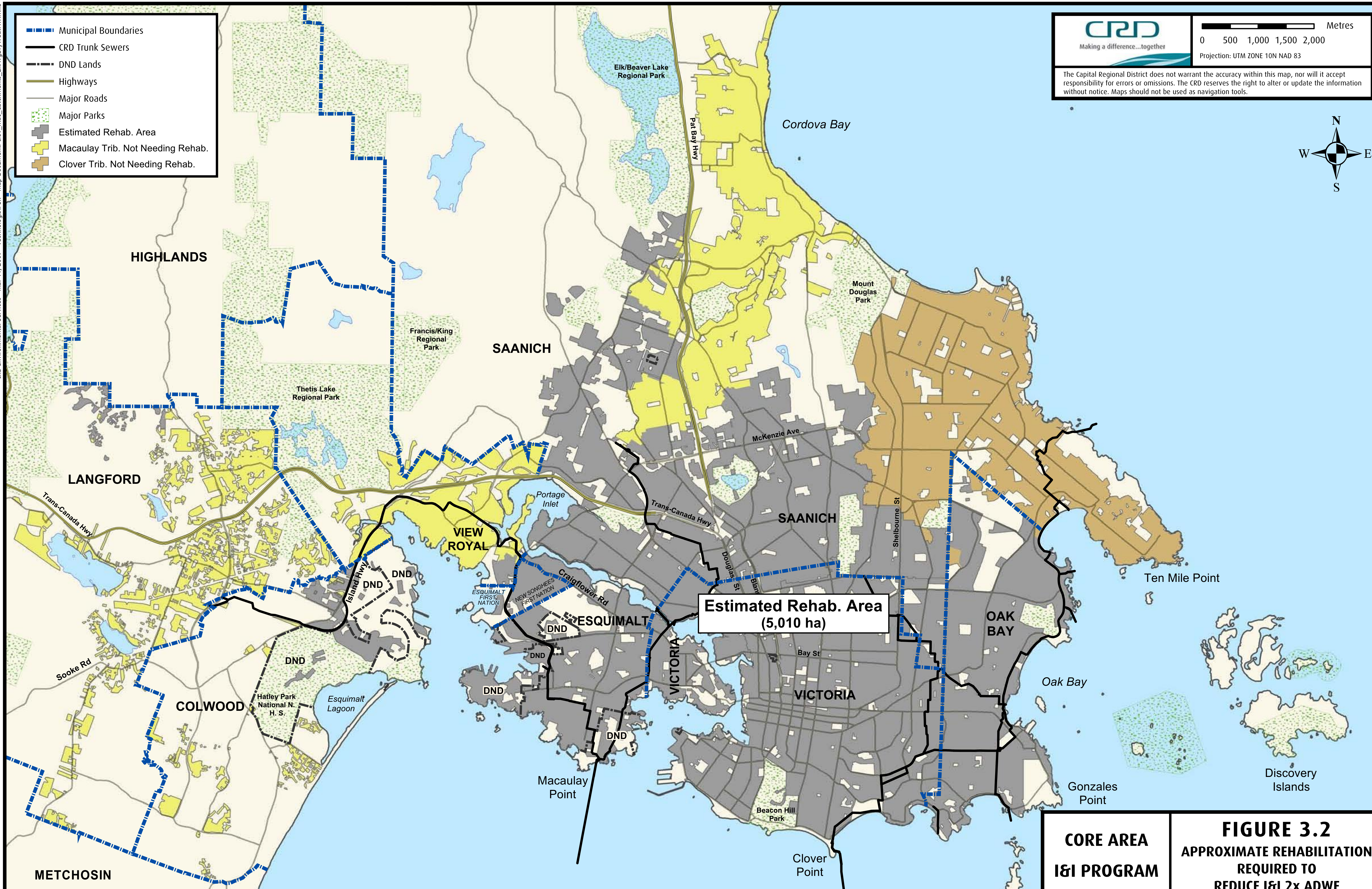


FIGURE 3.1
APPROXIMATE REHABILITATION REQUIRED TO REDUCE I&I 4x ADWF

CRD Environmental Services - Mar 11, 2009 - Technologist: SR - Map Document: Clov_Mac_Catchments_4xAvgDryWeatFlw.mxd



CRD Environmental Services - Mar 11, 2009 - Technologist: SR - Map Document: Clov_Mac_Catchments_2xAvgDryWeatFlw.mxd

Based on the actual sewer infrastructure data stored within our geographic information system, (GIS), the following quantities of infrastructure types were determined to be located within the rehabilitation areas shown in Figures 3.1 and 3.2:

Table 3.2 Estimated Quantities of Infrastructure to be Rehabilitated

Infrastructure Description	Quantity located within the 2,270 ha Rehab Area (Fig. 3.1)	Quantity located within the 5,010 ha Rehab Area (Fig. 3.2)
Total number of manholes	4,750	8,330
Total number of vents (City of Victoria)	890	910
Total length of public collection sewers	365 km	685 km
Total number of private sewer laterals	20,900	35,600
Total number of private storm laterals	20,900	35,600

The private storm laterals have been noted because in many parts of the old system, the storm sewer is higher than the sanitary sewer. This is because the storm sewer was built by enclosing ditches. As a result, many of the roof leaders and foundation drains are tied to the sanitary sewer because it is deeper, and the storm sewer is too shallow. So in addition to rehabilitating a leaky sanitary sewer, some of the private storm laterals would need to be raised (which could also require a sump pump to connect the perimeter drains).

Now that the total estimated quantities of infrastructure are known within the proposed rehabilitation areas, some initial assumptions have to be made on what percentage of the quantities would need rehabilitation and what type of rehabilitation technologies/costs would be utilized.

As previously noted, past case studies have indicated that a completely rehabilitated basin (100% of all sewer infrastructure) can reduce I&I down to about 25,000 L/ha/day. In order to not over-estimate the rehabilitation costs, initially, it shall be assumed that only 60% and 70% of the above noted infrastructure would need to be rehabilitated to meet 4xADWF and 2xADWF, respectively. Also, it is assumed that only 30% of the storm laterals would need to be corrected. A higher rehabilitation percentage of 70% is assumed for the greater I&I reduction based on the research noted above to get to an I&I rate of about 25,000 L/ha/day.

With respect to rehabilitation technologies, there are many different types each with their own merit and specific application. Some technologies include: grouting, lining, point repairs, pipe bursting, and pipe replacement. The unit rate for each of these technologies varies so an average of all options shall be used as follows:

Unit rate to rehabilitate manholes = $2,500 each

Unit rate to rehabilitate vents = $2,000 each

Unit rate to rehabilitate public sewers = $500/m

Unit rate to rehabilitate private sewer laterals = $4,500 each

Unit rate to raise and reconnect private storm laterals = $5,000 each

Based on the above noted quantities, assumptions and unit rates the following cost estimates are determined.

Table 3.3 Cost Estimate to Rehabilitate 2,270 ha to Reduce Flow to 4xADWF

Item Description	Quantity	Percent Requiring Rehabilitation	Unit Rate	Total Cost (million)
Manholes	4,750 no.	60%	$2,500	$7.13
Vents	890 no.	60%	$2,000	$1.07
Public Sewers	365 km	60%	$500	$109.50
Private Sewer Laterals	20,900 no.	60%	$4,500	$56.43
Private Storm Laterals	20,900 no.	30%	$5,000	$31.35
			TOTAL	**$205.48**

Table 3.4 Cost Estimate to Rehabilitate 5,010 ha to Reduce Flow to 2xADWF

Item Description	Quantity	Percent Requiring Rehabilitation	Unit Rate	Total Cost (million)
Manholes	8,330 no.	70%	$2,500	$14.58
Vents	910 no.	70%	$2,000	$1.27
Public Sewers	685 km	70%	$500	$239.75
Private Sewer Laterals	35,600 no.	70%	$4,500	$112.14
Private Storm Laterals	35,600 no.	30%	$5,000	$53.40
			TOTAL	**$421.14**

4.0 BENEFITS FROM REDUCING INFLOW AND INFILTRATION

There are a variety of potential benefits that can be realized by reducing inflow and infiltration, but unfortunately it usually takes quite some time before the benefits come to fruition. There are many possible solutions that utilities may consider using to reduce inflow and infiltration. Effective management, maintenance, operation, capacity enhancement and rehabilitation of collection system will inevitably reduce inflow and infiltration. While any single solution would prove useful under a certain set of circumstances, there is no single and universal solution that works to reduce inflow and infiltration in each catchment. Combinations of solutions are normally required to bring about the expected results.

The question has been asked - what kind of savings can be realized by reducing inflow and infiltration such that the:

- operational cost of conveyance (ie. pumping) is reduced
- size and capital cost the impending treatment plants is reduced
- operational cost of treatment and disposal can be reduced

This analysis could be quite complex and detailed, but for the purposes of this discussion paper and in relative comparison to the rehabilitation cost estimates noted in section 3, it has been somewhat simplified as follows.

4.1 Conveyance Benefits

With respect to conveyance, the average wet weather versus dry weather electrical cost to operate all of the Core Area pump stations was compared. The cost difference between the two is assumed to be the extra cost of pumping more wastewater due to inflow and infiltration, although an allowance has been made for increased heating costs during the wet (winter) months.

The eleven Core Area pump stations taken into consideration for this analysis includes: Clover Point, Craigflower, Currie, Harling, Hood, Humber, Lang Cove, Macaulay Point, Marigold, Penrhyn, and Rutland (Trent was not included since it is brand new and no data was available).

The average monthly wet weather versus dry weather power consumption cost for all of these stations is summarized in Table 4.1.

Table 4.1 Wet Weather vs. Dry Weather Electrical Cost of All Core Area Pump Stations

Average Monthly Wet Weather Electrical Cost	Average Monthly Dry Weather Electrical Cost
$25,000	$20,000

Note: An allowance was deducted off the wet weather cost for heating.

As noted above, it is assumed that the monthly cost difference between the wet weather vs dry weather electrical cost are associated with increased pumping, etc. due to inflow and infiltration.

Therefore, knowing that we typically only get 4-5 wet weather months, (November to February), the total yearly cost savings from reduced I&I and conveyance would be about $20,000.

There are also about 140 municipal pump stations located within the Core Area, but most of them are quite small in size (say 10 to 20 horsepower pumps). Therefore, the estimated power consumption for all of these smaller pump stations is approximately one half of the large CRD pump stations, so the total yearly cost savings including all the municipal conveyance would be about $30,000.

In addition to the operational benefits from reduced electricity, maintenance, etc. there is likely be some conveyance upgrades that could be deferred due to I&I reduction. Currently, as part of the proposed trunk sewer upgrades noted in Chapter 16 of the LWMP, there is about $80 million dollars of planned upgrades. It is assumed that about half of these capital upgrades would not be required if I&I was reduced to 4xADWF and the other half would not be required if I&I was reduced to 2xADWF.

4.2 Treatment and Disposal Benefits

With respect to the size and capital cost of the impending treatment plants, as noted in section 1.6 of this discussion paper, the proposed treatment strategy is to provide:

- secondary treatment for all flows up to 2 times ADWF,
- primary treatment for flows between 2 times and 4 times ADWF with the ability to blend the primary and secondary effluent, and
- 6-mm screening for flows that exceed 4 times ADWF.

On that basis, the sizing and capital cost of the proposed treatment plants can not be reduced any further with respect to secondary treatment unless inflow and infiltration can be reduced to less than 2 times average dry weather flow (2xAWDF), which based on research, would be very difficult to achieve using rehabilitation techniques.

However, if inflow and infiltration can be reduced down to 2xADWF, then it would be possible to eliminate the primary treatment wet weather plants. The capital cost of the proposed wet weather plants at Clover and Macaulay Points are estimated to be about $150 million.

With respect to the operational cost saving of reduced treatment, this too could not be reduced any further unless inflow and infiltration could be reduced to less than 2xADWF, but if it was reduced down to 2XADWF then the proposed operational costs of the wet weather plants could be reduced or eliminated.

Since the wet weather plants would only operate for a few days each year, the estimated cost savings from reducing or eliminating their operation would only be about $10,000 per year, maximum.

To compare the operational cost savings of reduced conveyance and treatment in 2009 dollars, it was assumed that this saving would be extended over a 30 year period using a discount rate of 3% (cost of inflation minus cost of interest).

Therefore, Table 4.3 summarizes the potential cost savings from reducing I&I to 4 times and 2 times ADWF (this includes capital cost savings as well as the net present value of operational savings).

Table 4.3 Potential Cost Saving from Reducing I&I to 4 and 2xADWF

Potential Benefit Category	Cost Saving from Reducing I&I to 4xADWF	Cost Saving from Reducing I&I to 2xADWF
Reduced Conveyance [1]	$200,000	$590,000
Defer Planned Conveyance Upgrades	$40,000,000	$80,000,000
Eliminate Wet Weather Plants	$0	$150,000,000
Reduced Treatment and Disposal [1]	$0	$200,000
TOTAL	**$40,200,000**	**$230,790,000**

Note: 1. Net Present Value of yearly saving over a 30-year period with a 3% discount rate.

Aside from the potential cost saving benefits of reducing inflow and infiltration, there are many other very tangible benefits such as: environmental, hydraulic, safety and asset management.

4.2 Environmental/Social Benefits

Within the Core Area, a majority of overflows and back-ups are generally caused by excessive inflow and infiltration entering the sewer system during heavy rainstorms.

Although the overflows are heavily diluted by rainwater, they still contain sewage and, thus are a concern to public health and the environment.

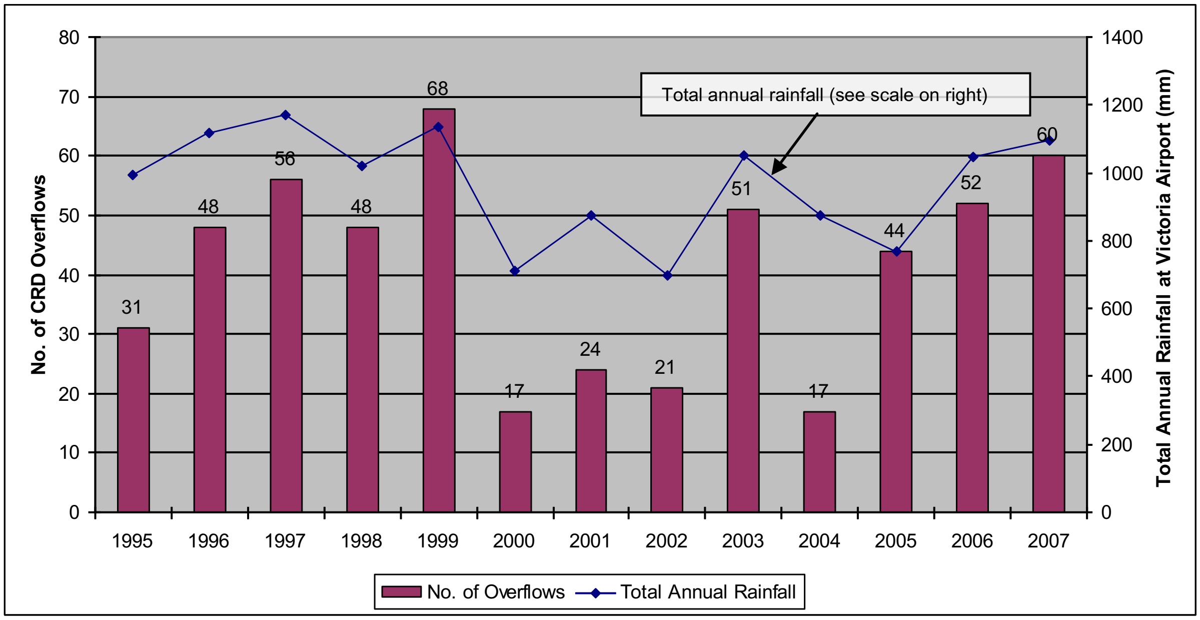
As shown in the picture, when the flow exceeds the capacity of the system it results in a sewer overflow usually at low lying areas and/or back-ups into basements, etc.

A sewer overflow from a surcharging manhole.

Consequently, receiving environments are adversely affected and back-ups can result in extensive decontamination measures and compensation claims not to mention the emotional impact of destroyed personal affects.

As expected, most capacity-related overflows are generally wet-weather related events. This relationship is shown graphically on Figure 4.1 by plotting the number of overflows from the CRD facilities versus the total annual rainfall recorded at Victoria International Airport (AES Rain Gauge) from 1995 to 2007.

Figure 4.1 Graphical Comparison of Rainfall vs. Number of Overflows



As can been in Figure 4.1, the number of overflows rise and fall in relation to the amount of rainfall that had fallen for the year. Significant improvements to CRD sewerage collection facilities started in 2003 which could account for the overflow decrease in 2004. The subsequent rise in overflows from 2005 to 2007, aside from the increased rainfall, was primarily due to the northeast trunk-Bowker sewer overflow at Monterey Avenue. This sewer was transferred to the CRD in 2003 and monitoring equipment was installed in 2005 (prior to that the overflows were not monitored). The construction of Trent pump station in 2008 has now eliminated potential overflows at Monterey for up to a 5-year storm event.

Fortunately, due to the design of the original trunk sewer system, most of the CRD overflow points are located at relatively low impact areas and discharge out well beyond the foreshore coast line.

Even so, work still needs to be undertaken, (particularly in regards to reducing inflow and infiltration), to meet the overflow regulations as specified in the Municipal Sewage Regulation which is to reduce and eventually eliminate sanitary sewer overflows that occur during 5-year storm events.

The CRD and all of its municipal partners have made long-term commitments to reduce the frequency and quantity of overflows to meet the regulations by reducing their inflow and infiltration.

4.3 Hydraulic Benefits

Design criteria for sewer systems and treatment plants usually include flow allowance for growth and expansion. Without I&I control, sewage collection and treatment facilities may require premature and costly upgrades to meet the hydraulic loads.

Conversely, I&I that is controlled and/or reduced will free up peak flow capacity and extend the design life of conveyance and treatment facilities. This in-turn provides additional financial social benefits of not having to expand the facilities until when they are actually needed.

4.4 Safety Benefits

As previously noted, basement and street flooding can present a serious health risk. Furthermore, contamination of water courses, beaches and shorelines can also pose health hazards to the public and natural environment.

Structural defects in the sewer system can be the source of excessive inflow and infiltration. Continued deterioration can lead to the surrounding pipe soil to be washed into the pipe which, in turn, can lead to pipe blockages, voids, sewer collapses and sinkholes. Voids and/or sinkholes can cause serious damage to adjacent infrastructure such as watermains, hydro, gas lines and road structures. Such damage is not only costly, but highly dangerous to the public.

4.5 Asset Management Benefits

Much of the infrastructure installed in older parts or the Core Area are about 80 to 100 years old, so many of the sewers need to be rehabilitated or they will eventually fail.

Therefore, as has been the practice of most major cities throughout North America, a capital rehabilitation fund of 1% has been established to reduce the average age of sewer infrastructure to about 50 years.

This kind of asset investment will ensure that the system will be well maintained and to keep inflow and infiltration from escalating out of control.

5.0 PRELIMINARY CONCLUSIONS

Inflow and infiltration is unavoidable and must be accounted for in routine sewer and treatment plant design. It has been shown through previous studies that I&I typically increases with time as the sewer system ages and decays. Due to the average age of the existing Core Area infrastructure, inflow and infiltration is quire high (in the order of 4-8 times the average dry weather flow).

However, due to the wastewater treatment strategy of,

- secondary treatment for all flows up to 2 times ADWF,
- primary treatment for flows between 2 times and 4 times ADWF, and
- 6-mm screening for flows that exceed 4 times ADWF,

it is unlikely that reduced I&I flows will result in making the new treatment plants smaller or less expensive. This is due to the fact that the actual flows (as measured at Clover and Macaulay Point pump stations) are below 2xADWF 95-99% of the time. The only real potential cost saving would be to reduce the flow down to a maximum of 2xADWF so that the wet weather, primary treatment facilities would not be required.

Rehabilitation to reduce I&I in the Core Area does not appear cost effective based on capital costs, or even present worth of operational costs.

However, there are other motivations/requirements that justify investing in I&I rehabilitation as follows:

Environmental/Social – Receiving environments are adversely affected by sanitary sewer overflows and basement back-ups can result in extensive decontamination measures and compensation claims. Overflow requirements dictate that I&I must be reduced, over the long-term, to meet the Municipal Sewage Regulation.

Hydraulic - Reduction in peak flows will free up peak flow capacity for future growth and may extend the design life of conveyance and treatment facilities.

Safety – Reduced overflows and back ups limit the risk of being exposed to raw sewage and addressing structural defects in deteriorated sewers can prevent sinkholes and/or serious damage to adjacent infrastructure.

Asset Management - Old infrastructure that is decaying and needs to be rehabilitated anyways. Annual investment into the maintenance of infrastructure assets will ensure that the system is maintained and prevent I&I from escalating out of control.

Table 5.1 below summarizes the cost versus benefit to reduce inflow and infiltration to 4 times and 2 times average dry weather flow, including the other benefits as noted.

Table 5.1 Cost vs. Benefit Summary from Reducing I&I to 4 and 2xADWF

Cost vs. Savings		Reduce I&I to 4xADWF (million)	Reduce I&I to 2xADWF (million)
Cost to Reduce I&I		$205.48	$421.14
Savings from Reduced I&I [1]		($40.20)	($230.79)
Net Cost Difference		**$165.28**	**$190.35**
Annual cost over 100 years [2]		$2.05	$4.21
Other Benefits			
Reduction in Annual Overflows			
Current avg. no. of overflows per year	**60**	**5**	**0**
Reduction in Average Age of Infrastructure			
Current avg. age	**75**	**50**	**40**

Note: 1. The savings are a combination of capital cost savings plus the net present value of operational savings over a 30-year period with a 3% discount rate.

2. The annual cost assumes that if $2.05 to $4.21 million were spent over 100 years then we would eventually reduce I&I over time to meet the LWMP and Municipal Sewage Regulation requirements. This level of expenditure is currently being spent within the Core Area.

The net cost difference noted in Table 5.1 is over and above the treatment plant capital cost. For example, (assuming that the capital cost of treatment is $1.2 billion), then the cost to implement treatment and reduce I&I to 4xADWF would be $1,200 million plus $165 million for a total of $1,365 million.

This analysis concurs with past recommendations, that I&I programs are effective when implemented in a holistic manner. That is to determine which areas have chronic overflow locations, critical sewers, old sewers, high I&I rates, and can be planned concurrently with other infrastructure upgrades (ie. roads, storm sewers, watermains, etc.). When those areas have been identified and prioritized for I&I rehabilitation then multiple cost-effective benefits can be achieved at the same time while working towards the long-term goal of I&I reduction.

APPENDIX G

MUNICIPAL SANITARY SEWER OVERFLOW ACTION PLAN REPORTS

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (in same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
1. Marigold Pump Station	Storm drain o/f into Colquitz River	High	Resolved	Installed a peak flow storage tank in 2003.	Nov-03	$3,300,000	---	---	---
2. Craigflower Pump Station	O/F pipe to Portage Inlet west of Christie Point	High	A	New Craigflower PS will pump higher flows c/w standby power.	2006-2008	$5,000,000	Westshore wastewater treatment plant will reduce incoming sewage flows	---	---
3. Shoreline Trunk Sewer O/F (MH 4 at Brigadoon)	O/F pipe to Portage Inlet south of Christie Point	High	A	New Craigflower PS will lower HGL and keep it below o/f pipe.	2006-2008	Included in Item 2	Twin bottom 200m of Shoreline trunk to better accommodate sewage flows	---	---
4. Gorge Harriet Siphon (Saanich)	O/F pipe from siphon inlet into Gorge channel	High	C	Only operates if siphon plugs. O/F sensor has no recorded overflows for last 2-3 yrs. Including 100 yr. storm events. Check and calibrate sensor ea. winter.			---	---	---

1. Marigold Pump Station — Overflow Details

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
Not an active overflow anymore.			

2. Craigflower Pump Station — Overflow Details

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
01-Feb-00	0.2		
06-Nov-06	1.2		25-year storm

3. Shoreline Trunk Sewer O/F — Overflow Details

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
No overflows recorded during this reporting period (2000 - 2007).			

4. Gorge Harriet Siphon (Saanich) — Overflow Details

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
No overflows recorded during this reporting period (2000 - 2007).			

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (In same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
5. Gorge Siphon (Victoria)	Manual valve o/f pipe into Gorge/Selkirk water	High	Resolved	Manual valve seized shut. No action required.			---	---	---
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause Not an active overflow. Manual o/f valve is siezed shut.				Added a third siphon to increase capacity	2005(?)				
6. Lang Cove Pump Station	Storm drain o/f into Lang Cove at CRD #	Moderate	Resolved	Installed new pump and emergency genset in 1996, and no overflows have occurred since then.			---	---	---
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause Not an active overflow since pump station was upgraded in 1996.									

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (in same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
7. Macaulay Point PS Bypass Outfall	307m long outfall 11m deep south of Victoria Harbour	Low	Resolved for Short-term	Marigold storage tank reduces o/f's and new low level screen removes solids.	Nov-03 Jan-04	$3,300,000 $1,200,000	Upgrade (twin) several NWT sections	2015-2030	$19,000,000
							As part of the new treatment plant, include a deep outfall (no o/f for upto a 5 yr storm)		

Overflow Details

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
22-Sep-00	0.1		
23-Sep-00	408		
16-Dec-00	1.4		
28-Oct-01	1.1		
16-Dec-01	7.1		
21-Feb-02	8		5 yr storm
02-Mar-02	0.9		
03-Mar-02	0.1		
14-Mar-02	1.2		
18-Mar-02	1		
04-Apr-02	3.8		
18-Jul-02	0.4		
11-Dec-02	0.3		
16-Oct-03	6		100 yr storm
20-Oct-03	6		5 yr storm
18-Nov-03	3.6		
28-Nov-03	6		
10-Dec-04	6		
17-Jan-05	14		
18-Jan-05	5.5		
19-Jan-05	6		
03-Nov-05	1.6		
29-Dec-05	2.5		
19-Jan-06	6.5		by permit (mag meter install)
06-Nov-06	12		25-year storm
11-Dec-06	2		
14-Dec-06	4		
02-Jan-07	9.8		
05-Jan-07	8.9		
06-Jan-07	1.3		
07-Jan-07	14.0		
11-Mar-07	4.0		
22-Apr-07	0.2		

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (in same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
8. Head Street Overflow	Northwest Trunk o/f's into West Bay Marina via stm pipe	High	Resolved for Short-term	Marigold storage tank and raised weir to reduce o/f's	Nov-03	See Item 1	Upgrade NWT (twin sewers and outfall). Eliminate overflow.	2015-2030	See Item 7
9. Sea Terrace Overflow	Northwest Trunk o/f's into West Bay off of Barnard Park	Moderate	Resolved for Short-term	Marigold storage tank and raised weir to reduce o/f's	Nov-03	See Item 1	Upgrade (twin) several NWT sections and deep outfall (no o/f for upto a 5 yr storm)	2015-2030	See Item 7

Overflow Details (8. Head Street Overflow)

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
16-Oct-03	0.1		100 yr storm

Overflow Details (9. Sea Terrace Overflow)

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
16-Oct-03	13		100 yr storm
20-Oct-03	3.5		5 yr storm
18-Nov-03	2		
28-Nov-03	5		
05-Jan-07	1.4		
07-Jan-07	3.4		

Corrective Action Ranking: A = Top Priority; B = Medium Priority; C = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (in same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
10. Clover Point Bypass Outfall	340m x 13m deep and 80m x 5m deep twin outfalls into Juan de Fuca Strt.	Low	C	When Clover PS can't handle peak storm flow, screened sewage flows into the 340m outfall. When 340m outfall capacity is exceeded, the twin 80m outfall is activated.			New Trent PS and Saanich East WWTP will reduce o/f's	2005-2010	$12,000,000
11. Clover Point Emergency Outfall	80 m long outfall discharging at a 5m depth	Low	C	If the pumps and/or screens fail at Clover, screened and/or unscreened sewage flows into the 340m outfall. When the 340m outfall capacity is exceeded, the twin 80m outfall is activated.			Other NET/ECI upgrades and WWTP projects will reduce overflows	2010-2025	$40,000,000

Overflow Details (10. Clover Point Bypass Outfall)

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
01-Feb-00	0.2		
16-Dec-00	1.1		
13-Dec-01	4.75		
15-Dec-01	3.5		
16-Dec-01	10.1		
29-Sep-02	0.9		
30-Jan-03	1.1		
10-Apr-03	0.5		
16-Oct-03	4		100 yr storm
20-Oct-03	28		5 yr storm
06-Nov-06	19		25-year storm
02-Jan-07	4.1		
05-Jan-07	8.3		
07-Jan-07	5.9		
19-Feb-07	0.3		
11-Mar-07	2.8		
29-Nov-07	6.0		

Overflow Details (11. Clover Point Emergency Outfall)

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
Same as Item 10 above.			

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (in same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
12. Currie Pump Station / McMicking Outfall	285m long outfall 18m deep into Enterprise Channel	Low	C	Currie o/f's are screened. New Trent PS will divert flow from Currie PS to reduce o/f's	2005-2010	See Item 10	Other NET/ECI upgrades and WWTP projects will reduce overflows	2010-2025	See Item 11

Overflow Details

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
16-Dec-00	---		
04-Jan-01	4		
28-Nov-01	0.3		
29-Nov-01	2.2		
13-Dec-01	6.6		
15-Dec-01	3.3		
16-Dec-01	1.5		
08-Jan-02	---		
24-Jan-02	20.6		
30-Jan-03	4.9		
21-Feb-03	8.8		
13-Apr-03	1.2		
16-Oct-03	15		100 yr storm
20-Oct-03	30.25		5 yr storm
17-Nov-03	3.3		
18-Nov-03	19		
19-Nov-03	4.8		
28-Nov-03	14		
29-Jan-04	2		
24-Nov-04	7.1		
09-Dec-04	17.3		
17-Jan-05	16		
18-Jan-05	14		
19-Jan-05	21		
22-Jan-05	5		
06-Feb-05	2.7		
29-Sep-05	0.7		
05-Nov-05	1.1		
10-Jan-06	0.5		
16-Jan-06	1.3		
29-Jan-06	12.5		
06-Nov-06	11.2		25-year storm
12-Nov-06	4.4		
13-Nov-06	3.5		
26-Nov-06	0.8		
14-Dec-06	11		
24-Dec-06	0.5		
02-Jan-07	16.9		

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (in same order as Table 13.1 of LWMP)			Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
03-Jan-07	8.0										
05-Jan-07	14.7										
06-Jan-07	10.9										
07-Jan-07	17.4										
08-Jan-07	0.8										
19-Feb-07	8.7										
11-Mar-07	6.3										
12-Nov-07	2.7										
03-Dec-07	6.4	5 yr storm									

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (In same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
13. East Coast Interceptor / Finnerty Outfall	400m long outfall 14m deep into Haro Straight	Low	C	New Trent PS will lower HGL at upper end and reduce o/f's	2005-2010	See Item 10	Saanich East WWTP will reduce overflows	2015-2020	#########

Overflow Details

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
16-Dec-00			
10-May-01	21.6		
13-Dec-01	0.5		
16-Dec-01	10		
24-Jan-02	7.5		
21-Feb-02	13.5		5 yr storm
22-Feb-02	6.6		
01-Nov-02	7		
02-Nov-02	3.75		
30-Jan-03	4.1		
21-Feb-03	3.5		
16-Oct-03	16		100 yr storm
20-Oct-03	24		5 yr storm
17-Nov-03	2.5		
18-Nov-03	15		
19-Nov-03	0.5		
28-Nov-03	11		
24-Nov-04	0.8		
09-Dec-04	8		
17-Jan-05	13.6		
18-Jan-05	4.9		
19-Jan-05	9.7		
29-Jan-06	7.5		
06-Nov-06	9.5		25-year storm
12-Nov-06	3.8		
13-Nov-06	0.5		
14-Dec-06	4.3		
02-Jan-07	9.0		
05-Jan-07	13.6		
06-Jan-07	0.8		
07-Jan-07	16.8		
19-Feb-07	6.7		
11-Mar-07	5.6		
12-Nov-07	0.6		
03-Dec-07	4.2		5 yr storm

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (in same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
14. Penryhn Booster Station	Finnerty Outfall	Low	N/A	No direct o/f from this station. If station fails, the system could back-up and o/f at Finnerty, but unlikely as it has redundancy and back-up power.			Proposed Arbutus storage tank will prevent o/f during failure.	2015-2020	See Item 13
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No overflow at this station.									
15. Penryhn Lift Station	Storm drain o/f in Cadboro Bay at Gyro Park Beach	High	C	Will only overflow if pump station fails. However, this local lift station has some redundancy and genset for one pump.			Change impellors to increase capacity and new genset for 2 pumps	2010	$350,000
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No overflow at this station.									

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (in same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
16. Humber Pump Station / Combined Sewer O/F	110 m long outfall 7 m deep at mouth of Cadboro Bay	Low	C	Change existing screens to mech. screens for better reliability	2005	$250,000	Oak Bay is required to address their combined sewers.	2030	

Overflow Details

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
01-Jan-00	---		
20-Oct-00	0.3		
04-Nov-00	0.2		
16-Dec-00	2		
04-Jan-01	3.2		
13-Dec-01	0.4		
16-Dec-01	4.3		
24-Jan-02	4		
04-Jan-03	0.4		
30-Jan-03	1		
16-Oct-03	2		100 yr storm
20-Oct-03	21		5 yr storm
17-Nov-03	2.5		
18-Nov-03	0.5		
28-Nov-03	5.9		
24-Aug-04	0.7		
08-Dec-04	0.6		
09-Dec-04	7.2		
17-Jan-05	10.3		
18-Jan-05	0.3		
19-Jan-05	6.7		
17-Aug-05	0.5		
29-Sep-05	0.9		
22-Dec-05	0.9		
10-Jan-06	1.8		
29-Jan-06	2.3		
30-Jan-00	2		
09-Sep-06	0.8		
04-Nov-06	0.3		
06-Nov-06	10.8		25-year storm
12-Nov-06	2.1		
27-Nov-06	5.3		
14-Dec-06	2.5		
02-Jan-07	4.9		
05-Jan-07	10.5		
07-Jan-07	11.7		
19-Feb-07	3.6		
11-Mar-07	4.5		
03-Dec-07	3.9		5 yr storm

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (In same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Completed By	Estimated Cost	Proposed Long-term Action: Action Description	Completed By	Estimated Cost
17. Rutland Pump Station / Combined Sewer O/F	220 m long outfall 4 m deep at mouth of Cadboro Bay	Low	C	Change existing screens to mech. screens for better reliability	2005	$250,000	Oak Bay is required to address their combined sewers.	2030	

Overflow Details

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
01-Jan-00	—		
20-Oct-00	0.5		
03-Nov-00	0.4		
16-Dec-00	1.4		
17-Apr-01	0.2		
11-Jun-01	0.3		
31-Oct-01	0.2		
29-Nov-01	0.2		
13-Dec-01	3		
16-Dec-01	5		
24-Jan-02	6.5		
21-Feb-02	2.6		5 yr storm
22-Feb-02	2.5		
04-Jan-03	0.4		
30-Jan-03	0.8		
04-May-03	0.2		
16-Oct-03	0.4		100 yr storm
20-Oct-03	21.5		5 yr storm
17-Nov-03	2.7		
18-Nov-03	1.4		
19-Nov-03	0.2		
28-Nov-03	8.1		
05-Dec-03	0.5		
29-Jan-04	0.4		
06-Jul-04	0.3		
24-Aug-04	0.8		
02-Nov-04	0.3		
24-Nov-04	2		
08-Dec-04	0.5		
09-Dec-04	2.9		
10-Dec-04	2.5		
17-Jan-05	12.2		
18-Jan-05	4		
19-Jan-05	5.9		
22-Jan-05	2.7		
06-Feb-05	2.3		
17-Aug-05	1.2		
29-Sep-05	1.1		
05-Nov-05	0.7		

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
22-Dec-05	1		
25-Dec-05	0.3		
10-Jan-06	3.4		
29-Jan-06	4.5		
09-Sep-06	0.9		
04-Nov-06	0.4		
06-Nov-06	10.1		25 yr storm
12-Nov-06	2.7		
27-Nov-06	5.2		
14-Dec-06	4		
02-Jan-07	7.3		
03-Jan-07	0.9		
05-Jan-07	16.3		
07-Jan-07	17.0		
19-Feb-07	5.6		
11-Mar-07	5.0		
12-Nov-07	0.5		
03-Dec-07	3.8		5 yr storm

Overflow Name / Location (In same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
18. Broom Road Overflow	ECI and NET-B storm drain o/f at shoreline of Glenlyon School	High	A	New Trent PS will divert flow away from this overflow location	2005-2010	See Item 10	Other NET/ECI upgrades to increase capacity (no o/f's for upto a 100 yr storm event)	2010-2025	See Item 11

Overflow Details

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
25-Feb-00	0.5		
06-Nov-06	7		25-year storm

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (In same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
18A NET-Bowker Overflow at Monterey	NET-B overflow into Bowker Creek at Monterey	High	A	New Trent PS will divert flow away from this overflow location	2005-2010	See Item 10	Other NET/ECI upgrades to increase capacity (no o/f's for upto a 100 yr storm event)	2010-2025	See Item 11

Overflow Details

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
10-Dec-04	2.4		
17-Jan-05	15.3		
18-Jan-05	13.5		
19-Jan-05	22.7		
22-Jan-05	6		
04-Feb-05	0.2		
06-Feb-05	3.8		
17-Aug-05	0.2		
29-Sep-05	1.2		
05-Nov-05	1.9		
25-Nov-05	0.3		
22-Dec-05	0.7		
10-Jan-06	3.2		
16-Jan-06	2.2		
29-Jan-06	12.8		
31-Jan-06	0.2		
04-Nov-06	1.3		
06-Nov-06	12		25 yr storm
12-Nov-06	7.5		
13-Nov-06	4.5		
26-Nov-06	1.1		
14-Dec-06	12.3		
02-Jan-07	17.5		
03-Jan-07	6.0		
05-Jan-07	21.6		
07-Jan-07	19.6		
19-Feb-07	9.0		
20-Feb-07	1.0		
11-Mar-07	8.0		
24-Mar-07	1.2		
12-Nov-07	1.2		
03-Dec-07	8.2		5 yr storm

*Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Capital Regional District

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: **01 Jan 00** To: **31 Dec 08**

Overflow Name / Location (In same order as Table 13.1 of LWMP)	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
19. Currie Lift Station / Transit Overflow	Sewage backs up to Deal and Orchard where it overflows to the storm sewer and goes to CRD Discharge # 306	Low	C	---	---	---	Reduce I&I in Oak Bay	2005-2030	$100,000 per year
20. Harling Point Pump Station	Shoreline outfall off Harling Point	Low	C	Install screen on overflow to remove solids	2008	$10,000	Reduce I&I in Oak Bay	2005-2030	$100,000 per year
21. Hood Pump Station / McMicking Outfall	285m long outfall 18m deep into Enterprise Channel	Low	C	Local catchment of only 15 homes. Overflows infrequently.	---	---	Reduce I&I in Oak Bay	2005-2030	100,000 per year

Overflow Details (19. Currie Lift Station / Transit Overflow)

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
16-Oct-03	1.2		100 yr storm
05-Jan-07	1.1		

Overflow Details (20. Harling Point Pump Station)

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
15-Dec-01	0.1		
16-Oct-03	4		100 yr storm
20-Oct-03	3		5 yr storm
18-Nov-03	7.5		
19-Jan-05	2		
06-Nov-06	7.8		25-year storm
26-Nov-06	0.2		
15-Dec-06	1.5		
02-Jan-07	1.7		
05-Jan-07	4.7		
07-Jan-07	3.9		

Overflow Details (21. Hood Pump Station / McMicking Outfall)

Overflow Observation Date	Estimated Duration (hours)	Estimated Quantity (litres)	Overflow Cause
16-Oct-03	0.5		100 yr storm
19-Jan-05	1.5		
26-Nov-06	0.02		

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

City of Esquimalt

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Completed By	Estimated Cost	Proposed Long-term Action: Action Description	Completed By	Estimated Cost
1. Canteen Pump Station									
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause)	Out Fall to DND Drain to Esquimalt Harbour	Low	C	Radio Com Link	Aug-07	$ 1,300	Pump Replacement	2018	$16,000.00
				SCADA Installed	Aug-07	$ 15,000			
				Controls	Aug-07	$ 43,000			
				KIOSK	Aug-07	$ 6,000			
				Fixed Emergency Back Up Power	Sep-07	$ 5,300			
				Mobile Emergency Back Up Power	Oct-07	$ 2,900			
				Trans ducer Flow Measurement	Aug-08	$ 2,200			
				New Acces Hatch	Feb-08	$ 3,000			
				Repair Concrete Platform	Feb-08	$ 1,300			
				Emergency Float Redundancy	Feb-08	$ 1,200			
2. Constance Pump Station									
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause)	Out Fall to CRD #809	Medium	B	New Internal Mechanical	Oct-07	$ 5,700			
				Removed Storm Out Fall	Nov-07	$ 2,300			
				KIOSK	Dec-07	$ 33,000			
				SCADA Installed	Jan-08	$ 15,000			
				Mobile Emergency Back Up Power	Jan-08	$ 2,900			
				Trans ducer Flow Measurement	Feb-08	$ 2,200			
				New Acces Hatch	Feb-08	$ 1,800			
				Repair Concrete Platform	Feb-08	$ 3,900			
				Emergency Float Redundancy	Feb-08	$ 1,400			
				Added Pump - Duplex Station	08-Feb	$ 4,300			
				New Isalation Valves	Feb-08	$ 3,100			
				New Electricl service		$ 4,600			
				Pump 1 Replacement	2011	$ 5,000			
3. Craigflower Pump Station									
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause)	Out Fall to Gorge Waterway at CRD # 726	High	A	Emergency Float Redundancy	Mar-07	$ 1,400	Pumps 1& 2	2017	$10,000
				SCADA Installed	Mar-07	$ 15,000			
				KIOSK	Feb-07	$ 37,000			
				Repair Concrete Platform	Feb-07	$ 2,700			
				Mobile Emergency Back Up	Feb-07	$ 4,800			
				Trans ducer Flow Measurement	May-07	$ 2,200			
				New Electrical Service	Jan-08	$ 15,000			
				New Acces Hatch	2009	$ 3,700			

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City of Esquimalt

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
4. Forshaw Pump Station									
Overflow Details — Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause	Out Fall to Gorge Waterway at CRD # 745	High	A	Peak Over Flow Storage	2005	$ 30,000			
				SCADA Installed	Jun-07	$ 15,000			
				New inlet structure	Jun-07	$ 1,500			
				Emergency Float Redundancy	Jun-07	$ 2,500			
				Mobile Emergency Back Up	Jun-07	$ 4,200			
				Trans ducer Flow Measurement	Jun-07	$ 2,200			
				New Acces Hatch	2009	$ 5,200			
				Repair Concrete Platform	2009	$ 5,000			
5. Garthland Pump Station									
Overflow Details — Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause	Out Fall to Gorge Waterway at CRD # 737	High	A	New Internal Mechanical	Jun-07	$ 4,900			
				SCADA Installed	Jun-07	$ 15,000			
				KIOSK	Jun-07	$ 42,000			
				New Isolation Valve	Jun-07	$ 8,400			
				Mobile Emergency Back Up	Jun-07	$ 4,400			
				Trans ducer Flow Measurement	Jun-07	$ 2,200			
				New Acces Hatch	Jun-07	$ 3,600			
				Repair Concrete Platform	Jun-07	$ 4,900			
				Emergency Float Redundancy	Jun-07	$ 1,400			
				Isolation Valves / forcemain	Jun-07	$ 4,400			
				New Peak Storage	Jun-07	$ 24,000			
6. Grafton Pump Station									
Overflow Details — Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause	Out Fall toJuan de Fuca Straight at CRD # 814	Medium	B	New Electrical Service	2008	$ 30,000			
				SCADA Installed	2007	$ 15,000			
				KIOSK	2007	$ 48,000			
				Internal Mechanical upgrade	2008	$ 5,700			
				Mobile Emergency Back Up	2007	$ 5,000			
				Trans ducer Flow Measurement	2007	$ 2,200			
				New Acces Hatch	2007	$ 4,000			
				Repair Concrete Platform	2008	$ 2,800			
				Emergency Float Redundancy	2007	$ 1,400			
				Pumps 1 & 2	2012	$ 40,000			

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Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Completed By	Estimated Cost	Proposed Long-term Action: Action Description	Completed By	Estimated Cost
7. Kinver Pump Station									
Overflow Details: Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause	Out Fall to Fleming Beach at CRD # 805	High	A	New Internal Mechanical	2008	$ 14,000	Pumps 1&2	2017	$40,000.00
				SCADA Installed	2007	$ 15,000			
				Emergency Float Redundancy	2007	$ 1,400			
				New Acces Hatch	2008	$ 3,400			
				Mobile Emergency Back Up	2007	$ 4,400			
				Trans ducer Flow Measurement	2007	$ 2,200			
8. Lampson Pump Station									
Overflow Details: Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause	Out Fall to Trunk Sewer	N/A		SCADA Installed	Nov-07	$ 15,000			
				KIOSK	Nov-07	$ 34,000			
				Mobile Emergency Back Up	Nov-07	$ 4,000			
				Trans ducer Flow Measurement	Nov-07	$ 2,200			
				Emergency Float Redundancy	Nov-07	$ 1,400			
9. Luscombe Pump Station									
Overflow Details: Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause	Out Fall to Below level in Esquimalt Harbour CRD #865 A	Low	C	New Internal Mechanical	2008	$ 14,000			
				SCADA Installed	Nov-07	$ 15,000			
				KIOSK	Nov-07	$ 38,000			
				New electrical service	Nov-07	$ 2,300			
				Mobile Emergency Back Up	Nov-07	$ 4,100			
				Trans ducer Flow Measurement	Nov-07	$ 2,200			
				New Acces Hatch	2008	$ 2,400			
				Repair Concrete Platform	2008	$ 2,000			
				Emergency Float Redundancy	Nov-07	$ 1,400			
10. Sea Haven Pump Station									
Overflow Details: Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause	Out Fall to CRD # 863	Medium	B	New Internal Mechanical	2008	$ 15,000			
				SCADA Installed	Nov-07	$ 15,000			
				KIOSK	Nov-07	$ 35,000			
				New electrical service	Nov-07	$ 2,700			
				Mobile Emergency Back Up	Nov-07	$ 4,000			
				Trans ducer Flow Measurement	Nov-07	$ 2,200			
				New Acces Hatch	2008	$ 3,000			
				Repair Concrete Platform	2008	$ 3,000			
				Emergency Float Redundancy	Nov-07	$ 1,400			

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Sanitary Sewer Overflows and Action Plans

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Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
11. Uganda Pump Station									
Overflow Details: Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause	Out Fall toCRD # 749	High	A	New Internal Mechanical	2008	$ 25,000			
				SCADA Installed	Nov-07	$ 15,000			
				KIOSK	2008	$ 55,000			
				New Wet Well	2008	$ 90,000			
				Mobile Emergency Back Up	Nov-07	$ 4,000			
				Trans ducer Flow Measurement	Nov-07	$ 2,200			
				New Acces Hatch	2008	$ 7,000			
				Repair Concrete Platform	2008	$ 6,000			
				Emergency Float Redundancy	Nov-07	$ 1,400			
				New Pumps	2008	$ 60,000			
				Major upgrade to increase pump capacity	2009	n/a			

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Sanitary Sewer Overflows and Action Plans

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	Overflow Name / Location			Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action			Proposed Long-term Action		
							Action Description	Completed By	Estimated Cost	Action Description	Completed By	Estimated Cost
1	MH# S633	Area 1	(915 Garthland Pl.)	Gorge Waterway at CRD #737	High	Complete	Seperated Manhole	Completed	$ 5,800			
2	MH# S638	Area 1	(943 Garthland Rd.)	Gorge Waterway at CRD #737	High	Complete	Seperated Manhole	Completed	$ 5,800			
3	MH# S637	Area 1	(Garthland Rd./Garthland Pl.)	Gorge Waterway at CRD #737	High	Complete	Seperated Manhole	Completed	$ 5,800			
4	MH# S632	Area 1	(927 Garthland Pl.)	Gorge Waterway at CRD #737	High	Complete	Seperated Manhole	Completed	$ 5,800			
5	MH# S639	Area 1	(930 Garthland Rd.)	Gorge Waterway at CRD #737	High	B	Separate Manhole	2008	$ 6,000			
6	MH# S640	Area 1	(944 Garthland Rd.)	Gorge Waterway at CRD #737	High	B	Separate Manhole	2008	$ 6,000			
7	MH# S731	Area 1	(1178 Rhoda)	Gorge Waterway at CRD #737	High	B	Separate Manhole	2008	$ 6,000			
8	MH# S408	Area 1	(318 Uganda)	Gorge Waterway at CRD #749	High	B	Separate Manhole	2008	$ 6,000			
9	MH# S407	Area 1	(314 Uganda Ave.)	Gorge Waterway at CRD #749	High	B	Separate Manhole	Jun-05	$ 6,000			
10	MH# S757	Area 1	(306 Uganda Avenue)	Gorge Waterway at CRD #749	High	B	Separate Manhole	2008	$ 6,000			
11	MH# S415	Area 1	(313 Uganda Avenue)	Gorge Waterway at CRD #749	High	B	Separate Manhole	2016	$ 7,600			
12	MH# S414	Area 1	(305 UGANDA AVE)	Gorge Waterway at CRD #749	High	B				Separate Manhole	2016	$ 7,600
13	MH# S756	Area 1	(307 UGANDA AVE)	Gorge Waterway at CRD #749	High	B	Separate Manhole	2008	$ 6,000			

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Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

	Overflow Name / Location			Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action			Proposed Long-term Action		
							Action Description	Completed By	Estimated Cost	Action Description	Completed By	Estimated Cost
14	MH# S833	Area 1	(938 SELKIRK AVE)	Gorge Waterway at CRD #749	High	B	Separate Manhole	2008	$ 6,000			
15	MH# S666	Area 1	(Craigflower Rd & Aral Rd)	Gorge Waterway at CRD #728	High	Complete	Seperated Manhole	Complete	$ 5,800			
16	MH# S665	Area 1	(1390 Craigflower)	Gorge Waterway at CRD #728	High	Complete	Seperated Manhole	Complete	$ 5,800			
17	MH# S667	Area 1	(947 Aral Rd)	Gorge Waterway at CRD #728	High	Complete	Seperated Manhole	Complete	$ 5,800			
18	MH# S668	Area 1	(Aral Rd & Treebank Rd West)	Gorge Waterway at CRD #728	High	Complete	Seperated Manhole	Complete	$ 5,800			
19	MH# S808	Area 1	(905 Aral Rd)	Gorge Waterway at CRD #728	High	Complete	Seperated Manhole	Complete	$ 5,800			
20	MH# S650	Area 1	(Craigflower Rd & Dellwood Rd)	Gorge Waterway at CRD #735	High	Complete	Seperated Manhole	Complete	$ 5,800			
21	MH# S649	Area 1	(909 Dellwood Rd)	Gorge Waterway at CRD #735	High	Complete	Seperated Manhole	Complete	$ 5,800			
22	MH# S648	Area 1	(905 Dellwood Rd)	Gorge Waterway at CRD #735	High	Complete	Seperated Manhole	Complete	$ 5,800			
23	MH# S647	Area 1	(Dellwood Rd & Treebank Rd)	Gorge Waterway at CRD #735	High	Complete	Seperated Manhole	Complete	$ 5,800			
24	MH# S653	Area 1	(405 Treebank Rd)	Gorge Waterway at CRD #735	High	Complete	Seperated Manhole	Complete	$ 5,800			
25	MH# S645	Area 1	(937 Mesher Place)	Gorge Waterway at CRD #736	High	B	Separate Manhole	2008	$ 6,000			
26	MH# S469	Area 2	(967 Lampson Place)	Victoria Harbour at CRD #780	Moderate	Complete	Seperated Manhole	Completed	$ 5,800			

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Sanitary Sewer Overflows and Action Plans

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	Overflow Name / Location			Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Completed By	Estimated Cost	Proposed Long-term Action: Action Description	Completed By	Estimated Cost
27	MH# S468	Area 2	(951 Lampson Place)	Victoria Harbour at CRD #780	Moderate	Complete	Seperated Manhole	Completed	$ 5,800			
28	MH# S467	Area 2	(954 Lampson Place)	Victoria Harbour at CRD #780	Moderate	B	Seperate Manhole	2008	$ 5,800			
29	MH# S466	Area 2	(954 Lampson Place)	Victoria Harbour at CRD #780	Moderate	B	Separate Manhole	2008	$ 6,000			
30	MH# S695	Area 2	(538 West Bay Ice)	Victoria Harbour at CRD #780	Moderate	B	Separate Manhole	2008	$ 6,000			
31	MH# S582	Area 2	(Outfall 779)	Victoria Harbour at CRD #779	Moderate	B	Separate Manhole	2008	$ 6,000			
32	MH# S343	Area 2	(538 Sea Terrece)	Victoria Harbour at CRD #779	Moderate	B	Separate Manhole	2008	$ 6,000			
33	MH# S696	Area 2	(531 West Bay Ice)	Victoria Harbour at CRD #779	Moderate	B	Separate Manhole	2008	$ 6,000			
34	MH# S344	Area 2	(Back lot of 537 Head Street)	Victoria Harbour at CRD #779	Moderate	Complete	Seperated manhole	Completed	—			
35	MH# S465	Area 2	(954 LAMPSON PL)	Victoria Harbour at CRD #780	Moderate	A	Separate Manhole	2008	$ 6,000			
36	MH# S606	Area 2	(535 Joffre Street)	Victoria Harbour at CRD #781	Moderate	A	Separate Manhole	2008	$ 6,000			
37	MH# S580	Area 2	(900 Carlton Terrace)	Victoria Harbour at CRD #780	Moderate	B	Separate Manhole	Jun-05	$ 6,000			
38	MH# S579	Area 2	(904 Carlton Terrace)	Victoria Harbour at CRD #780	Moderate	B	Separate Manhole	2008	$ 6,000			
39	MH# S737	Area 2	(994 Wordsley Street)	Victoria Harbour at CRD #781	Moderate	A	Separate Manhole	2008	$ 6,000			

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Sanitary Sewer Overflows and Action Plans

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	Overflow Name / Location			Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action			Proposed Long-term Action		
							Action Description	Completed By	Estimated Cost	Action Description	Completed By	Estimated Cost
40	MH# S561	Area 2	(611 FERNHILL RD)	Victoria Harbour at CRD #781	Moderate	Complete	Seperated Manhole	Completed	$ 5,800			
41	MH# S562	Area 2	(619 FERNHILL RD)	Victoria Harbour at CRD #781	Moderate	Complete	Seperated Manhole	Completed	$ 5,800			
42	MH# S587	Area 2	(618 FERNHILL PL)	Victoria Harbour at CRD #781	Moderate	Complete	Seperated Manhole	Completed	$ 5,800			
43	MH# S563	Area 2	(625 FERNHILL RD)	Victoria Harbour at CRD #781	Moderate	Complete	Seperated Manhole	Completed	$ 5,800			
44	MH# S564	Area 2	(648 FERNHILL RD)	Victoria Harbour at CRD #781	Moderate	A	Separate Manhole	Jun-05	$ 6,000			
45	MH# S565	Area 2	(667 FERNHILL RD)	Victoria Harbour at CRD #781	Moderate	Complete	Seperated Manhole	Completed	$ 5,800			
46	MH# S578	Area 2	(908 CARLTON TERR)	Victoria Harbour at CRD #780	Moderate	Complete	Seperated Manhole	Completed	—			
47	MH# S554	Area 2	(1151 ESQUIMALT RD)	Victoria Harbour at CRD #781	Moderate	A	Separate Manhole	2008	$ 6,000			
48	MH# S555	Area 2	(1151 ESQUIMALT RD)	Victoria Harbour at CRD #781	Moderate	A	Separate Manhole	2008	$ 6,000			
49	MH# S475	Area 2	(1158 Greenwood Avenue)	Juan de Fuca Straight at CRD #805	Low	Complete	Seperated Manhole	Completed	$ 5,800			
50	MH# S476	Area 2	(1166 Greenwood Avenue)	Juan de Fuca Straight at CRD #805	Low	Complete	Seperated Manhole	Completed	$ 5,800			
51	MH# S474	Area 2	(1166 Hadfield Avenue)	Juan de Fuca Straight at CRD #806	Low	Complete	Seperated Manhole	Completed	$ -			
52	MH# S473	Area 2	(1146 Hadfield Avenue)	Juan de Fuca Straight at CRD #806	Low	Complete	Seperated Manhole	Completed	$ 5,800			

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				Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action			Proposed Long-term Action		
Overflow Name / Location							Action Description	Completed By	Estimated Cost	Action Description	Completed By	Estimated Cost
53	MH# S621	Area 2	(1206 Wychbury Avenue)	Juan de Fuca Straight at CRD #805	Low	Complete	Seperated Manhole	Completed	$ 5,800			
54	MH# S622	Area 2	(1215 Wychbury Avenue)	Juan de Fuca Straight at CRD #805	Low	Complete	Seperated Manhole	Completed	$ 5,800			
55	MH# S478	Area 2	(1163 Greenwood Avenue)	Juan de Fuca Straight at CRD #805	Low	Complete	Seperated Manhole	Completed	$ 5,800			
56	MH# S557	Area 2	(1210 Greenwood Avenue)	Juan de Fuca Straight at CRD #806	Low	Complete	Seperated Manhole	Completed	$ 5,800			
57	MH# S472	Area 2	(1116 Hadfield)	Juan de Fuca Straight at CRD #806	Low	Complete	Seperated Manhole	Completed	$ 5,800			
58	MH# S477	Area 2	(1172 Greenwood Avenue)	Juan de Fuca Straight at CRD #805	Low	Complete	Seperated Manhole	Completed	$ 5,800			
59	MH# S484	Area 2	(420 Constance Avenue)	Juan de Fuca Straight at CRD #809	Low	A	Separate Manhole	2008	$ 6,000			
60	MH# S558	Area 2	(520 block of Foster Street)	Juan de Fuca Straight at CRD #813	Low	Complete	Seperated Manhole	Completed	$ 5,800			
61	MH# S909	Area 2	(430 Grafton Street)	Juan de Fuca Straight at CRD #814	Low	A	Separate Manhole	2008	$ 6,000			
62	MH# S915	Area 2	(387 Constance Ave)	Juan de Fuca Straight at CRD #809	Low	A	Separate Manhole	2008	$ 6,000			
63	MH# S497	Area 3	(1046 Gospher Cr.)	Gorge Waterway at CRD #745	High	Complete	Seperated Manhole	Completed	$ 5,800			
64	MH# S406	Area 3	(1028 Gospher Cr.)	Gorge Waterway at CRD #745	High	Complete	Seperated Manhole	Completed	$ 5,800			
65	MH# S405	Area 3	(1016 Gospher Cr.)	Gorge Waterway at CRD #745	High	Complete	Seperated Manhole	Completed	$ 5,800			

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							Action Description	Completed By	Estimated Cost	Action Description	Completed By	Estimated Cost
66	MH# S501	Area 3	(1074 Gospher Cr.)	Gorge Waterway at CRD #745	High	B				Separate Manhole	2016	$ 7,600
67	MH# S499	Area 3	(1078 Gospher Cr.)	Gorge Waterway at CRD #745	High	B				Separate Manhole	2016	$ 7,600
68	MH# S500	Area 3	(1074 Gospher Cr.)	Gorge Waterway at CRD #745	High	B				Separate Manhole	2016	$ 7,600
69	MH# S494	Area 3	(1060 Tilicum)	Gorge Waterway at CRD #745	High	Complete	Seperated Manhole	Completed	$ 5,800			
70	MH# S403	Area 3	(1052 Tillicum)	Gorge Waterway at CRD #745	High	Complete	Seperated Manhole	Completed	$ 5,800			
71	MH# S498	Area 3	(1090 GOSPER CRES)	Gorge Waterway at CRD #745	High	B				Separate Manhole	2017	$ 7,800
72	MH# S495	Area 3	(1063 Gosper Crescent)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2008	$ 6,000			
73	MH# S402	Area 3	(1040 Tillicum)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2008	$ 6,000			
74	MH# S401	Area 3	(1098 Gosper Crescent)	Gorge Waterway at CRD #745	High	Complete	Seperated Manhole	Completed	—			
75	MH# S385	Area 3	(1098 GOSPER CRES)	Gorge Waterway at CRD #745	High	B				Separate Manhole	2017	$ 7,800
76	MH# S551	Area 3	(Back lane of 836 Elrick Place)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2021	$ 8,600
77	MH# S539	Area 3	(791 Hutchinson)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2021	$ 8,600
78	MH# S541	Area 3	(1298 Highrock)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2020	$ 8,400

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79	MH# S600	Area 3	(1259 Highrock Ave.)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2021	$ 8,600
80	MH# S552	Area 3	(831 Elrick Place)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2020	$ 8,400
81	MH# S546	Area 3	(1140 Lugrin Place)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2025	$ 9,400
82	MH# S543	Area 3	(Behind 1195 Lockley Rd.)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2017	$ 7,800
83	MH# S792	Area 3	(819 Condor Avenue)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2015	$ 7,400
84	MH# S547	Area 3	(1151 LUGRIN PL)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2021	$ 8,600
85	MH# S612	Area 3	(1291 HIGHROCK AVE)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2022	$ 8,800
86	MH# S791	Area 3	(819 Condor Ave.)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2022	$ 8,800
87	MH# S599	Area 3	(1275 HIGHROCK AVE)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2022	$ 8,800
88	MH# S795	Area 3	(1061 Wurtele Place)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2009	$ 6,200			
89	MH# S794	Area 3	(1033 Wurtele Place)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2009	$ 6,200			
90	MH# S538	Area 3	(816 Rockheights Ave.)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2009	$ 6,200			
91	MH# S537	Area 3	(832 Rockheights)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2009	$ 6,200			

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							Action Description	Completed By	Estimated Cost	Action Description	Completed By	Estimated Cost
92	MH# S534	Area 3	(864 Rockheights)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2009	$ 6,200			
93	MH# S796	Area 3	(775 Matheson Ave.)	Gorge Waterway at CRD #745	High	B				Separate Manhole	2018	$ 8,000
94	MH# S531	Area 3	(783 Matheson Ave.)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2008	$ 6,000			
95	MH# S529	Area 3	(879 Rockheights)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2010	$ 6,400			
96	MH# S527	Area 3	(Backyard of 860 Rockheights)	Gorge Waterway at CRD #745	High	B				Separate Manhole	2017	$ 7,800
97	MH# S525	Area 3	(1009 Wurtele Place)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2010	$ 6,400			
98	MH# S535	Area 3	(856 Rockheights)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2010	$ 6,400			
99	MH# S528	Area 3	(880 Rockheights)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2010	$ 6,400			
100	MH# S526	Area 3	(Backyard of 880 Rockheights)	Gorge Waterway at CRD #745	High	B				Separate Manhole	2017	$ 7,800
101	MH# S536	Area 3	(844 ROCKHEIGHTS AVE)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2010	$ 6,400			
102	MH# S793	Area 3	(1027 Wurtele Place)	Gorge Waterway at CRD #746	High	B	Separate Manhole	2011	$ 6,600			
103	MH# S607	Area 3	(741 Porter Road)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2011	$ 6,600			
104	MH# S570	Area 3	(929 Shearwater Street)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2011	$ 6,600			

Corrective Action Ranking: A = Top Priority; B = Medium Priority; C = Lower Priority

City of Esquimalt

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

	Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
105	MH# S569 Area 3 (913 Shearwater St.)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2011	$ 6,600			
106	MH# S906 Area 3 (901 Shearwater)	Gorge Waterway at CRD #745	High	B	Separate Manhole	2011	$ 6,600			
107	MH# S744 Area 3 (953 Shearwater Street)	Gorge Waterway at CRD #745	High	B				Separate Manhole	2018	$ 8,000
108	MH# S781 Area 3 (Naden St.)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2025	$ 9,400
109	MH# S429 Area 3 (842 Admirals Road)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2022	$ 8,800
110	MH# S504 Area 3 (861 Kindersley Road)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2023	$ 9,000
111	MH# S601 Area 5 (1235 High Rock Avenue)	Gorge Vale Golf Course at Q210	High	C				Separate Manhole	2025	$ 9,400
112	MH# S223 Area 5 (685 Admirals Road)	Constance Cove at CRD #854	Moderate	B				Separate Manhole	2019	$ 8,200
113	MH# S509 Area 5 (652 Drake Avenue)	Constance Cove at CRD #854	Moderate	B				Separate Manhole	2018	$ 8,000
114	MH# S602 Area 5 (1220 Blk of Effingham St.)	Constance Cove at CRD #854	Moderate	B	Separate Manhole	2012	$ 6,800			
115	MH# S511 Area 5 (1217 Rock Crescent Ave.)	Constance Cove at CRD #854	Moderate	B	Separate Manhole	2012	$ 6,800			
116	MH# S611 Area 5 (1269 Rockcrest)	Constance Cove at CRD #854	Moderate	B				Separate Manhole	2018	$ 8,000
117	No Number Area 5 (671 Drake Avenue)	Constance Cove at CRD #854	Moderate	B				Separate Manhole	2018	$ 8,000

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City of Esquimalt

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

	Overflow Name / Location			Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action			Proposed Long-term Action		
							Action Description	Completed By	Estimated Cost	Action Description	Completed By	Estimated Cost
118	MH# S510	Area 5	(1245 Rock Crescent Ave.)	Constance Cove at CRD #854	Moderate	B	Separate Manhole	2012	$ 6,800			
119	MH# S826	Area 5	(680 block of Admirals Road)	Constance Cove at CRD #854	Moderate	B	Separate Manhole	2012	$ 6,800			
120	MH# S444	Area 5	(908 Alexander Road)	Constance Cove at CRD #864A	Moderate	B				Separate Manhole	2019	$ 8,200
121	MH# S440	Area 5	(856 Parklands Drive)	Constance Cove at CRD #864A	Moderate	B				Separate Manhole	2014	$ 7,200
122	MH# S441	Area 5	(872 Parklands Drive)	Constance Cove at CRD #864A	Moderate	B				Separate Manhole	2013	$ 7,000
123	MH# S432	Area 5	(883 Admirals Road)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2023	$ 9,000
124	MH# S506	Area 5	(877 Kindersley Road)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2025	$ 9,400
125	MH# S434	Area 5	(897 Admirals Road)	Constance Cove at CRD #864A	Moderate	B				Separate Manhole	2013	$ 7,000
126	MH# S448	Area 5	(870 Cunningham Road)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2023	$ 9,000
127	MH# S452	Area 5	(945 Kingsmill Road)	Constance Cove, on Federal Property, east of CRD #864A	Moderate	B				Separate Manhole	2019	$ 8,200
128	MH# S843	Area 5	(863 Admirals Road)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2023	$ 9,000

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Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

	Overflow Name / Location			Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action			Proposed Long-term Action		
							Action Description	Completed By	Estimated Cost	Action Description	Completed By	Estimated Cost
129	MH# S449	Area 5	(881 Cunningham Street)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2024	$ 9,200
130	MH# S450	Area 5	(910 Parklands Drive)	Constance Cove at CRD #864A	Moderate	B				Separate Manhole	2013	$ 7,000
131	MH# S443	Area 5	(907 Kingsmill Road)	Constance Cove at CRD #864A	Moderate	B				Separate Manhole	2013	$ 7,000
132	MH# S442	Area 5	(885 Parklands Drive)	Constance Cove at CRD #864A	Moderate	B				Separate Manhole	2013	$ 7,000
133	MH# S447	Area 5	(891 Cunningham Road)	Constance Cove, on Federal Property, east of CRD #864A	—	C	Separate Manhole	2012	$ 6,800			
134	MH# S431	Area 5	(845 Admirals Road)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2024	$ 9,200
135	MH# S503	Area 5	(854 Admirals Road)	Gorge Vale Golf Course at Q210	—	C				Separate Manhole	2025	$ 9,400
136	MH# S436	Area 5	(904B Admirals Road)	Constance Cove at CRD #864A	Moderate	B				Separate Manhole	2015	$ 7,400
137	MH# S430	Area 5	(850 Admirals Road)	Constance Cove at CRD #864A	Moderate	B				Separate Manhole	2019	$ 8,200
138	MH# S435	Area 5	(909 Admirals Road)	Constance Cove at CRD #864A	Moderate	B				Separate Manhole	2015	$ 7,400
139	MH# S425	Area 5	(800 block of Admirals Road)	Constance Cove at CRD #854	Moderate	B				Separate Manhole	2014	$ 7,200
140	MH# S457	Area 5	(936 Alexander Road)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2019	$ 8,200

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City of Esquimalt

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

	Overflow Name / Location			Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action			Proposed Long-term Action		
							Action Description	Completed By	Estimated Cost	Action Description	Completed By	Estimated Cost
141	MH# S451	Area 5	(914 Parklands Drive)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2021	$ 8,600
142	MH# S426	Area 5	(800 block of Admirals Road)	Constance Cove at CRD #854	Moderate	B				Separate Manhole	2014	$ 7,200
143	MH# S433	Area 5	(880 block of Admirals Road)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2023	$ 9,000
144	MH# S456	Area 5	(908 Alexander Road)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2024	$ 9,200
145	MH# S588	Area 5	(877 Kindersley Road)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2024	$ 9,200
146	MH# S508	Area 5	(877 Kindersley Road)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2024	$ 9,200
147	MH# S589	Area 5	(866 Glen Garry Place)	Constance Cove, on Federal Property, east of CRD #864A	—	C				Separate Manhole	2022	$ 8,800
148	MH# S521	Area 5	(734 ROCKHEIGHTS AVE)	Constance Cove at CRD #854	Moderate	B				Separate Manhole	2014	$ 7,200
149	MH# S515	Area 5	(707 ROCKHEIGHTS AVE)	Constance Cove at CRD #854	Moderate	B				Separate Manhole	2014	$ 7,200
150	MH# S514	Area 5	(704 ROCKHEIGHTS AVE)	Constance Cove at CRD #854	Moderate	B				Separate Manhole	2020	$ 8,400
151	MH# S522	Area 5	(Rock Heights & Hutchinson)	Constance Cove at CRD #854	Moderate	B				Separate Manhole	2015	$ 7,400

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City of Esquimalt

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

	Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
152	MH# S517 Area 5 (Rock Heights & High Rock)	Constance Cove at CRD #854	Moderate	B				Separate Manhole	2015	$ 7,400
153	MH# S703 Area 5 (Esquimalt Road)	Constance Cove on DND property	—	C				Separate Manhole	2020	$ 8,400
154	MH# S704 Area 5 (1382 Esquimalt Road)	Constance Cove on DND property	—	C				Separate Manhole	2020	$ 8,400

Corrective Action Ranking: A = Top Priority; B = Medium Priority; C = Lower Priority

Report Date: 14/04/2009

District of Oak Bay

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
1. Satellite Pump Station(2768 Satellite St)	MH #6402 sewer over flow.Pipe extends below low tide approx 25m into ocean								
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause Nov 27/06 / 12 / 80000 / Power Outage		Low	C	Wet well has storage for 4 to 5 hours On Scada system Oak Bay has 2 portable back up generators that can be used to service the pump stations temporarily	2013	$10,000	**Reduce I&I**		Unknown
2. Bowker Pump Station(1860 Bowker Plc)	Flows in downstream Drain MH #1947,pipe extends below low tide approx 50m out into ocean								
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause Nov 27/06 / 24 / 325000 / Power Outage Nov 28/06 / 24 / 325000 / Power Outage Nov 29/06 / 24 / 325000 / Power Outage		Low	B	Wet well has 47m3 storage(approx 12hrs) Existing Scada system. Oak Bay has 2 portable back up generators that can be used to service the pump stations temporarily			**Reduce I&I**		Unknown

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

District of Oak Bay

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
3. Radcliffe Pump Station(#663 Radcliffe Lane)	Flows into chamber then flows into old sanitary sewer that meets with the old NE trunk at McMicking Pt partially exposed along the rocks								
Overflow Details Overflow Observation Date: Nov 27/06 Estimated Duration (hours): 24 Estimated Quantity (litres): 51000 Overflow Cause: Power Outage		Low	B	Wet well has storage for about 2 hours Scada System Oak Bay has 2 portable back up generators that can be used to service the pump stations temporarily	2013	$10,000	**Reduce I&I**		Unknown
4. King George Pump Station(261 King G. Tce)									
Overflow Details Overflow Observation Date: Nov 27/06 Estimated Duration (hours): 12 Estimated Quantity (litres): 8500 Overflow Cause: Power Outage	Flows into a downstream storm mh # 2932. Pipe runs 82m down an easement to steep embankment and into the ocean west of McNeil Bay	Low	C	Scada System Oak Bay has 2 portable back up generators that can be used to service the pump stations temporarily Wet well has storage for about 4 hours	2013	$10,000	**Reduce I&I**		Unknown

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

District of Oak Bay

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
5. Beach Drive Pump Station(951 Beach Drive)									
Overflow Details — Overflow Observation Date: Nov 27/06; Estimated Duration (hours): 24; Estimated Quantity (litres): 4300; Overflow Cause: Power Outage	Goes downstream into old 150mm sewer pipe that extends down to the rocks and then the ocean	Med	B	Scada System Oak Bay has 2 portable back up generators that can be used to service the pump stations temporarily	2013	$10,000	**Reduce I&I**		Unknown
6. Haro Road Pump Station									
Overflow Details — Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause: None	Goes into creek running through Mystic Vale then out toward the ocean by Cadboro Bay	High	B	Scada System Existing stand alone back up generator	2013	$10,000	**Reduce I&I**		Unknown

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

District of Saanich

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: 2006 / 2007

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
1. **Allison Pump Station** (SNS00004) - 1426 Allison Rd.	to culvert S. side of Allison Road	medium							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows									
2. **Arbutus Cove Pump Station** (SNS000027) - 2202 Arbutus Cove Ln.	To Drain Main to Arbutus Cove at CRD #0545A	low							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows									
3. **Arundel Pump Station** (SNS000033) - 990 Arundel Dr.	Portage Inlet at CRD #0690AA	high							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows				Rebuild of the pump station Installation of a standby generator Removal of the overflow	2008	$250,000			
4. **Ash Pump Station** (SNS000029) - 1531 Ash Rd.	Mt. Douglas Park Creek upstream of CRD #0559	low							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows				Has standby power					

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

District of Saanich

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: 2006 / 2007

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
5. Ashley Pump Station (SNS000036) - 2899 Ashley Rd.	Portage Inlet at CRD #0684	high							
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause) No 2006/2007 sewage overflows				Rebuild of the pump station Installation of a standby generator Removal of the overflow	2008	$250,000			
6. Brett Pump Station (SNS 000005) - 848 Brett Ave.	Swan Lake	high							
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause) No 2006/2007 sewage overflows				Has standby power					
7. Christmas Pump Station (SNS000019) - 3821 Shelbourne St.	Bowker Creek	high							
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause) No 2006/2007 sewage overflows									
8. Colquitz Pump Station (SNS000041) 798 Gorge Road West	Gorge Waterway at CRD #0675	high							
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause) 1 overflow in 2006 due to pump station capacity being exceeded				Rebuild of the pump station Installation of a standby generator Removal of the overflow	2009	$250,000			

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

District of Saanich

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: 2006 / 2007

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
9. D'Arcy Lane Pump Station (SNS000007) - 1115 D'Arcy Lane	Cordova Bay at CRD #0573	low							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows									
10. Dunkirk Lane Pump Station (SNS000042) - 2800 Murray Dr.	Portage Inlet at CRD #0681	high							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows				Rebuild of the pump station Installation of a standby generator Removal of the overflow	2008	$250,000			
11. Durling Pump Station (SNS000030) - 4527 Durling Pl.	Cordova Bay Beach at CRD #0558	low							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows									
12. Dysart Pump Station (SNS000020) 3089 Dysart Rd.	Colquitz River & Tanks at CRD #0690BB	high							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause 4 overflows in 2006 due to I&I 5 overflows in 2007 (1 due to power failure and 4 due to PS capacity being exceeded)				Complete construction of a new pump station Installation of a standby generator Removal of the overflow	2008	$2,500,000			

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District of Saanich

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: 2006 / 2007

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
13. Garnet Pump Station (SNS000015) - 1630 Garnet Rd.	Bowker Creek	high							
Overflow Details — Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows				Has standby power					
14. Glenwood Pump Station (SNS000034) - 2900 Glenwood Ave.	Portage Inlet at CRD #0688	high							
Overflow Details — Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows				Rebuild of the pump station Installation of a standby generator Removal of the overflow	2008	$250,000			
15. Gorgeview Pump Station (SNS000040) 372 Gorge Road West	Gorge Waterway at CRD #0658	high							
Overflow Details — Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause 1 overflow in 2007 due to power failure				Rebuild of the pump station Installation of a standby generator Removal of the overflow	2010	$250,000			
16. Grange Pump Station (SNS000011) - 3732 Grange Rd.	Portage Inlet at CRD #0690C	high							
Overflow Details — Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause 1 overflow in 2006 due to power failure									

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

District of Saanich

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: 2006 / 2007

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
17. Murray # 1 Pump Station (SNS000018) - 3872A Murray Dr.	Portage Inlet at CRD# 0685	high							
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause) No 2006/2007 sewage overflows				Rebuild of the pump station Installation of a standby generator Removal of the overflow	2008	$250,000			
18. Murray # 2 Pump Station (SNS000035) 2834A Murray Dr.	Portage Inlet at CRD #0683	high							
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause) No 2006/2007 sewage overflows				Rebuild of the pump station Installation of a standby generator Removal of the overflow	2008	$250,000			
19. Nigel Pump Station (SNS000006) - 848 Nigel Ave.	Swan Lake	high							
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause) No 2006/2007 sewage overflows									
20. Pear Pump Station (SNS000003) - 1670 Pear St.	Bowker Creek	high	C						
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause) No 2006/2007 sewage overflows				Has standby power					

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

District of Saanich

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: 2006 / 2007

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
21. Phyllis Pump Station (SNS000021) - 3992 Tudor Ave.	Haro Strait at CRD #0527	low							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows									
22. Seaview # 1 Pump Station (SNS000024) 2738 Seaview Rd.	Adjacent drain to Cadboro Bay at CRD #0510	low							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause 2 overflows in 2006 due to power failure									
23. Seaview # 2 Pump Station (SNS000023) - 3820 Cadboro View Rd.	Cadboro Bay at CRD #0511	low							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows				Has standby power					

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

District of Saanich

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: 2006 / 2007

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
24. Seaview # 3 Pump Station (SNS000022) - 2978 Seaview Rd.	Adjacent drain to Cadboro Bay at CRD # 516	low							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause 2 overflows in 2006 due to power failure									
25. Shoreway Pump Station (SNS000031) - 4499 Shore Way	Haro Strait at CRD #0549	low							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows				Has standby power					
26. Smuggler's Cove Pump Station (SNS000017) - 3901 Smugglers Cove Rd.	Maynard Cove at CRD #0521A	low							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows									
27. Tudor Pump Station (SNS000016) - 3883 Tudor Ave.	Cadboro Bay at CRD #0518	low							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause No 2006/2007 sewage overflows				Has standby power					

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

District of Saanich

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: 2006 / 2007

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
28. Vantreight Pump Station (SNS000032) - 4649 Vantreight Dr.	Adjacent drain to Margaret Bay at CRD #0550	low							
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause) 1 overflow in 2006 due to power failure 2 overflows in 2007 due to power failure				Rebuild of the pump station Installation of a standby generator Removal of the overflow	2008	$250,000			
29. Wetherby Pump Station (SNS000037) - 3201 Wetherby Rd.	Bowker Creek	high							
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause) No 2006/2007 sewage overflows									
30. Wilkinson Pump Station (SNS000012) - 1192 Trans Canada Hwy.	Adjacent drain to Portage Inlet at CRD #0692	high							
Overflow Details (Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause) 2 overflows in 2006 due to power failures									

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Report Date: 01/11/2008

City of Victoria

Sanitary Sewer Overflow Action Plan

REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity[1]	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
1. Cecelia Pump Station	O/F to D4691 that drains into Cecelia Creek	High	B	Investigate and monitor to determine frequency and duration of O/F.	2010		Reduce I&I in Victoria.	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause				Upgrade lift station kiosk to allow external power supply (such as a portable generator)	complete				
2. Government Pump Station (O/F at MH S4367)	O/F at S4367 to D2379 that drains into Rock Bay at CRD #626	Moderate	B	Investigate and monitor to determine frequency and duration of O/F.	2010		Reduce I&I in Victoria.	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause				Upgrade lift station kiosk to allow external power supply (such as a portable generator)	2010				
3. Dockside Pump Station	O/F to private sewage treatment on Dockside development	Moderate	C	Continue monitoring to determine frequency and duration of O/F.	2010		Reduce I&I in Victoria.	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause				Upgrade lift station kiosk to allow external power supply (such as a portable generator)	complete				
4. Superior Pump Station (O/F at MH S5242)	O/F at S5242 that drains to Fisherman's Park at CRD #607	Moderate	B	Investigate and monitor to determine frequency and duration of O/F.	2010		Reduce I&I in Victoria.	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause				Upgrade lift station kiosk to allow external power supply (such as a portable generator)	2010				
5. Niagara Pump Station (O/F at MH S1585)	O/F from S1585 to D1385 that drains to Camel Pt at CRD #603	Low	C	Investigate and monitor to determine frequency and duration of O/F.	2010		Reduce I&I in Victoria.	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause				Upgrade lift station kiosk to allow external power supply (such as a portable generator)	complete				

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City of Victoria

Sanitary Sewer Overflow Action Plan

REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity[1]	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
6. Linden Pump Station	O/F at S3264 that drains into Ross Bay at CRD #216	Moderate	C	Investigate and monitor to determine frequency and duration of O/F.	2010		Reduce I&I in Victoria.	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause				Upgrade lift station kiosk to allow external power supply (such as a portable generator)	2010				
7. Garbally Pump Station	O/F at S4841 to SD that drains into Selkirk at CRD #636	Moderate	D	Abandoned			Reduce I&I in Victoria.	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause				Upgrade lift station kiosk to allow external power supply (such as a portable generator)	complete				
8. Dallas at South Turner (MH S1782)	O/F to D3549 removed	High	A	Removed					
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									
9. Dallas at Memorial (MH S3426)	O/F to SD main abandoned	Moderate	B	Abandoned					
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									
10. Douglas at Avalon (MH S1669)	O/F to D1456 removed	Moderate	B	Removed					
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									

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Sanitary Sewer Overflow Action Plan

REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

				Proposed Short-term Action			Proposed Long-term Action		
Overflow Name / Location	**Discharge Destination**	**Receiving Environment Sensitivity**[1]	**Corrective Action Ranking**	**Action Description**	**Completed By**	**Estimated Cost**	**Action Description**	**Completed By**	**Estimated Cost**
11. Douglas at Pembroke (MH S2220)	O/F into D2391 that drains into Rock Bay at CRD #626	Moderate	B	Investigate, monitor and abandon if possible.	2010		Reduce I&I in Victoria.	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									
12. Easement thru 850 McCaskill (MH S4309)	O/F to SD main that drains into West Bay at CRD #777	Moderate	B	Investigate, monitor and abandon if possible.	2010		Reduce I&I in Victoria.	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									
13. Griffiths at Sherk (MH S4291)	O/F into D1950 that drains into West Bay at CRD #777	Moderate	C	Investigate, monitor and abandon if possible.	2010		Reduce I&I in Victoria.	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									
14. Kings at Prior (MH S1515)	O/F to SD main abandoned	Moderate	B	Abandoned					
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									
15. Kings at Fifth (MH S1540)	O/F to SD main that drains into Rock Bay at CRD #627	Moderate	A	Investigate, monitor and abandon if possible.	2010		Reduce I&I in Victoria	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									

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REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity[1]	Corrective Actions Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
16. Linden, north of May (MH S3264)	O/F to SD main that drains into Ross Bay at CRD #216	Moderate	B	Investigate, monitor and abandon if possible.	2010		Reduce I&I in Victoria	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									
17. Maddison, south of Quamichan (MH S3682)	O/F to SD main that drains into Ross Bay at CRD #222	Moderate	C	Investigate, monitor and abandon if possible.	2010		Reduce I&I in Victoria	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									
18. May at Howe (MH S2624)	O/F to SD main that drains into Ross Bay at CRD #216	Moderate	B	Investigate, monitor and abandon if possible.	2010		Reduce I&I in Victoria	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									
19. Michigan at Parry (MH S1735)	O/F to D1503 that drains into Fisherman Wharf at CRD #607	Moderate	B	Investigate, monitor and abandon if possible.	2010		Reduce I&I in Victoria	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									
20. Niagara at San Jose (MH S1604)	O/F to D1395 that drains onto shoreline at CRD #208	High	A	Investigate, monitor and abandon if possible.	2010		Reduce I&I in Victoria	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									

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REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity[1]	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
21. Niagara at Rendall (MH S1608)	O/F to D1396 removed	High	A	Removed					
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									
22. St. Charles, north of Philippa (MH S3515)	O/F to SD main that drains into Ross Bay at CRD #222	Moderate	C	Investigate, monitor and abandon if possible.	2010		Reduce I&I in Victoria	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									
23. Wharf at Johnson (MH S2267)	O/F to SD main that drains into Inner Harbour at CRD #619	Moderate	B	Continue monitoring at metered MH (S2298)	Ongoing		Reduce I&I in Victoria	2005-2030	
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause									

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City of Victoria

Sanitary Sewer Combined MH Action Plan

REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Combined Manhole Location	Storm Drain Discharge Destination	Receiving Environment Sensitivity[1]	[redacted]	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
1. **Asquith Street, in front of #2543 (MH S1331 combined with MH D1225)**	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole or install 2 manholes, if required.	2025	$10,000
2. **Asquith Street, in front of #2577 (MH S1332 combined with MH D1226)**	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
3. **Balfour Place, west end (MH S4985 combined with MH D2014)**	Drains into Selkirk at Outfall #645	High	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
4. **Blackwood Street @ Topaz Avenue (MH S1033 combined with MH D1014)**	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
5. **Blackwood Street @ Montrose Avenue (MH S1026 combined with MH D1003)**	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
6. **Blackwood Street @ Summit Avenue (MH S1038 combined with MH D1019)**	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
7. **Blackwood Street, in front of #2983 (MH S1037 combined with MH D1018)**	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Combined Manhole Location	Storm Drain Discharge Destination	Receiving Environment Sensitivity[1]	Corrective Action Ranking	Proposed Short-term Action			Proposed Long-term Action		
				Action Description	Completed By	Estimated Cost	Action Description	Completed By	Estimated Cost
8. Blackwood Street @ Arthur Avenue (MH S1036 combined with MH D1017)	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
9. Bywood Place, in front of #1528 (MH S3813 combined with MH D4029)	Drains into Ross Bay at Outfall #222	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
10. Capital Heights, in front of #2620 (MH S1460 combined with MH D1304)	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
11. Capital Heights @ Kings Road (MH S5000 combined with MH D1301)	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
12. Capital Heights, in front of #2657 (MH S1459 combined with MH D1303)	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
13. Cedar Hill @ Hipwood Lane (MH S4718 combined with MH D1110)	Drains into Bowker Cr at Outfall #BC2	High	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
14. Cook Street @ Cedar Hill Road (MH S4713 combined with MH D4481)	Drains into Bowker Cr at Outfall #BC2	High	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Combined Manhole Location	Storm Drain Discharge Destination	Receiving Environment Sensitivity[1]	[redacted]	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
15. Cook Street, in front of #2811 (MH S4712 combined with MH D4483)	Drains into Bowker Cr at Outfall #BC2	High	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
16. Craigdarroch Road @ Royal Terrace (MH S3874 combined with MH D4005)	Drains into Ross Bay at Outfall #216	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
17. Craigdarroch Road, in front of #1026 (MH S3885 combined with MH D3975)	Drains into Inner Harbour at Outfall #614	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
18. Craigdarroch Road, in front of #1049 (MH S0283 combined with MH D3974)	Drains into Inner Harbour at Outfall #614	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
19. Craigdarroch Road @ Joan Crescent (MH S3872 combined with MH D4007)	Drains into Ross Bay at Outfall #216	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
20. Craigdarroch Road, in front of #1347 (MH S3884 combined with MH D3976)	Drains into Inner Harbour at Outfall #614	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
21. Craigdarroch Road, in front of #1380 (MH S3873 combined with MH D4006)	Drains into Ross Bay at Outfall #216	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Combined Manhole Location	Storm Drain Discharge Destination	Receiving Environment Sensitivity[1]	[illegible]	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
22. Dallas Road, in front of #1470 (MH S3419 combined with MH D0466)	Drains into Ross Bay at Outfall #216	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
23. Dalton Street @ Suffolk Street (MH S4237 combined with MH D4934)	Drains into West Bay at Outfall #776	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
24. Delatre Street, in front of #2849 (MH S1177 combined with MH D1132)	Drains into Bowker Cr at Outfall #BC2	High	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
25. Easement, thru 3134 Washington Avenue (MH S2524 combined with MH D2106)	Drains into Cecelia Cr at Outfall #641	High	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
26. Easement, behind 1287 Montrose Avenue (MH S1014 combined with MH D3195)	Drains into Rock Bay at Outfall #627	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
27. Easement, behind 2577 Asquith Street (MH S1333 combined with MH D0582)	Drains into Rock Bay at Outfall #627	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
28. Easement, behind 1345 Topaz Avenue (MH S0180 combined with MH D1011)	Drains into Rock Bay at Outfall #627	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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Combined Manhole Location	Storm Drain Discharge Destination	Receiving Environment Sensitivity[1]	[redacted]	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
29. Easement, behind 1259 Revercomb Place (MH S0177 combined with MH D4033)	Drains into Ross Bay at Outfall #216	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
30. Easement, thru 419 Burnside Road (MH S0039 combined with MH D5234)	Drains into Cecelia Cr at Outfall #641	High	[redacted]	Abandoned					
31. Easement, thru 419 Burnside Road (MH S2428 combined with MH D4715)	Drains into Cecelia Cr at Outfall #641	High	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
32. Easement, thru 419 Burnside Road (MH S2429 combined with MH D2103)	Drains into Cecelia Cr at Outfall #641	High	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
33. Easement, thru 419 Burnside Road (MH S0030 combined with MH D5233)	Drains into Cecelia Cr at Outfall #641	High	[redacted]	Abandoned					
34. Easement, behind 419 Burnside Road (MH S2521 combined with MH D2102)	Drains into Cecelia Cr at Outfall #641	High	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
35. Easement, behind 1159 Tolmie Avenue (MH S1106 combined with MH D1071)	Drains into Cecelia Cr at Outfall #641	High	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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Combined Manhole Location	Storm Drain Discharge Destination	Receiving Environment Sensitivity[1]	[redacted]	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
36. Easement, behind 407 Burnside Road (MH S5001 combined with MH D4703)	Drains into Cecelia Cr at Outfall #641	High	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
			[redacted]						
37. Easement, behind 1542 Bywood Place (MH S3812 combined with MH D4028)	Drains into Ross Bay at Outfall #222	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
			[redacted]						
38. Easement, east PL of 1236 Richardson (MH S4855 combined with MH D4042)	Drains into Ross Bay at Outfall #216	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
			[redacted]						
39. Easement, behind 1325 Topaz Avenue (MH S4605 combined with MH D3197)	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
			[redacted]						
40. Foul Bay Road @ Romney Road (MH S3603 combined with MH D3809)	Drains into Ross Bay at Outfall #222	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
			[redacted]						
41. Gosworth Road @ Stroud Road (MH S1183 combined with MH D1137)	Drains into Bowker Cr at Outfall #BC2	High	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
			[redacted]						
42. Graham Street, in front of #2537 (MH S1525 combined with MH D1342)	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
			[redacted]						

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REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

				Proposed Short-term Action			Proposed Long-term Action		
Combined Manhole Location	**Storm Drain Discharge Destination**	**Receiving Environment Sensitivity[1]**	**Corrective Action Ranking**	**Action Description**	**Completed By**	**Estimated Cost**	**Action Description**	**Completed By**	**Estimated Cost**
43. **Graham Street, in front of #2561 (MH S1526 combined with MH D1344)**	Drains into Rock Bay at Outfall #627	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
44. **Graham Street @ Summit Avenue (MH S1060 combined with MH D1034)**	Drains into Rock Bay at Outfall #627	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
45. **Graham Street, in front of #2934 (MH S1059 combined with MH D0654)**	Drains into Rock Bay at Outfall #627	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
46. **Green Oaks Terrace, in front of #1742 (MH S3795 combined with MH D4319)**	Drains into Ross Bay at Outfall #222	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
47. **Green Oaks Terrace, in front of #1723 (MH S3796 combined with MH D4320)**	Drains into Ross Bay at Outfall #222	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
48. **Green Oaks Terrace, west of Richmond Ave (MH S3794 combined with MH D4316)**	Drains into Ross Bay at Outfall #222	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
49. **Hamilton Road @ Myrtle Avenue (MH S1432 combined with MH D1286)**	Drains into Bowker Cr at Outfall #BC2	High	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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City of Victoria

Sanitary Sewer Combined MH Action Plan

REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Combined Manhole Location	Storm Drain Discharge Destination	Receiving Environment Sensitivity[1]	Corrective Action Ranking	Proposed Short-term Action			Proposed Long-term Action		
				Action Description	Completed By	Estimated Cost	Action Description	Completed By	Estimated Cost
50. Irma Street @ Lotus Street (MH S4980 combined with MH D2002)	Drains into Selkirk at Outfall #650	High	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
51. Irma Street, in front of #2975 (MH S4984 combined with MH D2000)	Drains into Selkirk at Outfall #645	High	C	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
52. Jackson Street @ Summit Avenue (MH S1061 combined with MH D3228)	Drains into Rock Bay at Outfall #627	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
53. Joan Crescent, north of Manor Road (MH S3869 combined with MH D4012)	Drains into Ross Bay at Outfall #222	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
54. Joan Crescent, in front of #1029 (MH S3876 combined with MH D4009)	Drains into Ross Bay at Outfall #216	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
55. Laneway, behind 239 St. Andrew Street (MH S1796 combined with MH D3572)	Drains into Fishermans Wharf at Outfall #607	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
56. Langham Court, in front of #801 (MH S4250 combined with MH D4041)	Drains into Ross Bay at Outfall #216	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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Sanitary Sewer Combined MH Action Plan

REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Combined Manhole Location	Storm Drain Discharge Destination	Receiving Environment Sensitivity[1]	[redacted]	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
57. **Langham Court, in front of #802 (MH S4253 combined with MH D4040)**	Drains into Ross Bay at Outfall #216	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
58. **Laurel Lane, in front of #1525 (MH S3836 combined with MH D3412)**	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
59. **Manor Road, in front of #1314 (MH S3866 combined with MH D5046)**	Drains into Ross Bay at Outfall #216	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
60. **Marifield Avenue, in front of #620 (MH S1675 combined with MH D1459)**	Drains into Fishermans Wharf at Outfall #607	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
61. **Montrose Avenue, in front of #1284 (MH S0173 combined with MH D1045)**	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
62. **Montrose Avenue, in front of #1276 (MH S1017 combined with MH D3196)**	Drains into Rock Bay at Outfall #627	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
63. **Reed Street @ Yew Street (MH S5106 combined with MH D4570)**	Drains into Cecelia Cr at Outfall #641	High	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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Sanitary Sewer Combined MH Action Plan

REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Combined Manhole Location	Storm Drain Discharge Destination	Receiving Environment Sensitivity[1]	Corrective Action Ranking	Proposed Short-term Action: Action Description	Completed By	Estimated Cost	Proposed Long-term Action: Action Description	Completed By	Estimated Cost
64. Reed Street, in front of #852 (MH S5107 combined with MH D4569)	Drains into Cecelia Cr at Outfall #641	High	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
65. Regents Place @ Laurel Lane (MH S3835 combined with MH D3411)	Drains into Rock Bay at Outfall #627	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
66. Revercomb Place, in front of #1253/55 (MH S0176 combined with MH D4034)	Drains into Ross Bay at Outfall #216	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
67. Richardson Street, in front of #1631 (MH S3567 combined with MH D0156)	Drains into Ross Bay at Outfall #222	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
68. Richardson Street, east of Harbinger Street (MH S0179 combined with MH D4046)	Drains into Ross Bay at Outfall #216	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
69. Richardson Street, in front of #1660 (MH S3568 combined with MH D0158)	Drains into Ross Bay at Outfall #222	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
70. Richardson Street, in front of #1636 (MH S3565 combined with MH D0157)	Drains into Ross Bay at Outfall #222	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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Sanitary Sewer Combined MH Action Plan

REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

				Proposed Short-term Action			Proposed Long-term Action		
Combined Manhole Location	**Storm Drain Discharge Destination**	**Receiving Environment Sensitivity[1]**	[redacted]	**Action Description**	**Completed By**	**Estimated Cost**	**Action Description**	**Completed By**	**Estimated Cost**
71. **Richardson Street, in front of #1959 (MH S3617 combined with MH D4376)**	Drains into Ross Bay at Outfall #222	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
72. **Rockland Avenue @ Cyril Close (MH S3780 combined with MH D4256)**	Drains into Ross Bay at Outfall #222	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
73. **Romney Road, in front of #2029 (MH S3608 combined with MH D0115)**	Drains into Ross Bay at Outfall #222	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
74. **Romney Road, in front of #2020 (MH S3607 combined with MH D0116)**	Drains into Ross Bay at Outfall #222	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
75. **Romney Road, in front of #2008 (MH S3606 combined with MH D4413)**	Drains into Ross Bay at Outfall #222	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
76. **Royal Terrace @ Manor Road (MH S3865 combined with MH D4004)**	Drains into Ross Bay at Outfall #216	Moderate	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
77. **Ryan Place, in front of #1332 (MH S1483 combined with MH D1318)**	Drains into Bowker Cr at Outfall #BC2	High	[redacted]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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Sanitary Sewer Combined MH Action Plan

REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Combined Manhole Location	Storm Drain Discharge Destination	Receiving Environment Sensitivity[1]	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
78. Ryan Place, in front of #1336 (MH S1485 combined with MH D1320)	Drains into Bowker Cr at Outfall #BC2	High	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
79. Shotbolt Road, in front of #1907 (MH S0102 combined with MH D0073)	Drains into Gonzales Bay at Outfall #230	High	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
80. Shotbolt Road, in front of #1917 (MH S0125 combined with MH D0101)	Drains into Gonzales Bay at Outfall #230	High	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
81. Stroud Road, in front of #1475 (MH S1182 combined with MH D1135)	Drains into Bowker Cr at Outfall #BC2	High	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
82. Stroud Road @ Delatre Street (MH S1178 combined with MH D1119)	Drains into Bowker Cr at Outfall #BC2	High	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
83. Suffolk Street, in front of #715 (MH S4235 combined with MH D4938)	Drains into West Bay at Outfall #776	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
84. The Rise, in front of #2816 (MH S1013 combined with MH D1005)	Drains into Rock Bay at Outfall #627	Moderate	[illegible]	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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Report Date: 02/15/2008

City of Victoria

Sanitary Sewer Combined MH Action Plan

REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Combined Manhole Location	Storm Drain Discharge Destination	Receiving Environment Sensitivity[1]	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
85. Topaz Avenue @ Glasgow Street (MH S4733 combined with MH D3256)	Drains into Rock Bay at Outfall #627	Moderate	C	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
86. Topaz Avenue, in front of #1248 (MH S1034 combined with MH D1015)	Drains into Rock Bay at Outfall #627	Moderate	C	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
87. Tovido Lane, behind 1408 Finlayson Street (MH S1147 combined with MH D1101)	Drains into Bowker Cr at Outfall #BC2	High	C	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
88. Tovido Lane, behind 1417 Finlayson Street (MH S1153 combined with MH D1104)	Drains into Bowker Cr at Outfall #BC2	High	C	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
89. Tovido Lane, south of Finlayson Place (MH S1154 combined with MH D1105)	Drains into Bowker Cr at Outfall #BC2	High	C	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
90. Warren Gardens, in front of #1685 (MH S3586 combined with MH D4215)	Drains into Ross Bay at Outfall #222	Moderate	C	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
91. Warren Gardens, in front of #1637 (MH S3583 combined with MH D0151)	Drains into Ross Bay at Outfall #222	Moderate	C	Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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Sanitary Sewer Combined MH Action Plan

REPORTING PERIOD: From: 01-Jan-07 To: 31-Dec-07

Combined Manhole Location	Storm Drain Discharge Destination	Receiving Environment Sensitivity[1]	Corrective Action Funding	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
92. **Warren Gardens, in front of #1604 (MH S3582 combined with MH D0150)**	Drains into Ross Bay at Outfall #222	Moderate		Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
93. **Warren Gardens, in front of #1658 (MH S3585 combined with MH D4214)**	Drains into Ross Bay at Outfall #222	Moderate		Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
94. **Wesley Place, in front of #2590 (MH S1467 combined with MH D1308)**	Drains into Rock Bay at Outfall #627	Moderate		Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
95. **Wesley Place, in front of #2490 (MH S1464 combined with MH D1306)**	Drains into Rock Bay at Outfall #627	Moderate		Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
96. **Wesley Place, in front of #2518 (MH S1466 combined with MH D1307)**	Drains into Rock Bay at Outfall #627	Moderate		Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
97. **Wilson Street, in front of #671 (MH S4244 combined with MH D4965)**	Drains into West Bay at Outfall #777	Moderate		Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000
98. **Windermere Place, in front of #330 (MH S3299 combined with MH D0350)**	Drains into Ross Bay at Outfall #216	Moderate		Investigate, detail & monitor to determine if overflow possible.	2009		Retrofit existing manhole, or install 2 manholes, if required.	2025	$10,000

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Town of View Royal

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
1. Glenairlie Pump Station	Portage Inlet at CRD #0711	High							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause None				Scada and electrical system upgraded in 2006			**New pumps & generator**	2010	$65,000
2. Heddle Pump Station	Esquimalt Harbour at CRD #0874	Med							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause None				Scada monitoring - response with mobile generator			**New pumps & generator**	2011	$65,000
3. Helmcken Park	Portage Inlet at CRD #0704	High							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause None				Scada monitoring - generator in place			**I&I area investigation** **Rain Gauge**	2008 2008	$10,000 $4,000
4. Helmcken Bay Pump Station	Esquimalt Harbour at CRD #0873	Med							
Overflow Details Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause None				Scada monitoring - generator in place			**Rain Gauge**	2009	$4,000

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Town of View Royal

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
5. Hospital Pump Station and Flume Chamber	Portage Inlet at CRD #0697	High							
Overflow Details — Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause: None				Pumps and Ventilation System updated in 2006 Generator Installed			**Rain gauge**	2009	$4,000
6. Midwood Pump Station	Portage Inlet at CRD #0706	High							
Overflow Details — Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause: None				Scada monitoring - response with mobile generator			**New pumps, fan, generator, flow meter, rain gauge**	2008	$80,000
7. Norquay Pump Station	Esquimalt Harbour at CRD #0875A	Med							
Overflow Details — Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause: None				Scada monitoring - response with mobile generator			**New pumps & generator**	2014	$65,000
8. Price Bay	Esquimalt Harbour at CRD #0878A	Med							
Overflow Details — Overflow Observation Date / Estimated Duration (hours) / Estimated Quantity (litres) / Overflow Cause: None				Scada monitoring - response with mobile generator			**New pumps, fan, generator, flow meter, rain gauge**	2009	$80,000

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

Town of View Royal

Sanitary Sewer Overflows and Action Plans

REPORTING PERIOD: From: To:

Overflow Name / Location	Discharge Destination	Receiving Environment Sensitivity	Corrective Action Ranking	Proposed Short-term Action: Action Description	Proposed Short-term Action: Completed By	Proposed Short-term Action: Estimated Cost	Proposed Long-term Action: Action Description	Proposed Long-term Action: Completed By	Proposed Long-term Action: Estimated Cost
9. Stewart Pump Station	Esquimalt Harbour at CRD #0872	Med							
Overflow Details — Overflow Observation Date: None; Estimated Duration (hours); Estimated Quantity (litres); Overflow Cause				Scada monitoring - response with mobile generator			**New pumps & generator**	2013	$65,000
10. Thetis Cove	Esquimalt Harbour at CRD # 867	Med							
Overflow Details — Overflow Observation Date: None; Estimated Duration (hours); Estimated Quantity (litres); Overflow Cause				Scada monitoring - response with mobile generator			**New pumps & generator**	2012	$65,000
11. View Royal Pump Station	Portage Inlet at CRD #0709	High							
Overflow Details — Overflow Observation Date: None; Estimated Duration (hours); Estimated Quantity (litres); Overflow Cause				Scada monitoring - generator in place					
12. Packer's Pump Station (at MH# 170)	Small pond, located next to the first manhole upstream of the pump station	Med							
Overflow Details — Overflow Observation Date: None; Estimated Duration (hours); Estimated Quantity (litres); Overflow Cause				Install datalogger to monitor for overflows					

Corrective Action Ranking: **A** = Top Priority; **B** = Medium Priority; **C** = Lower Priority

APPENDIX H

EDUCATION MATERIAL:
I&I BROCHURE AND
EXCERPTS FROM THE CRD I&I WEBSITE

Making a difference...together

Sanitary Sewer Inflow & Infiltration

CRD Inflow & Infiltration Program

The CRD's Inflow and Infiltration (I&I) Program was created in the early 1990's as part of the CRD's Core Area Liquid Waste Management Plan (LWMP).

The purpose of the program is to reduce the amount of rainwater and groundwater entering the sanitary sewer system when it is cost-effective to do so. Reduction of I&I in the system lowers the risk of sanitary sewer overflows and can decrease the costs of conveying and treating wastewater.

The LWMP mandates a joint responsibility between the municipalities and the CRD in reducing sanitary sewer I&I.

Sanitary Sewer I & I Overview

Inflow and infiltration refers to rainwater and groundwater that enters the sanitary sewer. A certain amount of I&I is unavoidable and is accounted for in routine sewer design. However, when I&I exceeds design allowances, sewer capacity is consumed and may result in overflows, risks to health, damage to the environment and increased conveyance costs.

The following links are helpful for further understanding I&I:

- Overview of Sanitary Sewers & Storm Sewers
- Common Sources of I&I (PDF)
- Reasons for Reducing I&I
- Methods of Detecting Sources of I &I

Sanitary Sewer Maintenance Responsibilities

Homeowners are responsible for maintaining the sewer service laterals on their private property. **Municipalities** are responsible for maintaining sewers and sewer laterals on public right of ways. Read more

How to Reduce I&I

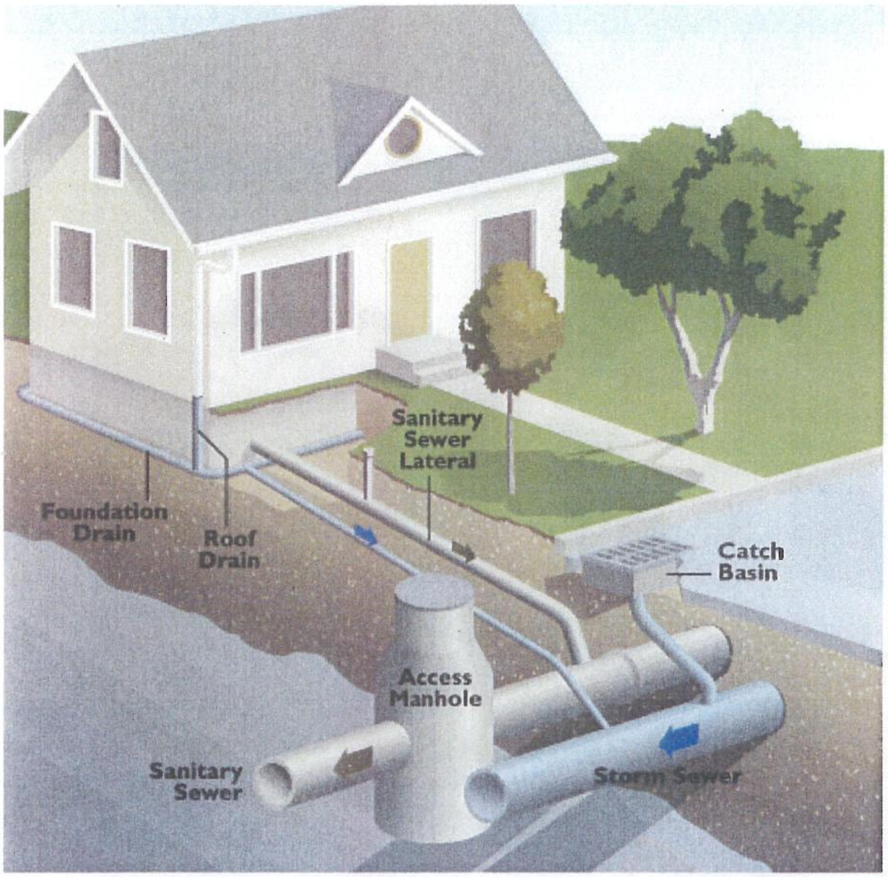
- Four techniques homeowners can use to reduce I&I
- Five techniques municipalities use to reduce I&I

Sewer overflows and backups can cause health hazards, require significant cleanup costs and result in long-term environmental damage. These problems can be prevented by finding and fixing sewer defects on both public and private property.

CRD

Making a difference...together

Sanitary Sewer & Storm Sewer Overview



Storm Sewers: Are designed to convey rainwater and groundwater flows to nearby water bodies. They are owned and maintained by municipality and are typically located within public road rights-of-way or private property easements.

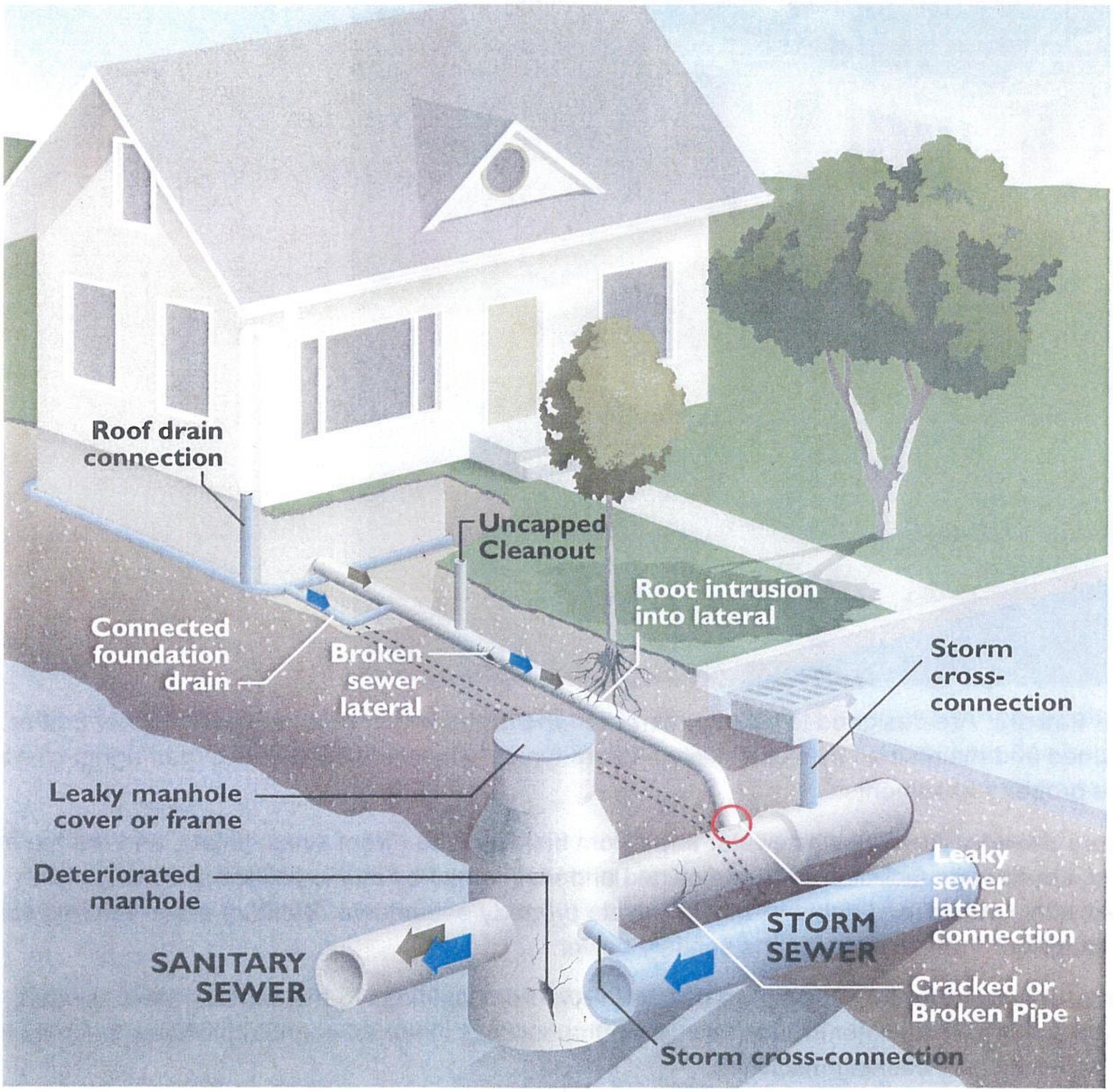
Sanitary Sewers: Receive wastewater flows from buildings (i.e., from sinks, toilets, and drains) and convey it to sewage facilities. They are owned and maintained by municipalities and are typically located within public road rights-of-way or private property easements. Sanitary sewer laterals convey the wastewater from buildings to the sanitary sewer.

Sanitary Sewer Laterals: Convey wastewater flows from buildings to the sanitary sewer system. Examples of the wastewater include flows from the building's internal plumbing fixtures, such as toilets, showers, sinks and washing machines.

Foundation Drains: Are perforated pipes that are installed around buildings at a depth below that of the building's foundation. They convey groundwater to the storm sewer and are designed to prevent buildings from flooding.

Roof Drains: Are used to convey rainwater from a building's roof to the storm sewer system.

Catch Basins: Are designed to collect rainwater runoff from roads and other paved surfaces. The rainwater enters the storm drains and is conveyed to a storm sewer.



Roof drain connection
Uncapped Cleanout
Root intrusion into lateral
Connected foundation drain
Broken sewer lateral
Storm cross-connection
Leaky manhole cover or frame
Deteriorated manhole
Leaky sewer lateral connection
STORM SEWER
SANITARY SEWER
Cracked or Broken Pipe
Storm cross-connection

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Inflow & Infiltration Detection

How Sources of I&I are Detected

Flow Monitoring – sewage flow rates are monitored at various locations within the municipal sewage collection system. The flow data is analyzed, along with rainfall data, to determine if there is excessive I&I within the study area.

Smoke Testing – a non-toxic, stainless, odourless, vegetable-based "smoke" is injected, under pressure, into a sanitary sewer manhole. If smoke escapes from a source not connected to the sanitary sewer system, this would indicate a sewer I&I cross-connection.

Dye Testing – non-toxic dye is added to an upstream freshwater source believed to be contributing to I&I. The downstream sanitary sewer is then monitored for traces of the dye to confirm the existence of a sewer cross-connection.

Closed Circuit Television Inspections – a video camera is sent through a sewer line to record the condition of the sewer. The video footage is analyzed for cracks, intrusions and leaks.

Inspections – building inspectors and trained maintenance personnel visually inspect and assess the condition of the sewer system.

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CRD Home > Wastewater > Inflow & Infiltration > Reasons to Reduce Inflow & Infiltration

Reasons to Reduce Inflow & Infiltration

I&I Consumes Valuable Sewer Capacity

I&I consumes sewer capacity needed for future growth in the region. It is very expensive to add capacity to existing sewers.

Damage to the Environment

Sewer overflows are damaging to the environment and sensitive ecosystems.

I&I is a Potential Health Hazard

Sewer overflows, whether into private residences and buildings, into parks and streets or into waterways, are potential health hazards.

Regulatory Requirements

British Columbia's Municipal Sewage Regulation requires that no person allow a sanitary sewer overflow to occur during storm events with less than a 5-year return period (i.e., on average, there shall be no more than one overflow every five years) .

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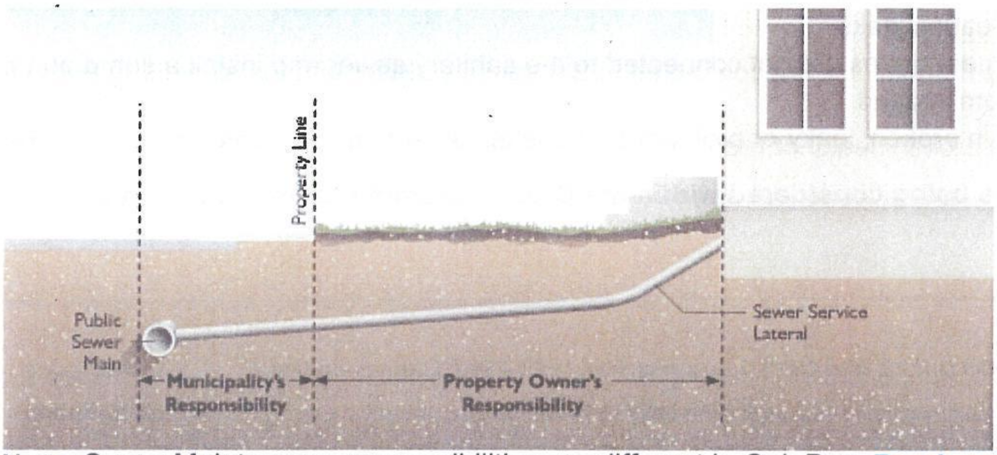
Sanitary Sewer Maintenance Responsibiliti

Homeowners – own and maintain the sewer service laterals on their property. Sewer service laterals pipes that connect a building's plumbing to the municipal sewer system.

Municipality – owns and maintains public sewer mains and the part of the sewer service laterals loc between the property line and the sewer mains.



Note: Sewer Maintenance responsibilities are different in Oak Bay. Read more

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Inflow & Infiltration Homeowner Information

Homeowners Can Reduce I&I from their Property

1. Check that gutters and outside drains are not connected to the sewer system. Contact the municipality to find out how to connect drains to the dedicated storm drainage system.
2. Avoid planting trees and shrubs over sewer laterals. The roots can damage the structure of the sewer lateral and cause leaks.
3. Ensure that basement drains are not connected to the sanitary sewer and install a sump pump to the drainage system instead.
4. Replace any known broken, leaky or problem sections of sewer that are located on your property.

Note: Regulations are being considered within the CRD to promote I&I reduction on private property.

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CRD Home > Wastewater > Inflow & Infiltration > Municipal Information

Inflow & Infiltration Municipal Information

How a Municipality Reduces Known Sources of I&I

The municipality takes steps to identify sources of I&I in its sanitary sewers. Once identified, the sources are incorporated into the municipality's long-term maintenance and capital projects plans. This allows for the reduction of I&I and the elimination of sewer overflows in a cost-effective manner.

Municipalities use the following techniques to reduce and eliminate sources of I&I:

1. Replacing or rehabilitating the defective sewer pipe, lateral and/or manhole
2. Pipe grouting – using a cement-based grout to fill a hole or crack in a pipe or manhole
3. Pipe relining – inserting a flexible liner into a defective sewer pipe or sewer service lateral which hardens into an impervious surface
4. Disconnecting known inflow sources, such as cross-connected catch basin drains, footing drains or rainwater leaders
5. Installing drainage systems that will allow cross-connected sewers to be separated