DISCUSSION PAPER

Capital Regional District
Core Area Wastewater Management Program

Wastewater Flow Management Strategy

Discussion Paper – Sanitary and Combined Overflow Locations
033-DP-3

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1 Introduction

As of the date of this writing, there are 3 main wastewater treatment options being considered:

Option 1 – Regional Resource Recovery;
Option 2 – Regional-Local Resource Recovery;
Option 3 – Local Resource Recovery;

Detailed design flow tables, from which design flows have been derived for the different facilities as required by the above options, have already been presented in 033-DP-2. This document describes the locations and magnitudes of overflows that are not handled by the primary treatment facilities under the various scenarios.

2 Return Periods

In order to classify different storm events, we introduce the concept of "return period". The return period of a storm specifies the probability of how often a given storm event will occur. For example, a 100-year return period storm should, on average, occur once every 100 years. This does not mean that a storm has to occur within any given 100 year period, or that more than one of these storms cannot occur in a shorter period of time. For example, in November 1990 the CRD was hit by 2 separate 100-year storms, only 13 days apart! However, on average these should occur only once every 100 years.

Historically, the CRD system has been designed to convey different return periods at different locations, primarily to reflect the differing impact of overflows to various receiving water bodies. In most Western parts of the CRD system, the goal is to convey the 100-year storm without incident. Facilities that were intended for smaller flows (on the order of the 5-year storm level) are the Macaulay Point pump station and deep outfall, the Clover Point pump station and deep outfall, and the connecting sewer between the Currie Rd. pump station and the Clover Point pump station. The intention was that flows above the 5-year level at Macaulay Point would be relieved by the overflow structure at Macaulay Point. Clover Point would be relieved by McMicking Point (excess flow bypassing the Currie Rd. pump station), and the Clover Point short outfall. In extreme cases the emergency outfall at Clover Point also functions (which is a storm sewer outfall with a bypass weir from the Clover Point short outfall).

Under the currently considered Options 1-3, any flows between a given multiple of ADWF (e.g. 4xADWF, which receive primary treatment) and 100-year return period flows at Saanich East, Macaulay Point, and Clover Point will bypass through 6 mm screens. The multiple of ADWF used varies by location and is described elsewhere outside of this discussion paper. In addition, McMicking Point can be used for flows that exceed the Currie Pump Station capacity, again to bypass through 6mm screens.

3 Overflow Rates vs. Overflow Volumes, Durations, and Frequencies

For the purposes of discussing overflows, the following definitions are used:

- Overflow Rate – the peak flow rate (e.g. 100 L/s) leaving an overflow facility;
- Overflow Volume – the total volume of the overflow (e.g. 100 m3) for a given overflow event;
- Overflow Duration – the length of time (e.g. 8 hours) that an overflow occurred for.

There are 2 levels of detail that can be calculated, requiring considerably different levels of effort:

First Approximation

This level of detail simply adds and subtracts flow rates at different facilities, in order to estimate the peak overflow rate at a given facility. For example, if the total peak wet weather flow at a site is 1,000 L/s, and the treatment plant can treat 800 L/s, then the estimated overflow rate will be 200 L/s.

The benefit of the first level approximation is that calculations can be completed quickly, and numerous scenarios can be assessed without extensive detailed modelling. The disadvantage is that overflow volumes and durations cannot be assessed with any accuracy, which must be done by the second method (dynamic computer simulation). However, first approximation calculations are always done in order to provide validation for the computer simulation results.

Dynamic Computer Simulation

Sanitary sewer systems such as the CRD's are very complex systems. In order to estimate how long such a system will overflow for in a given storm, and hence how much volume of sewage will be spilled, dynamic computer simulation must be used to account for such complexities. In the CRD system, these complexities include:

- The Marigold pump station storage tank (a 5,000 m3 tank used to protect Colquitz Creek and other downstream facilities);
- Certain extremely long overflow weirs, including the ones located at Sea Terrace and the Clover Pt. pump station;
- Interaction between the brand new Trent St. wet weather pump station (which has just been commissioned), and the existing Currie Rd. pump station;
- Control level logic which protects local homes from flooding by shutting down or throttling numerous pump stations, including Trent St, Currie Rd., Humber, Rutland, and Penrhyn;
- The time of day that a storm occurs relative to sanitary sewer levels;
- Peak flow attenuation, caused by the long travel times in a system as large as the CRD's;
- Tidal level impact on some of the overflow structures;
- The impact of planned but as yet uninstalled upgrades to the collection system.

Dynamic computer simulation is usually conducted after initial scenario selection using the first approximation results. Detailed dynamic computer simulation in order to estimate volumes and durations is to follow at a later stage.

4 Maps

Figures 1, 2, and 3 present known overflow points for Options 1, 2, and 3 accordingly.

5 Wet Weather Management Strategies

Since inception of the CRD Liquid Waste Management Plan, facility upgrade plans have been in place to work towards the ultimate elimination of overflows below minimum acceptable return periods. As previously discussed, this is a 100-year return period in most of the CRD system. Examples of facility upgrades that have already been completed to achieve this goal include the Marigold storage tank and the Trent St. wet weather pump station. Further upgrades that have not yet been implemented include an upgraded Craigflower pump station and various trunk sizing upgrades on both the NWT-N and ECI/NET-C. All of these upgrades were originally based on the assumption that wastewater conveyance would continue to occur to just Macaulay and Clover Points.

By virtue of the addition of more treatment facilities, many of the capacity bottlenecks in the system will now be bypassed or see reductions in flow. This will translate into significant reductions in overflow frequency and volumes. The required facility upgrades that remain after the treatment facilities are in place will also likely be smaller in scope and cost than originally planned as a result.

6 Option 1 – Regional Resource Recovery

Saanich East, Macaulay Pt., and Clover Pt.

Flows above a given multiple of ADWF, up to the 100-year event, will bypass through 6mm screens.

Other Locations

The following lists other active SSO/CSO locations within the CRD. Previous plans to eliminate most of these locations are further enhanced by water reduction efforts. Although dynamic simulation will be required to confirm these findings, the following lists the anticipated impacts on those locations.

McMicking Point – depending on the final design capacity of Currie Pump Station, flows in excess of this design capacity will bypass through 6mm screens at McMicking Point.

Humber & Rutland CSO catchments – these two catchments were originally designed as combined sewer systems, with the Humber and Rutland pump stations pumping only a portion of the total flow into the CRD East Coast Interceptor. It is anticipated that sewer separation programs in these two catchments will ultimately eliminate combined sewer overflows at these locations.

Broom Road overflow – the Broom Road overflow used to discharge into Oak Bay during storm events larger than about 5-year return period. The new Trent Street pump station, which diverts wet weather flows away from the lower portions of the Northeast Trunk, should now eliminate SSOs up to the 100-year return frequency.

Bowker Creek overflow – the new Trent Street pump station will also eliminate SSOs up to the 100-year return frequency from the Bowker Creek overflow located on the Northeast Trunk.

Colquitz Creek overflow – future additions to the Marigold storage tank, (which protects Colquitz Creek by storing wet weather flow that the Marigold pump station cannot handle), to take it beyond the original 2045 design horizon may be delayed or eliminated if water conservation efforts can offset population growth in the catchment.

Sea Terrace overflow – the Sea Terrace overflow weir is a deep underground overflow structure which relieves excess flow between it and the Macaulay pump station. Ultimate elimination of overflows at Sea Terrace requires planned sewer upgrades downstream of this location. This option would likely not impact the need for those upgrades, although it may reduce the size of upgrades required.

Craigflower Pump Station – Craigflower Pump station cannot currently convey the 100-year return flow to Macaulay Pt. due to rapid growth in Langford. The estimated conveyance capacity of Craigflower is estimated at 2 to 5 year return. The Colwood South WWTF will result in a drastic reduction to design flows at the station, which would then only require approximately $1.7 million in upgrades due to aging equipment and operational concerns, rather than a much larger capacity upgrade increase.

7 Option 2 – Regional-Local Resource Recovery

Saanich East, Macaulay Pt., and Clover Pt.

Flows above a given multiple of ADWF, up to the 100-year event, will bypass through 6mm screens.

Other Locations

As with Option 1, water reduction efforts in Option 2 further enhance existing SSO/CSO elimination plans. The significant structural difference between Option 1 and Option 2 is the reworking of the Marigold and Craigflower pump stations to provide 2xADWF pumping to the Juan de Fuca WWTF.

McMicking Point – depending on the final design capacity of Currie Pump Station, flows in excess of this design capacity will bypass through 6mm screens at McMicking Point.

Colquitz Creek overflow – diversion of 2xADWF from the downstream sewer could permit the Marigold Pump Station to operate at an overall higher capacity, which will increase the return period storm that the current storage tank can protect Colquitz Creek against, or extend the design horizon of the current storage tank past 2045.

Sea Terrace overflow – removal of 2xADWF from Marigold pump station will reduce the magnitude of SSO events at this location, and may ultimately reduce the size of upgrades required between this location and Macaulay Point.

Craigflower pump station – reworking or rebuilding of this pump station as part of this option will provide the opportunity to upgrade its capacity to sufficiently handle 100-year flows, eliminating SSO possibilities from this site.

8 Option 3 – Local Resource Recovery

Saanich East, Macaulay Pt., and Clover Pt.

Flows above a given multiple of ADWF, up to the 100-year event, will bypass through 6mm screens.

Other Locations

As with the previous options, water reduction efforts in Option 3 further enhance existing SSO/CSO elimination plans. Otherwise, comments made under Option 1 are generally applicable to Option 3 as well.

9 Perspective on Frequency of Overflows

The following table summarizes the number of overflows that have occurred at each location, between the years of 2000-2007, for all storm events that were less than a 5-year return period. The data is taken directly from the "Core Area Sanitary Sewer Overflow Management Plan" (CRD, June 2008). Although the data record is only 8 years long, it provides a good indicator of the relative activity of each overflow location.

We have also added an estimate for the return frequency of flows under Options 1-3 for those sites that are expected to have 6-mm bypass screens. This was done by calculating first level estimates (comparing current estimates of primary treatment capacity at each location against PWWF values calculated from the design tables presented in 033-DP2).

Table 1
First-Level Estimates for Overflow Frequencies

Overflow Site	Historical 2000-2007(1)		Estimated Return Period for Screened Bypasses (2065)			Comment
	Total	Avg. /Year	Option 1	Option 2	Option 3	
Marigold PS	0	0	Not needed	Not needed	Not needed	The existing storage tank provides 100-year protection to Colquitz Creek.
Craigflower PS	1	1 in 8	Not needed	Not needed	Not needed	Removal of significant portions of Langford/Colwood under Options 1 and 3 should push the capacity of the existing station back to 100-year return period. Under Option 2 the station would be completely rebuilt to a 100-year return period capacity.
Broom Rd.	1	1 in 8	Not needed	Not needed	Not needed	Trent St. pump station should now provide 100-year return period protection.
Monterey Ave.	29	10	Not needed	Not needed	Not needed	Data only includes 2005 onwards. Trent St. pump station should now provide 100-year return period protection.
Sea Terrace	4	1 in 2	Not needed	Not needed	Not needed	Dynamic modelling will show the required size of downstream upgrades.
Macaulay Pt.	29	4	25-Year	25-Year	25-Year	Based on current estimates of primary treatment capacity
Clover Pt.	14	2	5-Year	5-Year	5-Year	Based on current estimates of primary treatment capacity
McMicking Pt.	43	5	See comment	See comment	See comment	Assume that flows are conveyed to Clover Pt. for screening.
Finnerty Cove	29	4	25-Year	25-Year	25-Year	This is the location of the proposed Saanich East WWTP.
Humber Combined	34	4	Not needed	Not needed	Not needed	Sewer separation programs will eventually eliminate these combined sewer overflows.
Rutland Combined	53	7	Not needed	Not needed	Not needed	Sewer separation programs will eventually eliminate these combined sewer overflows.

10 Perspective on Magnitude of Screened Overflows

The following table presents first-level estimates, in 2065, of the peak screened overflow rates under the 3 Options, given primary facility sizing that is currently being undertaken.

Table 2
First Level Estimates – Peak Screened Overflow Rates - 2065 (L/s)

	Option 1	Option 2	Option 3
Saanich East	117	117	160
Macaulay Pt.	440	440	440
Clover Pt.	2,377	2,377	2,401
McMicking Pt.	See note	See note	See note
Note: Screened bypass flows at Clover Pt. could potentially be "shared" between the Clover Pt. and McMicking Pt. locations, depending on Currie Pump Station capacity.			

As previously discussed, calculation of overflow volumes and durations requires application of dynamic computer simulation. However, to put the screened overflow values in some perspective, previous dynamic simulation of the East Side of the CRD collection system estimated that a 100-year return period storm in 2045, assuming the Saanich East WWTF was built, would result in a total SSO volume from McMicking and Clover Points of approximately 100,000 m3. That translated into less than 0.5% of the total average annual flow discharged from Clover Pt. That estimate should be conservative, as the previous work did not consider water conservation efforts, nor did it model the system with conveyance upgrades in place. And once more, 100-year events happen, in theory, only once every 100 years.

Refinement of the projected values will occur as dynamic simulations are completed pending selection of the preferred treatment plant Option.

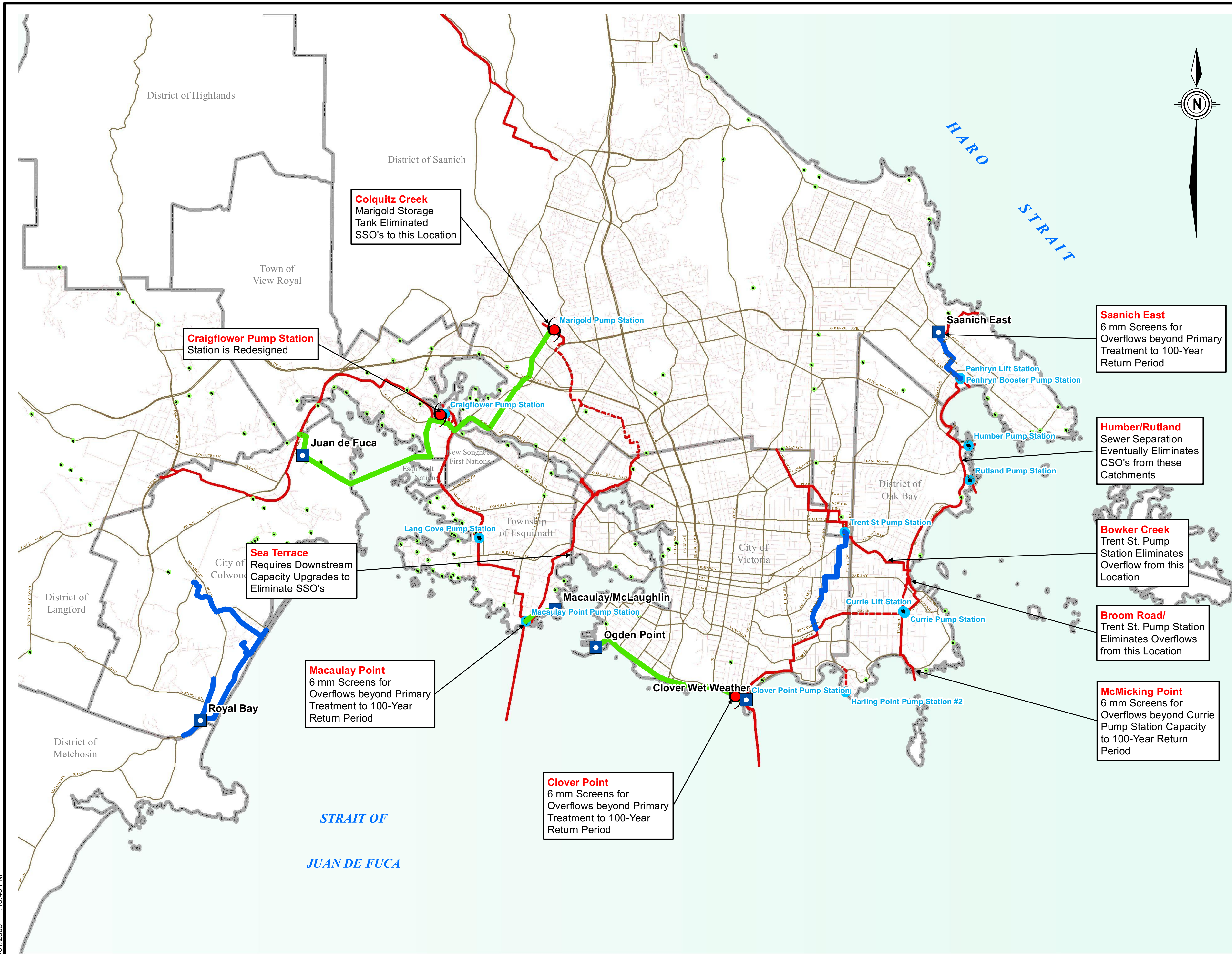
11 Impact of I&I Reduction Programs

All Municipalities in the Core Area are being encouraged to pursue inflow & infiltration (I&I) studies, both to quantify the amount of I&I within each sewer catchment, as well as to pursue I&I reduction programs. As an example, the CRD has global I&I values for each municipality and attempts to assist Municipalities with monitoring equipment loans and sharing of expertise through the CRD I&I Subcommittee. The City of Victoria is, for example, also undertaking a pilot I&I reduction study for the James Bay area.

It has been shown through previous research that I&I typically increases with time, as a sewer system deteriorates due to age. Due to the average age of the CRD core system, a considerable amount of investment will likely be required to bring I&I increases under control, let alone begin to produce a net reduction in total I&I. As a result, I&I programs should generally be viewed with the idea of maintaining existing I&I rates, rather than reducing them quickly enough to net a positive benefit to SSO reduction within the system.

12 Impact of Water Conservation and Fixture Reduction Programs

Estimates on the effect of water conservation and fixture reduction programs are built into the 3 currently presented Options. The benefits of these reductions will be automatically accounted for during the dynamic modelling phase. However, it is not anticipated that acceptance rates for these programs will be high enough to provide significant SSO reductions in the short term.



Capital Regional District
Core Area Wastewater
Management Strategy

Legend

- Municipal Boundary
- CRD Trunk Sewer - Gravity
- CRD Trunk Sewer - Forcemain/Syphon
- Sanitary Gravity Main

Existing CRD Sewer Facility
- Pump Station

Existing Municipal Sewer Facility
- Pump Station

Proposed Wastewater Facility
- Pump Station
- Wastewater Treatment Facility

Proposed Conveyance Works
- Dry Weather Only
- Peak Wet Weather

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associates limited
CONSULTING ENGINEERS

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Project No.	Date
764-011	January 2009

Sanitary Sewer Overflow Synopsis Option 2

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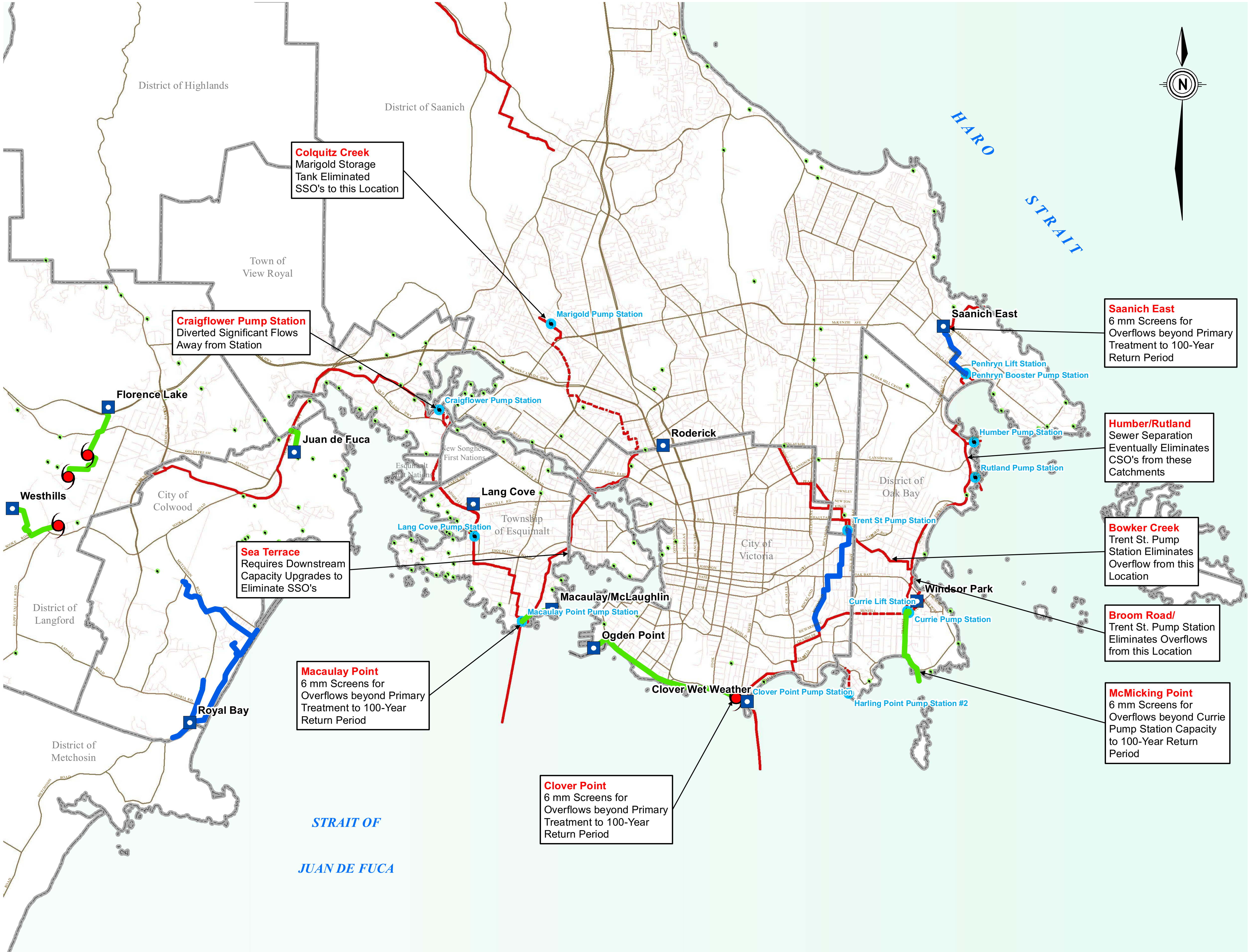

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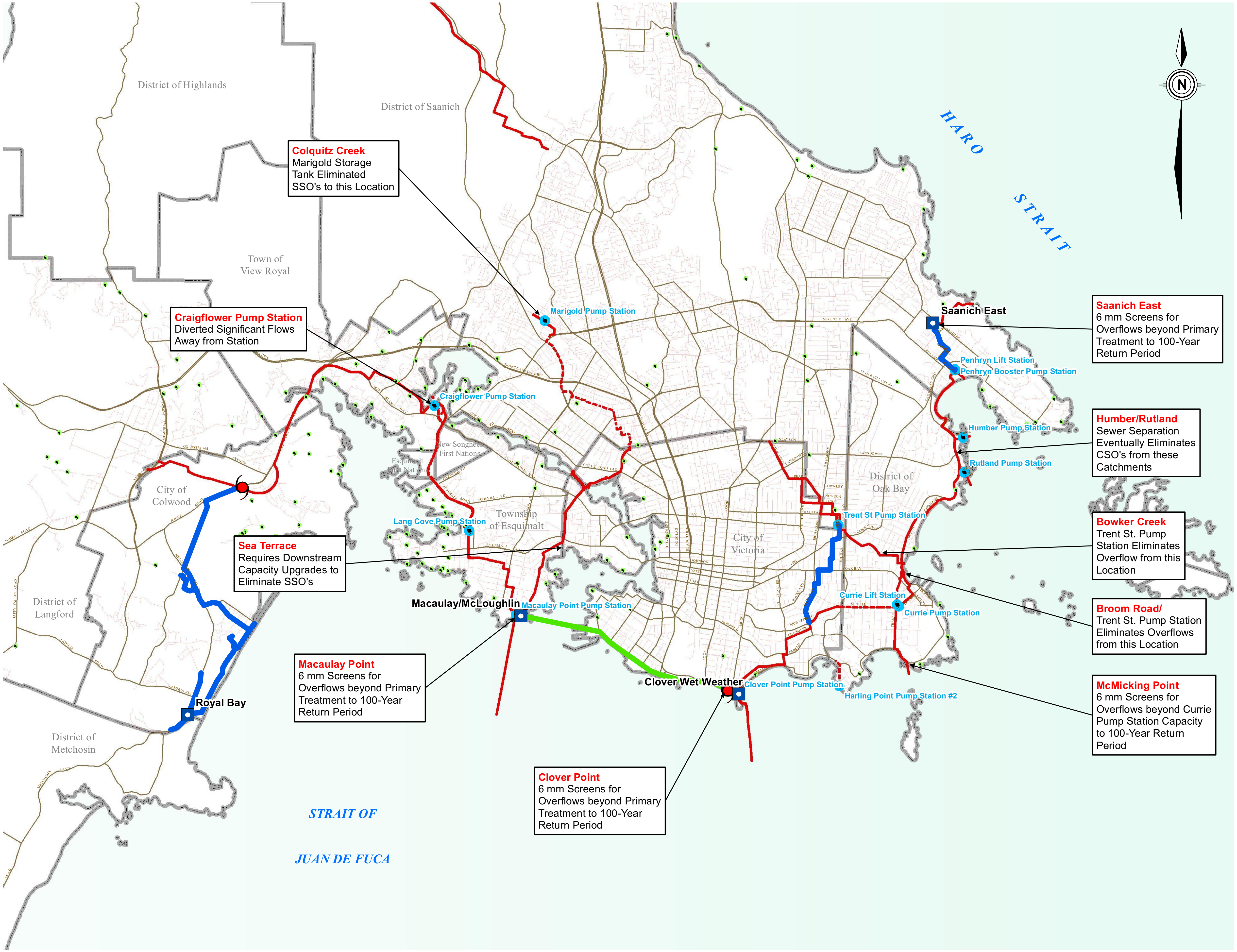

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Project No.	Date
764-011	January 2009

Sanitary Sewer Overflow Synopsis Option 1

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