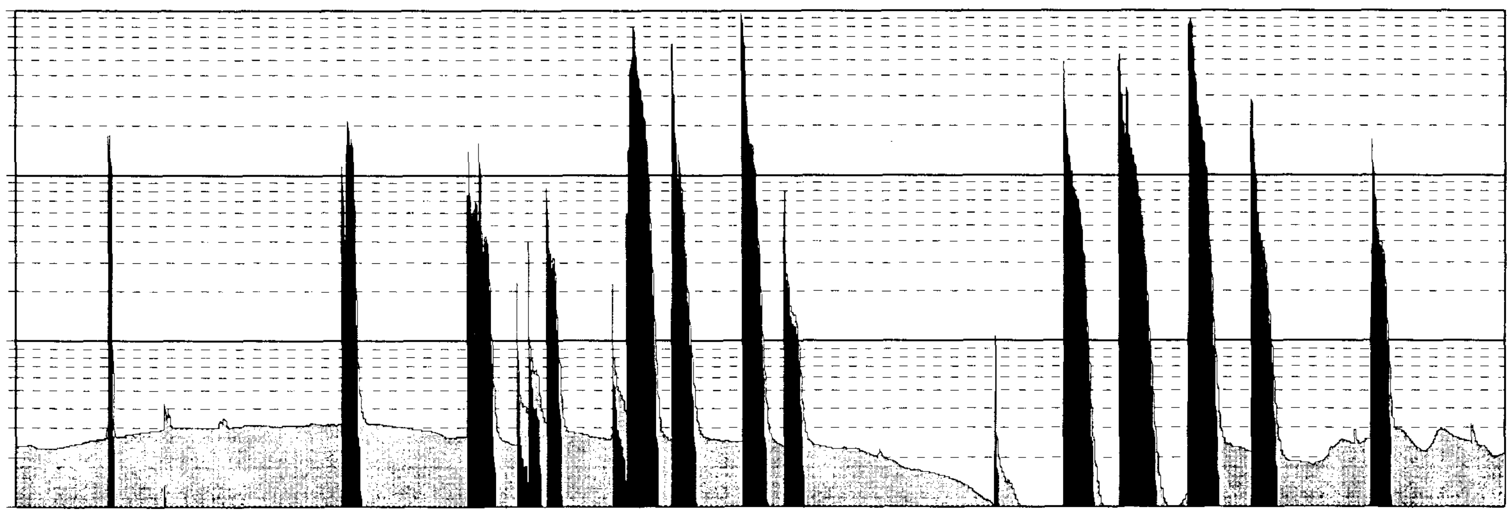
CSO MANAGEMENT STRATEGY
PHASE 2 REPORT

Prepared for:

City of Winnipeg
Water and Waste Department



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In Association With:

Gore & Storrie Limited and EMA Services Inc.

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Revision No. 1

ABBREVIATIONS AND TERMS USED IN THIS REPORT

CEC—Clean Environment Commission. A quasi-judicial body which holds public hearings on environmental concerns and makes recommendations to the Minister of Environment.

CSO—Combined Sewer Overflow. Winnipeg has old sewers where sewage and rainwater mix. During rainfall, some of the mixture overflows directly to the rivers.

Combined sewer districts—A district is an area of the City served by an independent network of sewers. There are 42 combined sewer districts in Winnipeg.

DWF—dry weather flow, or the amount of wastewater that flows through the sewers in dry weather. This flow occurs year round.

FC—fecal coliform. Bacteria associated with fecal matter from warm blooded animals. Fecal coliform level is an indicator of pollution from sewage which may cause gastrointestinal illness and skin and eye irritation. The MSWQO recommends fecal coliform levels for primary and secondary recreation.

Floatables—material that floats such as debris, scum and other floating material.

Gastrointestinal illness (GI)—flu-like symptoms which may result from exposure to waterbodies polluted with fecal matter from warm blooded animals.

Inline storage—a control option for combined sewer overflows which involves storing wastewater in the combined sewers up to the level which does not increase the risk of basement flooding.

LDS—land drainage sewers—sewers that carry only surface runoff to the rivers in areas served by separate sewers.

MSWQO—Manitoba Surface Water Quality Objectives, created by the provincial government. These provide criteria for fecal coliform levels for primary and secondary recreation and general requirements that the rivers be kept free of floatable material at all times.

Primary recreation—a type of water use, such as swimming or waterskiing, where your body comes in contact with the water. The MSWQO requires the fecal coliform level to be less than 200 organisms per 100 mL on a geometric mean basis for primary recreation.

Recreation season—for purposes of analyzing water quality, the recreation season is usually restricted to the period from May 1 to September 30 of the same year.

Sanitary sewers—sewers that carry only wastewater to the WPCCs in areas served by separate sewers.

Secondary recreation—a type of water use, such as fishing or boating, where your body would not normally come in contact with the water. The MSWQO require a fecal coliform level of less than 1000 organisms per 100 mL on a geometric mean basis for secondary recreation.

Separate sewers—a sewerage system that uses two types of sewers in newer areas of the city, sanitary sewers carry wastewater directly to the WPCCs, and land drainage or storm sewers carry surface runoff directly to the rivers.

SSO—Sanitary Sewer Overflow. Overflows to the rivers resulting from overloading of the sanitary sewers during high intensity storms. The main source of the high flow is residential basement footing drains (weeping tiles).

SWMM (XP-SWMM) —Storm Water Management Model. A mathematical computer model developed by U.S. EPA simulate the hydraulic behaviour of surface runoff and flows in sewers. It is a public domain model and freely distributed.

Upstream water quality—the condition of the water in our rivers when they reach Winnipeg.

U.S. EPA—United States Environmental Protection Agency.

WASP—Water Quality Analysis Simulation Program. A mathematical computer model developed by the U.S. EPA to simulate the water quality dynamics in a diverse set of waterbodies.

WPCC—Water Pollution Control Centre. There are three, the North End (NEWPCC), South End (SEWPCC) and West End (WEWPCC). Wastewater from 90 percent of the City's combined sewer districts flows to the NEWPCC. The SEWPCC and WEWPCC primarily serve areas with separate sewers.

WWF—Wet Weather Flow. The combined amount of rainwater or snowmelt and wastewater that flows through the sewers in wet weather.

XP-SWMM—"Expert" SWMM. A privately developed and enhanced version of the U.S. EPA SWMM. Contains several features to improve upon data input, numerical calculations, dynamic display, and output of computer simulations.

Contents

Introduction

In 1989, the Minister of the Environment asked the Clean Environment Commission (CEC) to hold hearings regarding the quality of the Red and Assiniboine Rivers within and downstream of Winnipeg.

In 1992, the CEC recommended, among other things, that the City of Winnipeg (City) study the impacts of Combined Sewer Overflows (CSOs) and formulate remedial measures. In response, the City initiated the CSO Management Strategy Study. The study is being done in four phases and should be finished in 1997.

The purpose of Phase 1 was to collect and analyze information on combined sewer overflows in Winnipeg and to examine the effects of these overflows on the quality of our rivers. The Phase 1 Report, issued in September 1994 describes the phased approach which has been adopted for the study, and contains important background information for the Phase 2 Report. It is provided as an appendix to this report.

Additional copies of the Report are available from the Water and Waste Department. The address can be found on the last page of this report.

Background

KEY FINDINGS FROM PHASE 1

Forty percent of the City's developed land is served by combined sewers. When it is not raining, all wastewater collected by combined sewers is directed to a Water Pollution Control Centre (WPCC) for treatment. Rainfall or snowmelt can cause combined sewers to overflow into the rivers. These overflows contain a mixture of surface runoff and wastewater. This mixture pollutes our rivers.

Sixty percent of the City's developed land is served by separate sewer systems. Household wastewater and surface runoff are conveyed in different pipes. Sanitary sewers carry wastewater directly to the WPCCs. Land drainage sewers carry surface runoff directly to the rivers. Surface runoff carries with it contaminants such as bacteria from animal waste, grease and oil from automobiles and other sources, and street litter which together also contribute to pollution in our rivers.

The City's three WPCCs provide state-of-the-art secondary treatment to all dry weather flow discharges. The facilities are valued at approximately 500 million dollars. In total, it costs the sewer utility in excess of 60 million dollars per year to operate and maintain its sewerage collection and treatment systems.

How CSOs affect river water quality

Urban wastewater contains a number of pollutants, including:

- organic matter, which consumes oxygen as it decomposes, thus possibly affecting fish and other aquatic life;
- ammonia, which may be toxic to fish and other aquatic life if present in large enough concentrations;
- microbiological organisms, primarily bacteria, which can cause flu-like illnesses or skin or eye irritations in people coming into contact with river water; and
- floatables, which include waste that people flush down their toilets or leave on the streets to be washed into the river through street drains.

Urban wastewater may also carry other pollutants, such as pesticides and heavy metals to the river. However, they are generally found in low concentrations, well within provincial objectives.

The Phase 1 report concluded that:

- oxygen levels are high enough to keep aquatic life healthy; the quality of treated wastewater from the three WPCCs is adequate to maintain healthy oxygen levels;
- CSOs are not a significant contributor to ammonia levels in the rivers; and
- the two water quality issues most affected by combined sewer overflows are bacterial content and floatables.

KEY ISSUES FOR PHASE 2—WHAT HAPPENS DURING WET WEATHER?

The CEC recommendations considered water quality objectives for two conditions, dry and wet weather. They recommended that during dry weather the Red River be protected for primary recreation and the Assiniboine River for secondary recreation. For wet weather conditions, the CEC concluded that there was insufficient site-specific information to classify the rivers. The CEC recommended that river studies be undertaken to address wet weather impacts and their possible control.

The river classifications under dry weather flow require the rivers to be less than specific fecal coliform levels on a geometric mean basis. In addition, as a general requirement, the CEC recommended that the rivers be kept free of floatable materials attributable to sewage at all times. Disinfection of effluent from the City's WPCCs will be required to meet the dry weather fecal coliform limits.

Combined sewer overflows are the major source of elevated fecal coliform levels in the rivers under wet weather conditions. As well, these overflows carry floatables to the rivers. The CEC recommended that a fecal coliform study be undertaken to determine water quality impacts of combined sewer overflows on the rivers, which is why they are a focus of this study.

CONTENTS OF THE PHASE 2 REPORT

The Phase 2 Report contains the following sections.

- *Technical analysis,* which describes data-gathering programs and the development of computer simulation models.
- *Addressing dry weather flow issues.*
- *Analysis of control options*, which looks at a wide range of possible options.
- *A comparison of the control options.*
- *Communicating with the public,* which summarizes activities undertaken in Phase 2.
- *Towards Phase 3*, which defines the next steps of the study.

Technical Analysis

Proper evaluation of the effects of overflows on river quality and development of appropriate solutions is a major undertaking. To identify possible solutions, the study has been assessing several factors such as:

- *rainfall distribution patterns;*
- *the functioning of the complex maze of combined sewers, some of which go back to the last century; and*
- *the frequency of overflows and their load of pollutants.*

Computer simulation brings a high level of sophistication and accuracy to the technical analysis. Information about the physical characteristics of our sewer system and the discharges can be represented by a computer model. A computer-based river model can be used to mathematically represent what happens in the river as a result of a discharge, which provides the advantage of being capable to predict water quality changes under future conditions. Using models has allowed the project engineers and scientists to propose modifications to our sewer system and assess the impacts on the rivers with a high degree of confidence.

GATHERING DATA

The City of Winnipeg has monitored and collected data on various aspects of sewer operation and river quality for many years.

The CSO Study, however, required more data than was available through previous monitoring programs. As part of Phase 2, existing monitoring and data gathering programs were expanded to be more comprehensive. The data-gathering programs included:

- recording rainfall;
- collecting information on the sewer system and pumping stations;
- monitoring flows in the sewers during wet and dry weather; and
- sampling discharges from sewers and WPCCs during wet and dry weather.

THE SEWER MODEL

The combined sewer system is complex. It interacts with diversion facilities, pumping stations, interceptor sewers and the WPCCs.

A computer model called the XP-SWMM computer software was chosen to simulate the hydraulic conditions in our sewers.

Using the monitoring data collected to set up the models, the study team can track what enters the sewer system in the form of wastewater and rainfall. The model can then be used to predict how much is conveyed to the WPCCs and the amount which overflows to the rivers.

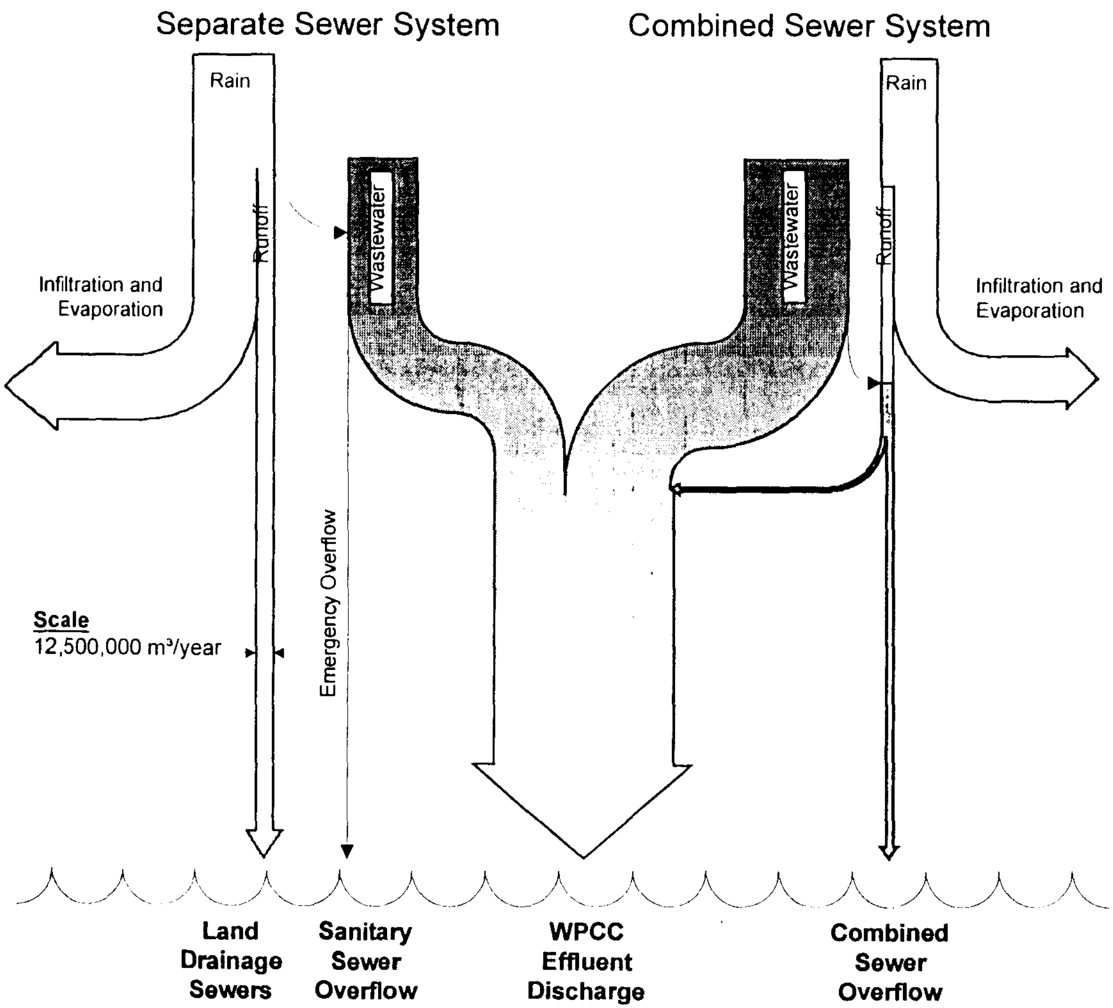
River quality impacts are not limited to discharges from combined sewers since land drainage sewers also carry surface runoff to the rivers during rain events. The operation of the land drainage sewers, including stormwater retention basins, was also modelled to include their impact on river quality.

The study team has used the monitoring data collected to verify the accuracy of the model. This provides a higher degree of confidence when used to predict the results of various control options. The results of the modelling are discussed later in the sections titled *Analysis of Control Options.*

Flow of wastewater

Average annual flows to the rivers from the City are represented schematically below.

The major sources of discharge from developed urban areas are separate land drainage sewers (LDS), treated effluent from WPCCs and combined sewer overflows. Sanitary Sewer Overflows (SSOs) may result from emergency conditions with separate wastewater sewers, or from excessive wet weather flow, such as weeping tile flow, entering the wastewater system. In an average year, the total discharges are:



Urban Discharges to the Rivers

	Average Annual Discharge to rivers (m^3)
LDS	12,500,000
SSO	120,000*
WPCC	120,000,000
CSO	4,800,000

* *assumed at 1% of LDS*

Classification of the rivers for primary or secondary recreation implies that the water quality objectives must be met for the recreation season. The recreation season is typically defined by Manitoba Environment to be from May 1 to September 30.

For a typical recreation season, combined sewers convey about 7.7 million cubic metres of runoff. The following table shows that approximately 60 percent, or 4.3 million cubic metres overflows to the rivers. The rest flows to the WPCCs. During the recreation season, these overflows occur between 7 to 35 times with an average of 21 times on a system-wide basis.

Combined Sewer Area
Existing Conditions

	Recreation	Annual
Volume of runoff (m^3)	7,700,000	8,600,000
Volume of overflow (m^3)	4,300,000	4,800,000
Number of overflows (average)	21	23

Overflows from combined sewers include a mixture of surface runoff and wastewater. On an annual basis, these overflows represent less than two percent of the wastewater produced in combined sewer districts and less than one percent of the total wastewater generated in the city.

THE RIVER MODEL

To simulate the water quality of rivers under dry and wet weather conditions, the study team chose the US Environmental Protection Agency's WASP computer software.

The river model takes into account the physical features of the rivers, the flow rate in the rivers, discharges to the rivers, and upstream quality of the rivers and predicts the resulting river water quality.

The five major sources of fecal coliform discharges to the rivers include:

- treated effluent from the WPCCs;
- combined sewer overflows (CSOs);
- sanitary sewer overflows (SSOs);
- land drainage sewers (LDSs); and
- upstream sources.

Since the discharges do not pollute equally, the level of pollution for each source had to be estimated. The average concentrations of fecal coliforms in the discharges from major sources are as follows:

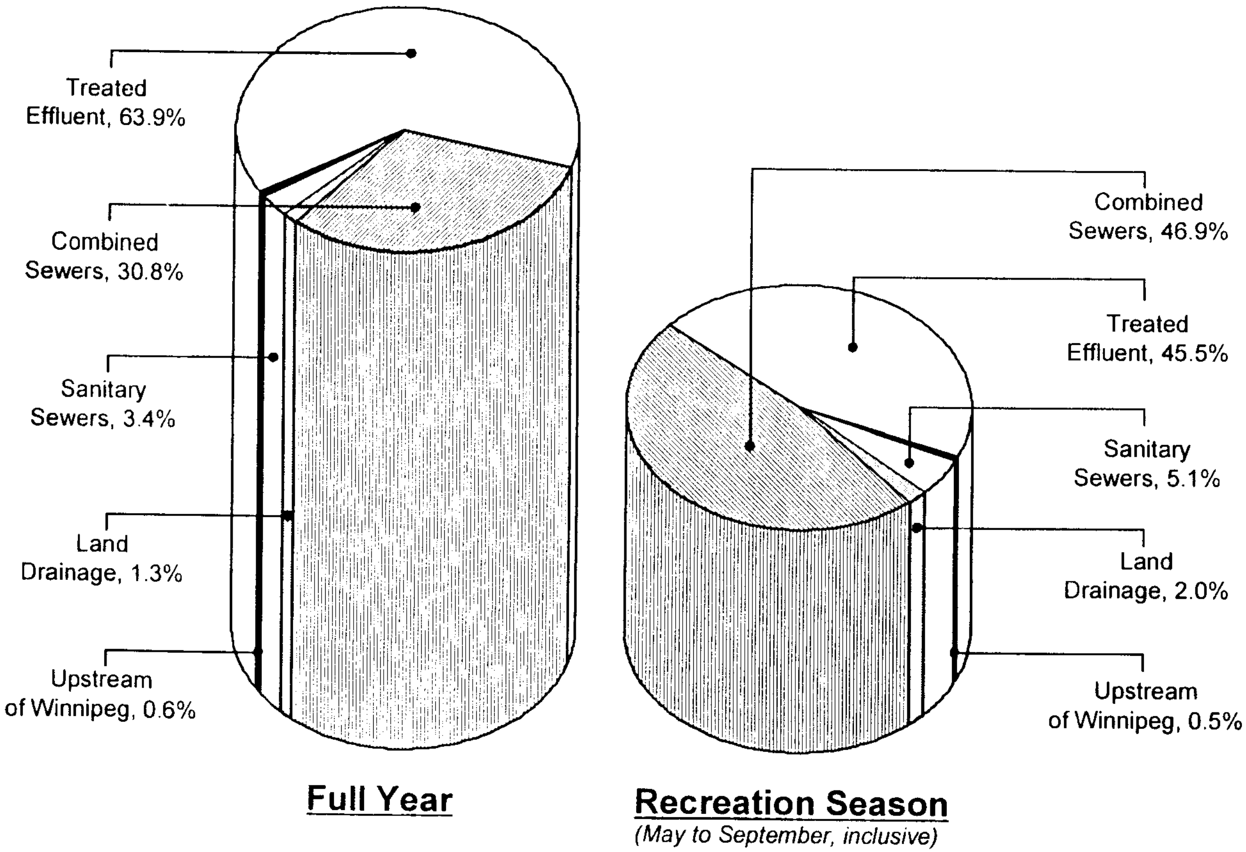
	Average Fecal Coliform per 100 mL
Upstream Sources	50
LDS	40,000
WPCC	200,000
CSO	2,400,000
SSO	10,000,000

The *loading* from each discharge is determined by multiplying the estimated fecal coliform level in the discharge by the volume of the discharge.

The number and volume of overflows to the rivers and the impact on the rivers depends on the amount of rainfall and river flow for that specific year. Analysis of all of the data available resulted in the conclusion that 1992 was a typical year in terms of average rainfall and river flow, and was therefore considered a typical year.

The loading from each source for a typical year is shown in the figure:

Comparison of Fecal Coliform Loading to the Rivers for a Typical Year



During dry weather

During dry weather, elevated fecal coliform levels in the rivers may originate from:

- upstream sources, which seldom have fecal coliform levels above the Manitoba Surface Water Quality Objectives (MSWQO) recreational limits;
- effluent from the WPCCs, which may cause levels to exceed the MSWQO for recreation; and
- dry weather overflows (DWO), which result from illegal or faulty sewer connections.

The City is planning to disinfect WPCC effluent to meet the CEC recommendation that the rivers be protected for recreation during dry weather conditions. The City's approved 1996–2000 Five-Year Capital Forecast includes budgeting for disinfection at all three treatment plants.

River monitoring revealed some unexpected fecal coliform levels, which originated from undetected dry weather overflows. The City is working to correct these as it does with all dry weather overflows, according to the mandate of Plan Winnipeg.

During wet weather

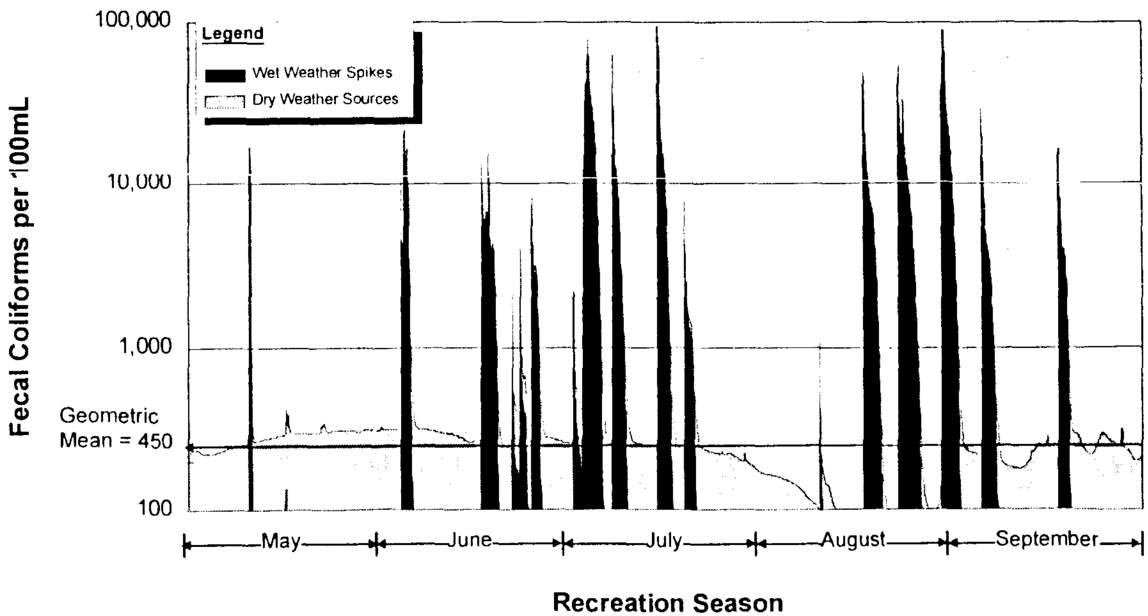
During wet weather, all five discharge sources containing fecal coliform affect water quality. Combined sewer overflows contribute the most fecal coliforms. Overflows generate high levels of fecal coliform "spikes" in the rivers which greatly exceed the MSWQO for recreation, as shown by the figure.

These fecal coliform levels tend to get higher as the rivers flow through the combined sewer areas. The combined sewers are concentrated in the central part of the City. Fecal coliform levels increase because bacteria from one sewer overflow will combine in the river with bacteria from the upstream discharge, and so on.

Natural die-off causes the elevated coliform levels to return to normal in about three days, depending on river temperature, sunlight and other factors.

Disinfection of WPCC effluents will improve the quality of river water. It is anticipated that WPCC disinfection will result in general compliance with the primary recreation objective (elimination of the grey area on the figure) during dry weather conditions. However, disinfection will have virtually no effect on the spikes of fecal coliform from CSOs as a result of rainfalls.

Fecal Coliform Levels at the Redwood Bridge for a Typical Year

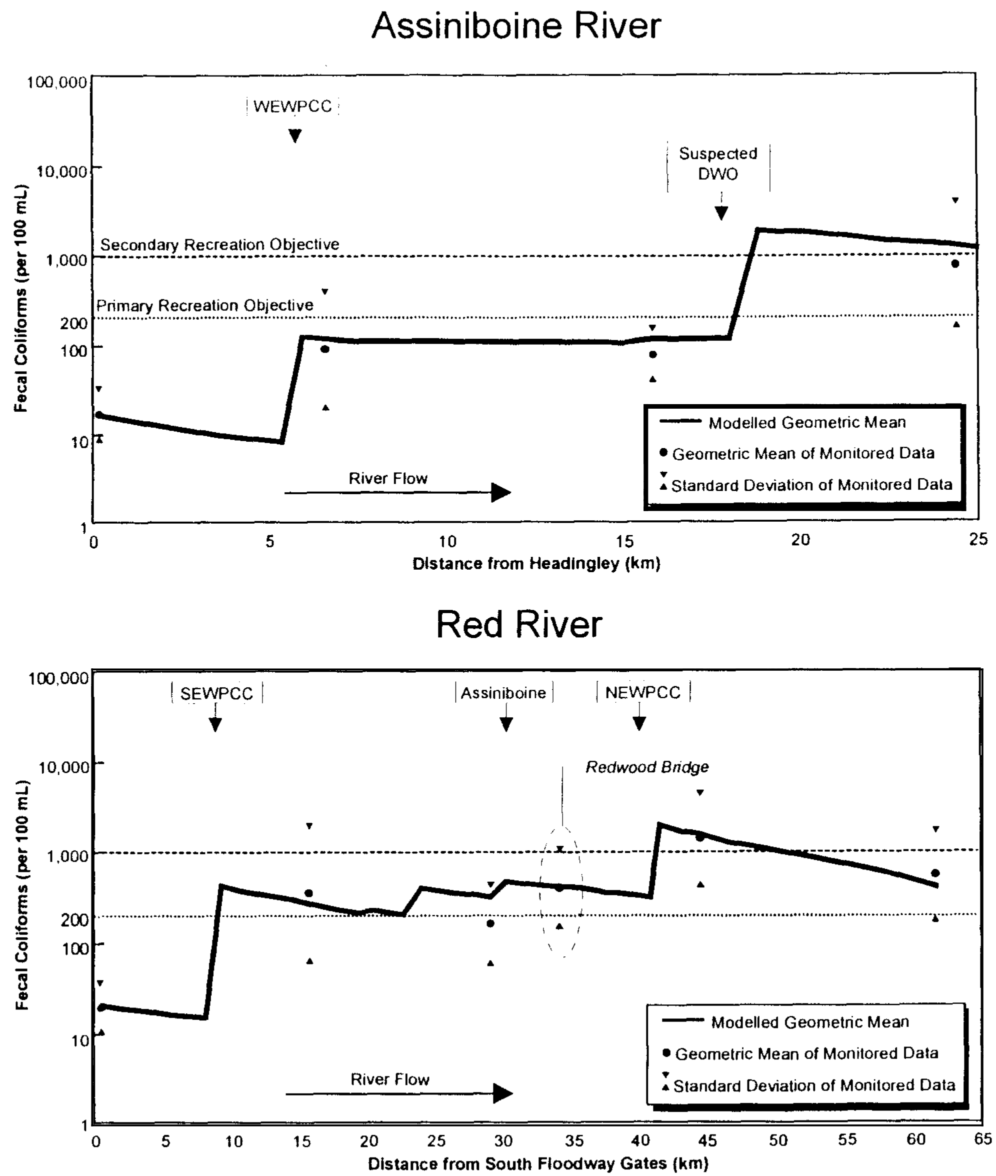


Average conditions

Fecal coliform measurements taken during dry weather and wet weather periods are combined to give us the average condition on the river. The City has collected data on river water quality at 10 sites every two weeks for 18 years. Results for various locations along the length of the rivers are shown in the following figure. The geometric mean and standard deviation of the monitored data are shown on the figure for each location. For example, the Redwood Bridge location from the previous figure is shown with a geometric mean for the typical year of 450 fecal coliform per 100 mL. Distinct increases in the mean fecal coliform levels are evident where continuous discharges occur, such as from the sewage treatment plants or dry weather overflows (DWOs).

Historical hourly fecal coliform levels were estimated for the ten monitoring stations for a typical recreational season. Fecal coliform levels were found to be within the objective recommended for primary recreation about 50 percent of the time and 85 percent of the time for secondary recreation.

The CEC has not recommended fecal coliform objectives for wet weather flow. If primary or secondary recreational objectives are to apply to wet weather conditions, the current CSOs would result in frequent and excessive noncompliance.



Average Fecal Coliform Levels for a Typical Year

Addressing the Dry Weather Flow Issues

There are two urban sources of dry weather flow that affect river water quality, dry weather overflows and WPCC effluent discharges.

CORRECTING DRY WEATHER OVERFLOWS

The City's sewage system is designed to collect and treat all dry weather flows. Occasionally, illegal or faulty sewer connections are discovered which cause discharges of raw sewage to the rivers when it is not raining. These are defined as dry weather overflows (DWOs).

The City routinely monitors and investigates suspicious discharges to the rivers and takes immediate actions to correct or eliminate DWOs.

DISINFECTION OF TREATED EFFLUENT

Winnipeg's WPCCs have not been designed to remove bacteria from the treated effluent discharged to the river. Although the fecal coliform levels are reduced through the treatment process, they remain high enough to exceed the MSWQO for recreation in the rivers during dry weather periods.

The 1992 CEC recommendations require the Red River to be protected for primary and secondary recreation and the Assiniboine River for secondary recreation during dry weather conditions. This will require disinfection facilities to be installed at the City's three WPCCs.

- The City is in the process of initiating disinfection of the SEWPCC effluent.
- The City has budgeted for NEWPCC and WEWPCC effluent disinfection projects in its Five-Year Capital Estimates.

Disinfection of effluent at the WPCCs:

- will cost about 25 million dollars to construct and about one million dollars each year to operate;
- will increase compliance from 50 percent to about 90 percent for primary recreation;
- will increase the average compliance from about 85 percent of the time to over 90 percent for secondary recreation;
- will not affect combined sewer overflows;
- will not affect floatables discharged during wet weather.

Disinfection and correction of dry weather overflows will improve river water quality during dry weather conditions and may improve public perception of the rivers. These controls cause little community disruption and few environmental concerns, and have a relatively low cost in comparison to CSO control options.

Analysis of Control Options—Floatables Removal

Two options which remove floatables but do not remove fecal coliforms are being studied.

- Mechanically cleaned bar screens could be installed at the end of each combined sewer outfall.

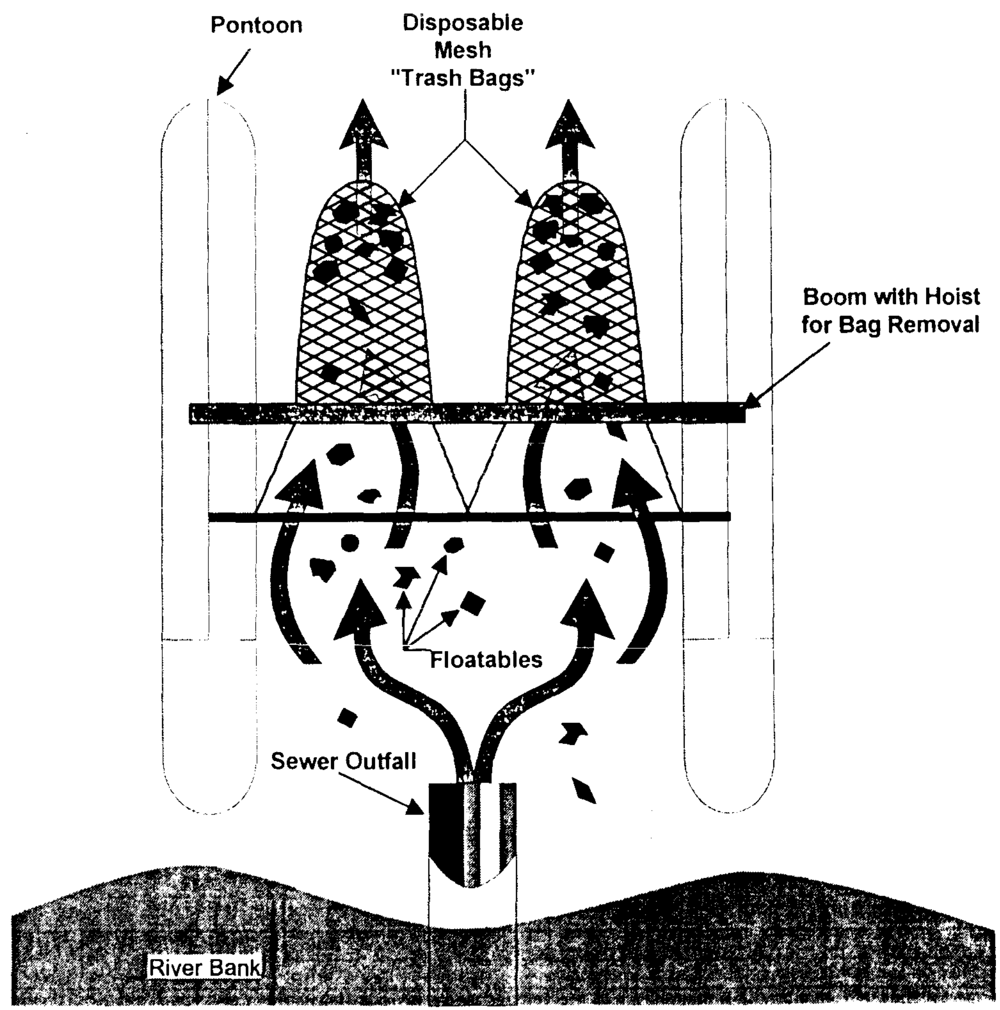
- A floatable netting system designed to capture floatables could be installed in the rivers at the end of each outfall as shown.

Capturing floatables with nets or screens would:

- cost from 100 to 200 million dollars;
- have no effect on fecal coliform levels or the volume of combined sewer overflows;
- eliminate floatables discharged by combined sewer overflows; and
- have no effect on floatables discharged from land drainage sewers.

Overall evaluation
Controlling floatables with nets or screens is an alternative if improved aesthetics is a major objective.

Floatable Netting System



Analysis of Control Options—Optimize the Existing System to Handle Wet Weather Flow

This section discusses the evaluation of a number of wet weather controls which may be suitable for Winnipeg. The benefits discussed for each control assume dry weather overflows have been corrected and disinfection at the WPCC has been implemented. In addition, although one particular wet weather control could be installed in all districts, it is more likely that different controls would be installed in different districts. For purposes of comparison, however, the Phase 2 analysis looked at each control separately and assumed that each control was installed for the entire City.

Controlling combined sewer overflows may involve improving the existing system. In Winnipeg, this means increasing the interception capacity and maximizing available inline storage. The interceptor system conveys wastewater collected by the combined sewers and separate sewers to the WPCC. Interception capacity is the maximum rate at which flow from combined sewers is diverted to the WPCCs.

INCREASE INTERCEPTION RATE

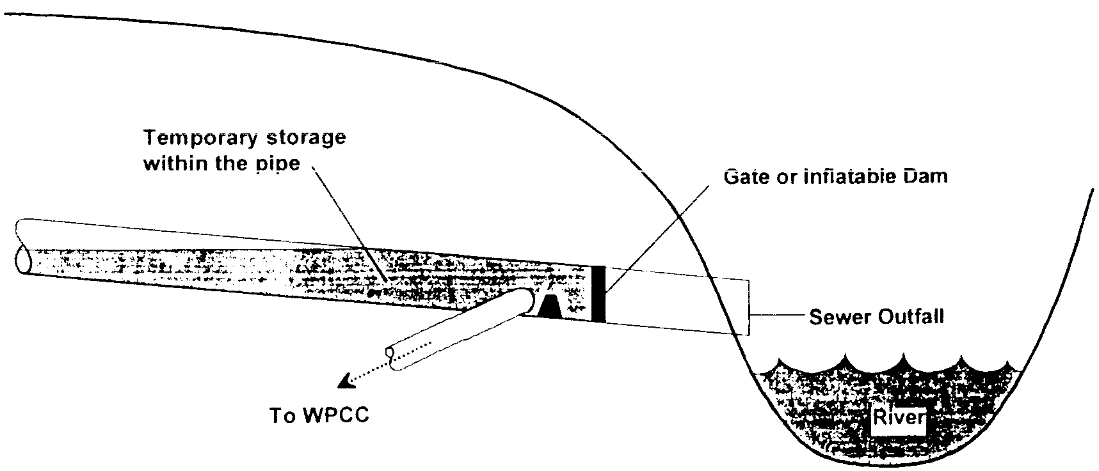
Phase 2 modelling of the main interceptor shows that, during wet weather, the system carries about four times DWF to the NEWPCC. Computer modelling found that the interception rate could be increased to a uniform rate of five times DWF throughout all districts. However, if the interception rate increases, the NEWPCC will likely have to be expanded.

The same concept applies to the SEWPCC and WEWPCC interceptor systems, however detailed assessment of these systems was not carried out because of the proportionally small area of combined sewer contributing to them.

INLINE STORAGE

Inline storage involves storing the combined sewage in the main trunk of the combined sewer up to a level which does not increase the risk of basement flooding. This can be done by a gate or inflatable dam, as illustrated.

Flows from small storms would be prevented from discharging to the river by closure of the gate. Flows from larger storms would be partially stored and the excess would overflow to the river.



Inline Storage

Summary of findings

Increasing the interception rate and adding inline storage would:

- cost about 85 million dollars, which includes the cost of expanding the NEWPCC and incorporation of effluent disinfection;
- reduce the volume of CSOs by about 50 percent, from 4.3 to 2.2 million m^3;
- reduce the number of CSOs by 50 percent, from 21 to 10, during the typical year recreation season;
- reduce fecal coliform levels only slightly on average—for small rainfalls which would be completely stored in the system, no bacteria discharges would occur, however for large storms, overflows would still occur;
- meet MSWQO for primary recreation 92 percent of the time for a typical year, and 95% of the time for secondary recreation; and
- reduce floatables, slightly.

Overall evaluation

Increased interception rate and use of available inline storage will reduce the number and volume of combined sewer overflows.

Inline storage is cost-effective and worth more study.

Analysis of Control Options—Structurally Intensive Options

If the previous measures are insufficient, structurally intensive controls could be installed. One control could be installed city-wide, or different controls could be installed in different districts. For purposes of comparison, the Phase 2 analysis looked at each control separately and assumed that each structurally intensive control was installed city-wide.

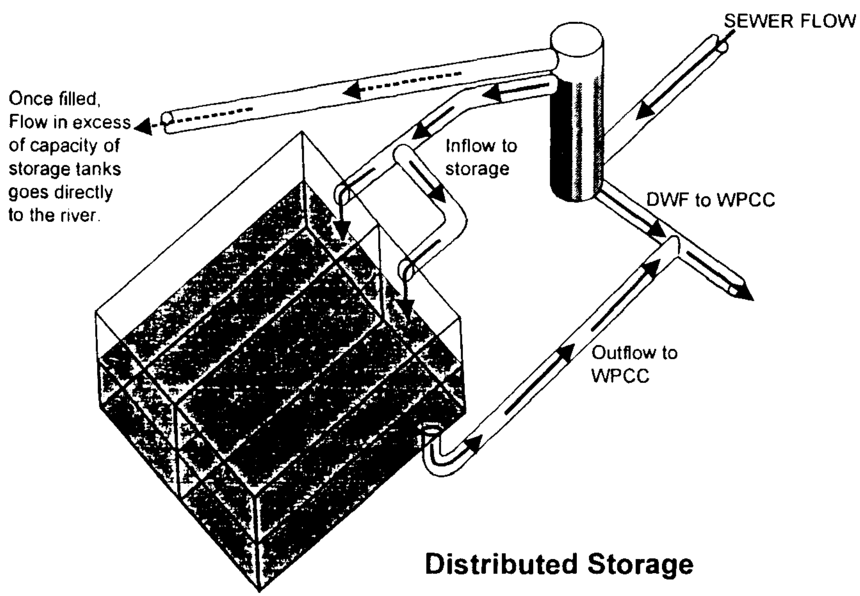
DISTRIBUTED (OR OFFLINE) STORAGE

Distributed storage consists of large tanks located just under the surface near a combined sewer trunk, as illustrated below.

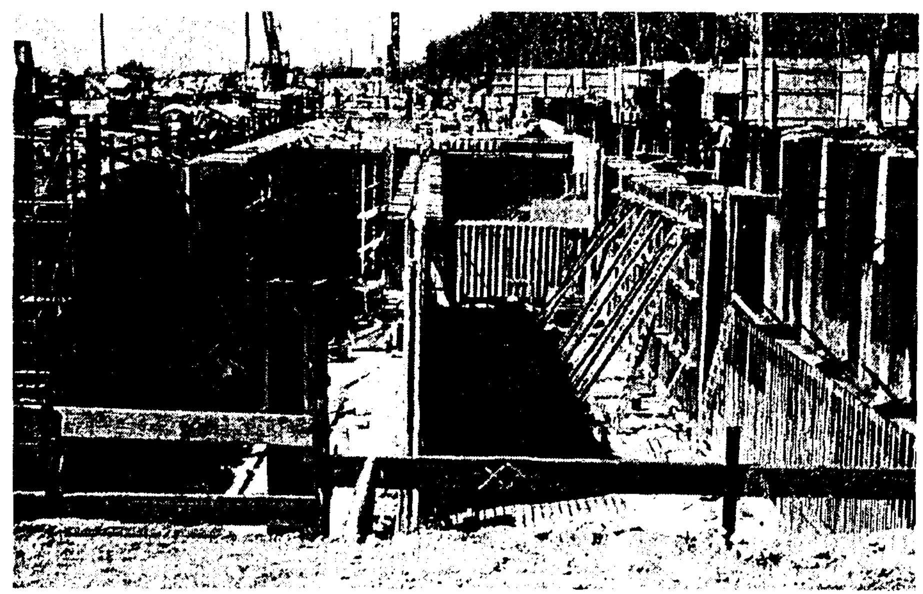
The intent of distributed storage is to provide additional storage volume to detain excessive wet weather flows until it can be accepted by the WPCCs for treatment. The stored wastewater would go to the WPCCs as treatment capacity becomes available.

Distributed storage would:

- cost about 300 million dollars, including improvements to the existing infrastructure to capture 85% of the runoff from a typical year;
- reduce combined sewer overflows to about four events during the recreation season;
- improve compliance with MSWQO up to about 93 percent of the time for primary recreation and 96 percent of the time for secondary recreation; and
- remove floatables for all storms, up to storage capacity.



Distributed Storage



Storage Tanks Under Construction

Overall evaluation

Distributed storage tanks that capture most combined sewer overflows could be part of a long-term control program. Capital costs are high but operating costs are low. The tanks require substantial space but, with appropriate care, could be located successfully in sensitive land use areas such as has been demonstrated at Toronto Beaches.

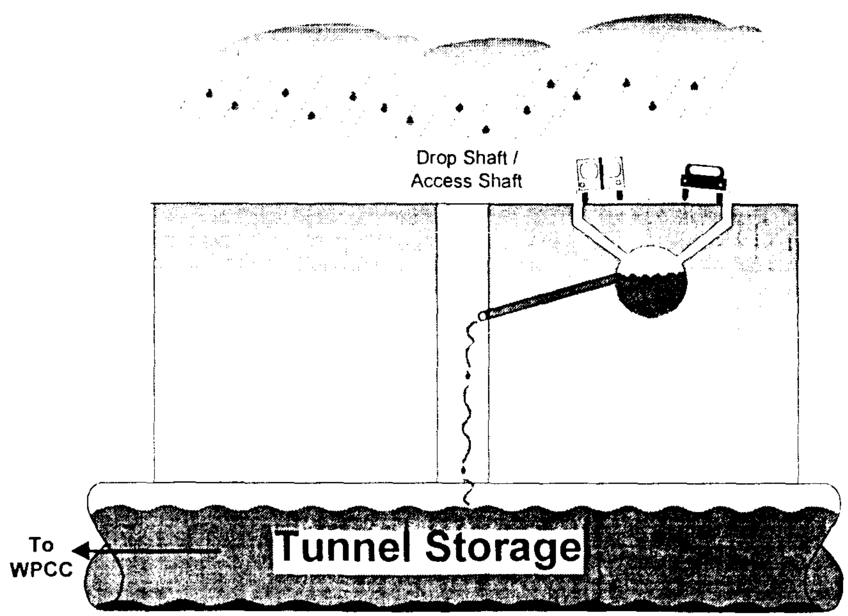
Surrounding areas would be disrupted during construction and the basins could raise environmental and land-use concerns.

Distributed storage is a relatively cost-effective way to reduce the number and volume of combined sewer overflows. It warrants more study.

TUNNEL STORAGE

Large tunnels could be used to store combined sewage. After rain, the stored wastewater could be drained or pumped to the WPCC's for treatment.

Major tunnel storage could be constructed to handle all the runoff from the largest rainfall (about 1,000,000 m^3 of storage for the 1992 typical year) and result in no overflows. Smaller tunnels (about 300,000 m^3) could be used to reduce overflows to about four each year and capture about 85 percent of the volume of runoff.



Tunnel storage would:

- cost 750 million dollars to capture all of the runoff for a typical year (capture of 85% of the runoff would cost 500 million dollars) including improvements to the existing infrastructure;
- virtually eliminate untreated combined sewer overflows
- MSWQO would be met 95 percent of the time for primary recreation and 98 percent of the time for secondary recreation for major tunnel storage; and
- remove all floatables attributable to CSOs.

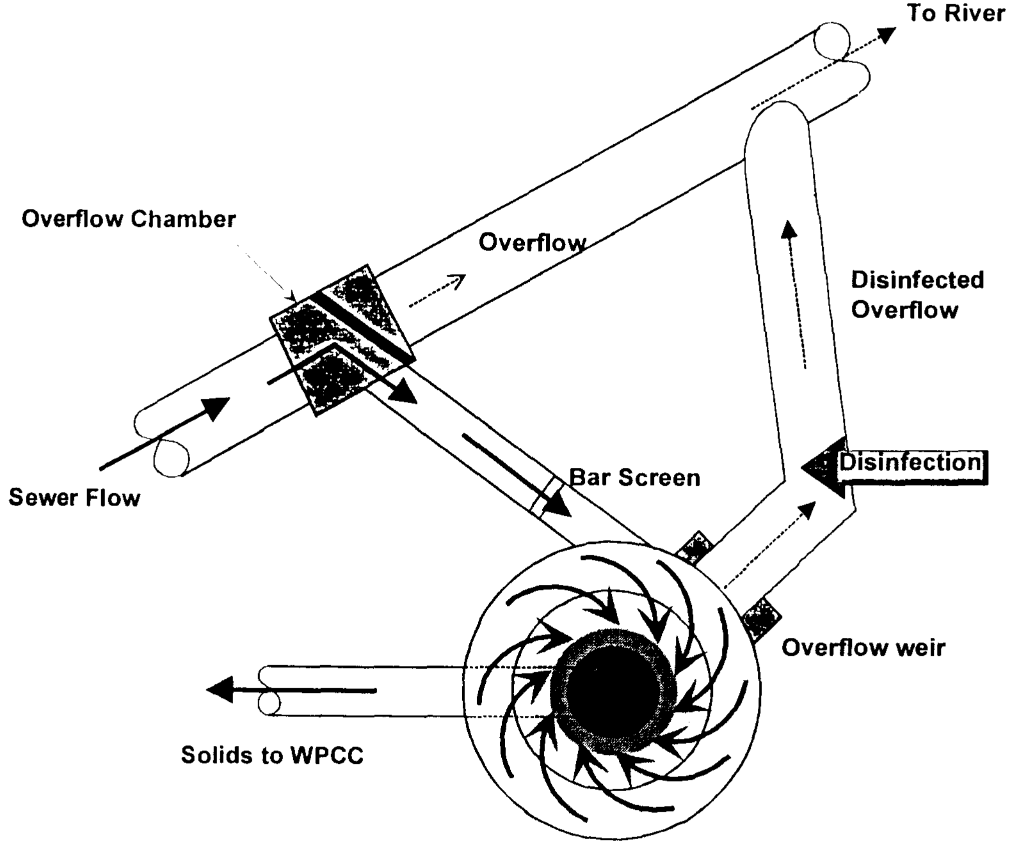
Overall evaluation

Tunnel storage to capture all combined sewer overflow is costly and provides very small incremental benefits. Smaller tunnels could be part of an overall control strategy.

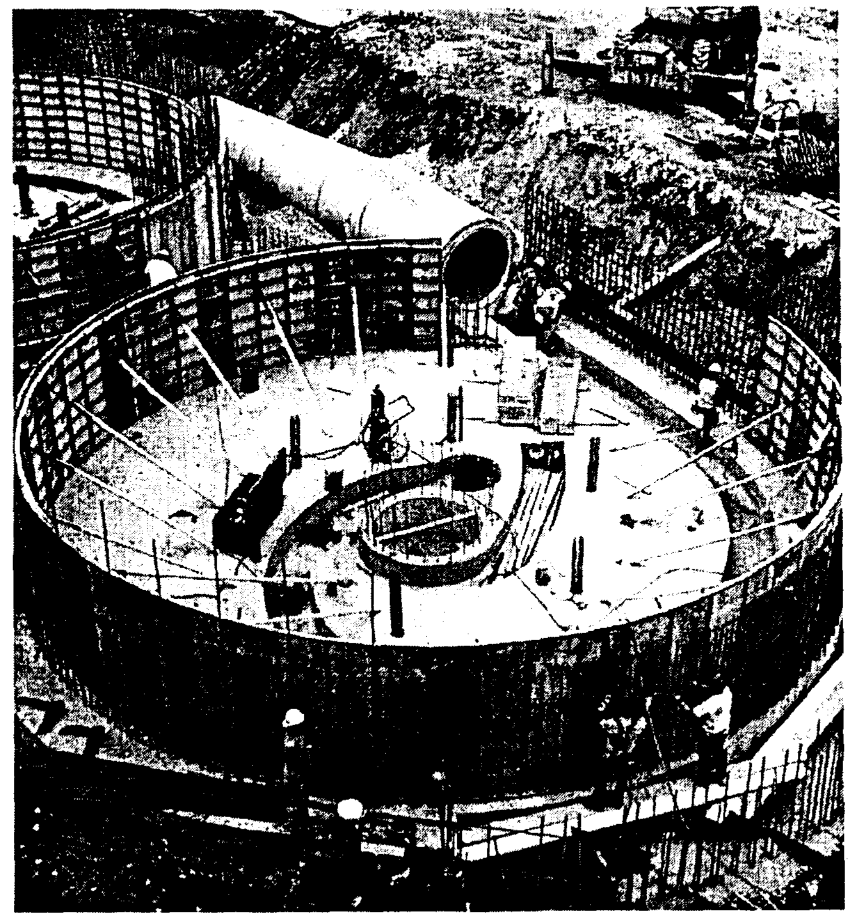
HIGH RATE TREATMENT DEVICES

Vortex solids separators (VSS) and disinfection

A VSS is a device which removes solids and thus makes it possible to disinfect the wastewater. VSS control devices could be located near the diversion points at combined sewer outlets. The figure below illustrates a VSS.



Vortex Solid Separator (VSS)

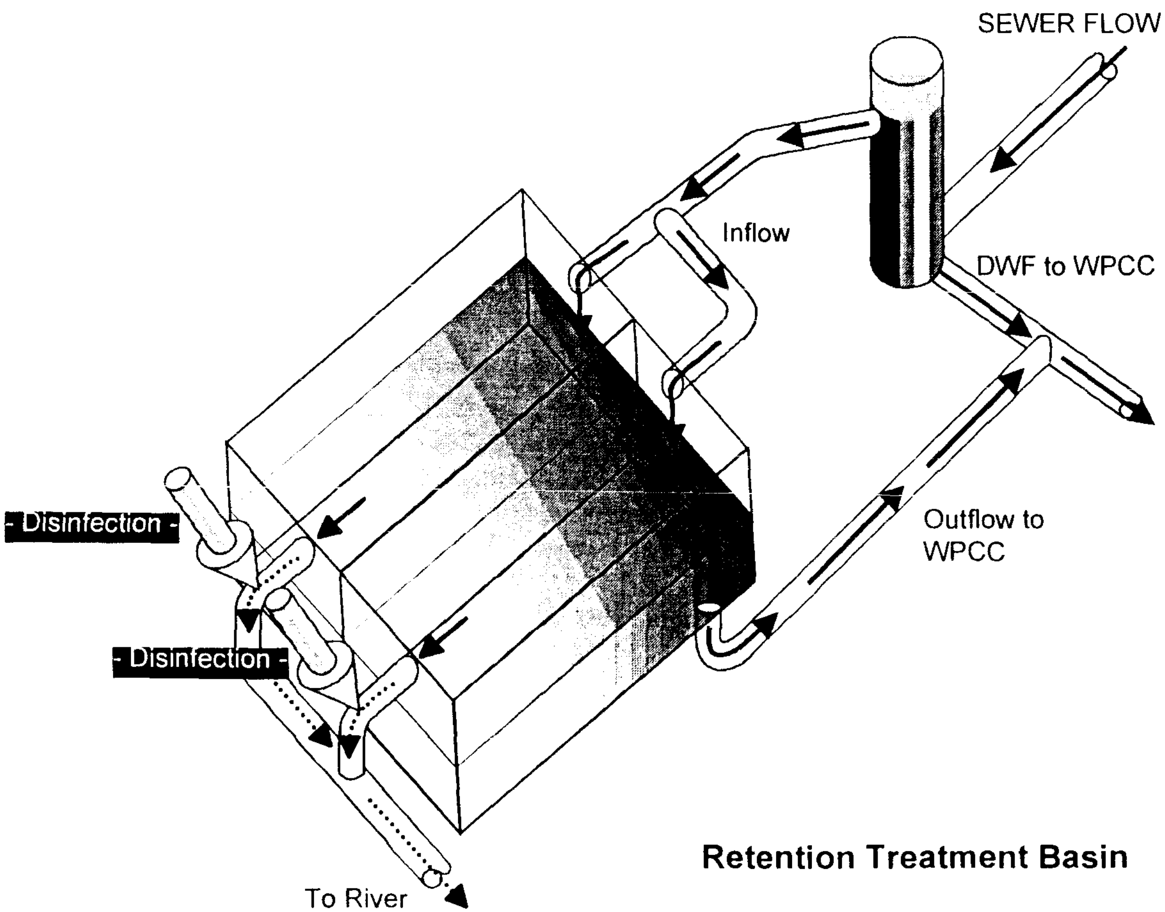


VSS Under Construction

Retention treatment basins (RTBs) and disinfection

Retention treatment basins are storage basins, which would be located near the combined sewer outfalls. They are like offline storage tanks except that, even when they are filled, the flow continues to pass through and the basins act as high rate settling basins.

Wastewater flowing through would be disinfected, thus fecal coliform levels are reduced before discharge to the rivers. After runoff stops, the stored wastewater would be diverted through the interceptor to the WPCC for treatment.



Retention Treatment Basin

Summary of findings

High rate treatment devices would:

- cost from 400 to 500 million dollars, depending on the disinfection options chosen, chlorination or UV, respectively including improvements to the existing infrastructure;
- improve compliance similar to major tunnel storage, 95% of the time for primary recreation and 98% of the time for secondary recreation;
- remove floatables attributable to CSOs most of the time.

Overall evaluation

High-rate treatment devices with disinfection may have a role in a long-term control program, depending on the degree of control required. The costs are high. Operating procedures are complex. The tangible benefits are modest. They raise many environmental and land-use concerns.

CENTRAL TREATMENT

Central treatment means all combined sewage would be intercepted and carried to a central facility or an expanded WPCC, where it would be treated and disinfected.

Central treatment would:

- require a major expansion to the City's interceptor and treatment system, at high cost; and
- remove floatables attributable to sewage for all storms.

Centralized treatment is one of the highest cost options, and is probably not practical.

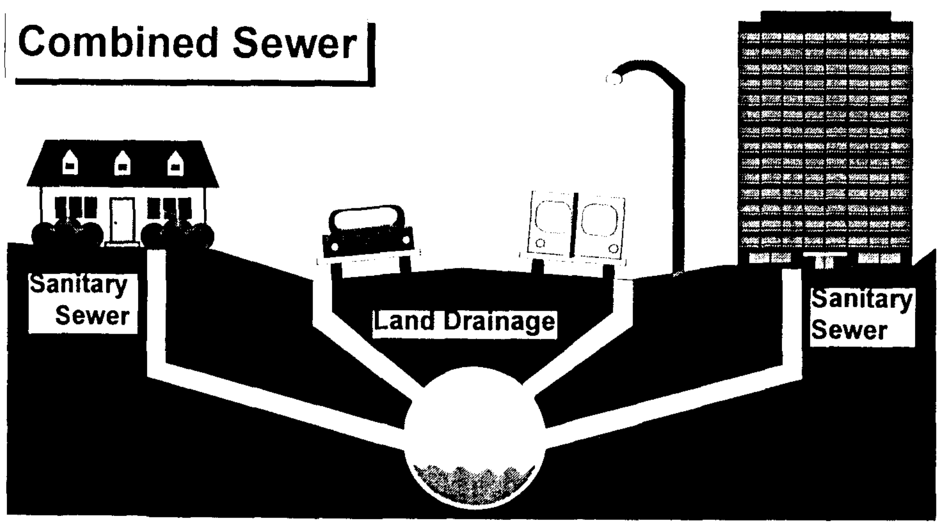
COMPLETE SEWER SEPARATION

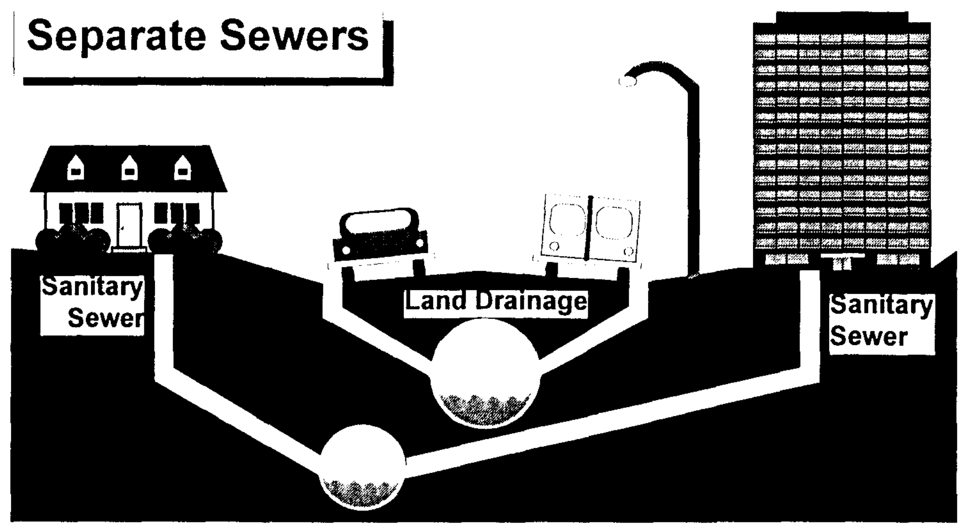
Replacing all combined sewers with a separate sewer system, i.e., complete separation, would:

- cost 1,000 million dollars;
- eliminate combined sewer overflows;
- result in compliance with MSWQO for fecal coliform 95 percent of the time for primary recreation and 98 percent of the time for secondary recreation;
- complete compliance is not possible because of discharge to the rivers through land drainage sewers;
- eliminate all floatables attributable to sanitary sewage but would not remove floatables that enter the river from the land drainage sewer.

Overall evaluation

Constructing a separate collector system for sanitary sewage eliminates combined sewer overflow and significantly reduces fecal coliform. However, construction would disrupt residential and commercial properties throughout the City. It is the most costly option.





Comparison of Options

Phase 1 listed control options for controlling combined sewer overflows.

Phase 2 analyzed the relative costs and benefits of the options. The results of this analysis are summarized in the following figures.

COST

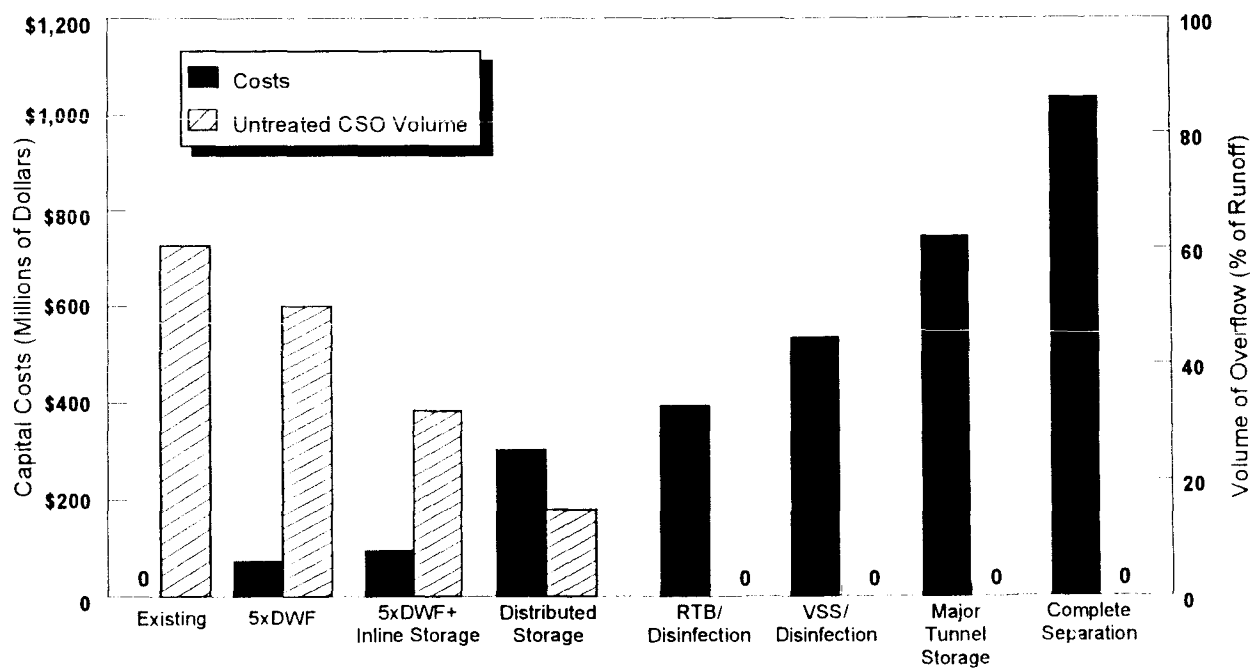
Costs were estimated by applying the control uniformly across the City for 1992, a typical year in terms of rainfall and river flows. ***Costs are approximate only, but provide a basis for comparison. The costs for each technology will be refined in Phase 3.***

Costs ranged from $70 million for simple changes to the existing system to $1,000 million for structurally intensive options.

EFFECT ON NUMBER OF OVERFLOWS

The lowest cost option, optimizing the existing infrastructure by increasing the interception rate and adding inline storage, reduces combined sewer overflows from 21 to 10 during the recreation season.

Only the most expensive options are capable of eliminating combined sewer overflows.



Results based on a typical year (1992)

EFFECT ON FECAL COLIFORM LEVELS

Under existing conditions, the rivers are suitable on average 50 percent of the time for primary recreation and 85 percent of the time for secondary recreation. Disinfecting effluent from the WPCCs increases average compliance for fecal coliform to 90 percent for primary recreation.

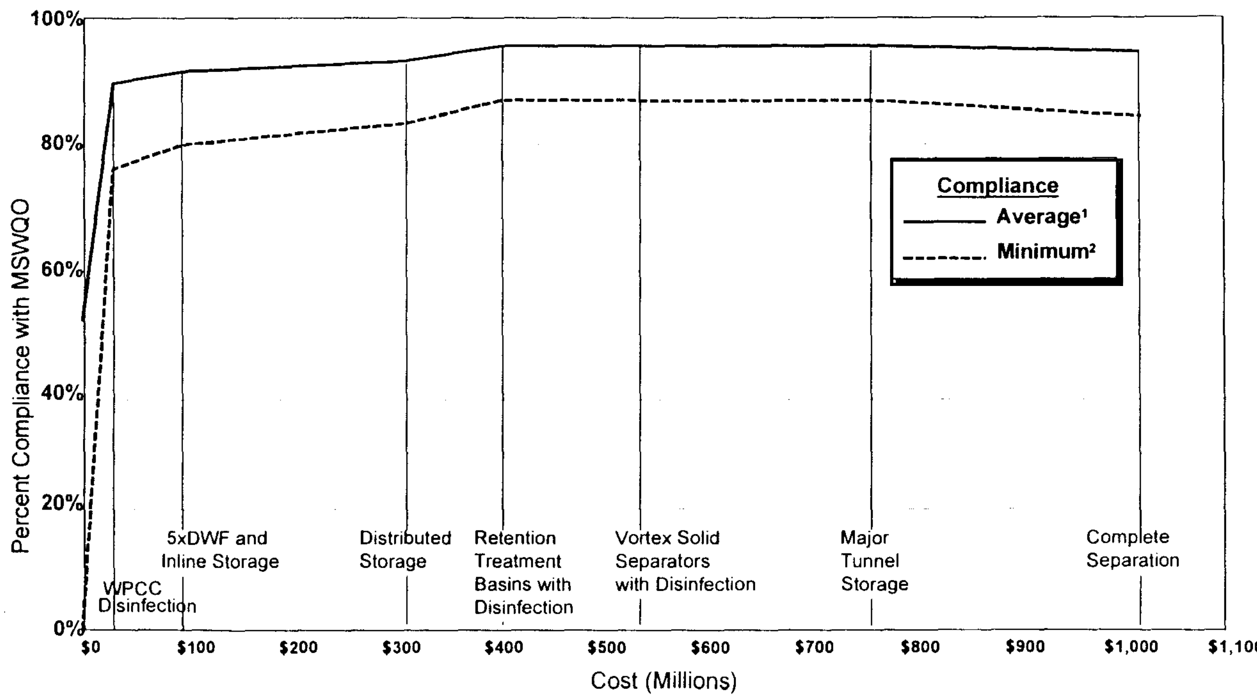
Wet weather control options increase compliance with the MSWQO only slightly. For average conditions, shown in the figure:

- adding an increased interception rate (5DWF) and inline storage costs 60 million dollars and increases compliance with recreational objectives from 90 to 92 percent;
- adding distributed or offline storage costs $300 million and increases average compliance to 93 percent; and
- other more costly options have an average compliance of 95 percent with the primary recreation fecal coliform objective and 98 percent compliance with the secondary recreation objective.

The figure also shows the minimum rate of compliance for each option (dashed line).

Even if the control option totally eliminates untreated combined sewer overflows, for example, by complete separation of the sewers, there will still be occasional high levels of fecal coliform from other sources, such as land drainage sewers and upstream river water quality.

Typical Year - Compliance with 200 Fecal Coliforms per 100 mL Objective for Different Control Options



1. The average compliance for all 10 monitoring stations throughout the Study Area reaches
2 Compliance level at the worst of the 10 stations

EFFECT ON AESTHETICS

During wet weather, the land drainage and combined sewers discharge floating debris, oil, grease, and other litter. Combined sewer discharges also contain matter attributable to sewage.

The MSWQO general requirements indicate that surface water should be free of floatable material from sewage or other sources.

Screens and nets installed at the ends of sewer outfalls would remove floatables at a moderate cost. Otherwise, only the most structurally intensive options, which are also the most costly, eliminate sewage related floatables entirely.

PRACTICALITY OF IMPLEMENTATION

The more costly structurally intensive options are the most difficult to implement. The structures required are large and may need to be constructed in highly developed areas where space is limited. Construction activities will likely cause substantial disruption to adjacent properties.

LAND USE ISSUES

The more costly structurally intensive options are the most likely to cause land use concerns. The construction and final use of these large structures may cause environmental and land use concerns.

Communicating with the Public

What you think is important. The City of Winnipeg encourages the public to participate in decisions about long-term projects. In addition, the CEC recommendation requires consultation. They will review the final CSO Management Strategy when it is finished in 1997.

There are many options for improving river water quality and options vary widely in cost. It's important that you help decide which options are chosen and that you understand what your choices mean.

DISTRIBUTING THE PHASE 1 REPORT

Copies of the Phase 1 Report were distributed to interested citizens of Winnipeg. These included all committees and groups contacted during Phase 2, the Advisory Committee, the scientific community group and interested environmental groups.

ADVISORY COMMITTEE

The Advisory Committee has 10 members selected from health organizations and the three levels of government. The project team has met quarterly with the Advisory Committee.

PUBLIC INFORMATION EVENTS

Phase 2 public information events included:

- An Open House in October 1994 at the Forks, attended by 100 people;

- A poster contest, aimed at students in Grades 4, 5 and 6, on the theme, *Steps you can take to keep floating debris out of our rivers*, with 17 schools taking part;

- Mall displays, in May and June 1995, at Grant Park and Polo Park shopping malls—500 handouts were distributed and 32 copies of the Phase 1 Report were mailed to individuals as a result; and

- A display and information centre at the Fishing Derby at The Forks in June 1995—200 brochures were distributed.

MEETINGS WITH STAKEHOLDER GROUPS

- Discussion with members of the scientific community in Phase 2 included a meeting with members of the University of Manitoba Department of Engineering who were invited to submit proposals for solutions to combined sewer overflow issues.

- Discussion with various environmental groups interested in water quality issues included a meeting on May 10, 1995, at the Centre Culturel Franco-Manitobain.

Towards Phase 3

The City of Winnipeg is planning to start disinfecting effluents from its three Water Pollution Control Centres, starting with the South End WPCC.

In dry weather, disinfection will improve the quality of river water, increase compliance with provincial objectives and lower health risks associated with use of the rivers.

Disinfection will have no effect on combined sewer overflows.

Phase 2 evaluated a number of options for controlling combined sewer overflows. Its main tools for evaluating these options were computer models.

Phase 2 modelling showed that even the most expensive control options will not ensure that provincial objectives are met at all times during wet weather. Even eliminating combined sewer overflows cannot ensure this because of the pollutants carried in land drainage sewers.

Phase 3 will refine the analysis and develop specific plans for controlling combined sewer overflows.

The plans developed will depend on what is important to the people of Winnipeg.

The study team utilizes public opinion to modify and adjust the plan for control of combined sewer overflows. Your input is needed to create the plan that best suits Winnipeg's situation and reflects the public's preferences.

You must tell the City what you value and what you are willing to pay for. We must all work together to define the plan for controlling combined sewer overflows. This is a complex undertaking.

For More Information

As they implement the Phase 3 program, the City will make many efforts to communicate with and inform the public. You are encouraged to participate in these activities and seek information on this important public policy issue.

Further information on the CSO Management Study can be obtained by contacting the Project Manager for the Water and Waste Department at the following address:

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Water and Waste Department
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Winnipeg, Manitoba R2C 5G6

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