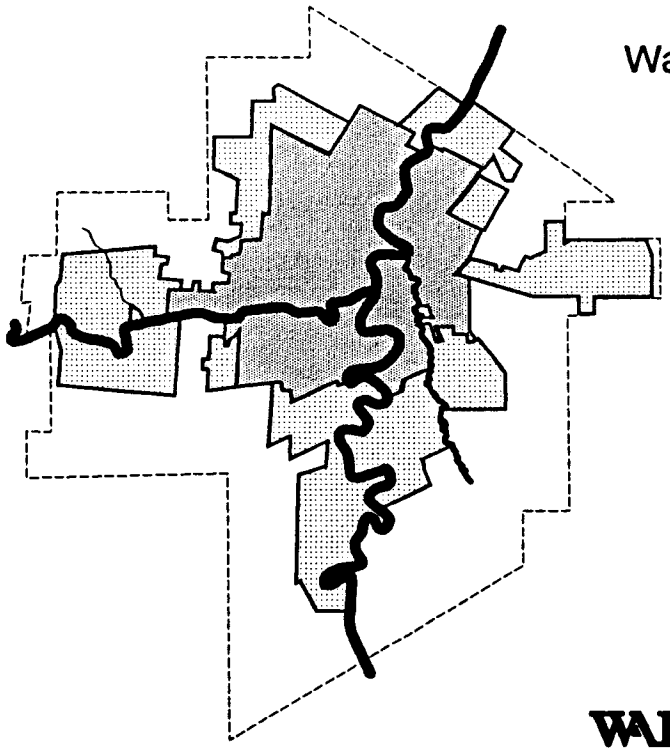
CSO MANAGEMENT STRATEGY
PHASE 1 REPORT

Prepared for:

City of Winnipeg
Waterworks, Waste and Disposal Department



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September, 1994

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Introduction

The City of Winnipeg's Waterworks, Waste and Disposal Department is conducting a comprehensive planning study of its combined sewer system in terms of the effects of combined sewer overflows on river water quality and related river uses. The study will develop a **Combined Sewer Overflow (CSO) Management Strategy** for the City of Winnipeg. This is a very important planning activity:

- it will help define the next generation of water pollution control for the City;
- it will result in the development of significant long-term environmental policies in relation to the City's major aesthetic and geographic features (the Rivers); and
- it could result in a substantive long-term commitment of financial resources.

The key product of the study will be the establishment of a **cost-effective, prioritized implementation plan for remedial work based on assessment of costs and benefits of practicable CSO control alternatives.** This plan and the supporting assessments, analyses, and documentation will be used by the City, after consultation with the public, to develop and substantiate its position in the ongoing regulatory review process, ultimately leading to the execution of an approved plan.

The study will be conducted in four phases and will take about three years to complete. **This report presents the results of Phase 1 of the study.**

Phase 1 was an introductory phase and was intended to review the available local information on CSOs, including their effect on river quality. It was also intended to develop a framework for technical evaluation and a program for communication of study issues and results to interested publics and stakeholders. **Phase 1 essentially began the interactive planning process of defining what Winnipeggers want in CSO control.**

The background leading up to the CSO study, as well as the current perspective with CSOs and their interaction with the City's Rivers is discussed in this report. This is followed by a brief outline of Phase 1 activities and the proposed Phase 2 work.

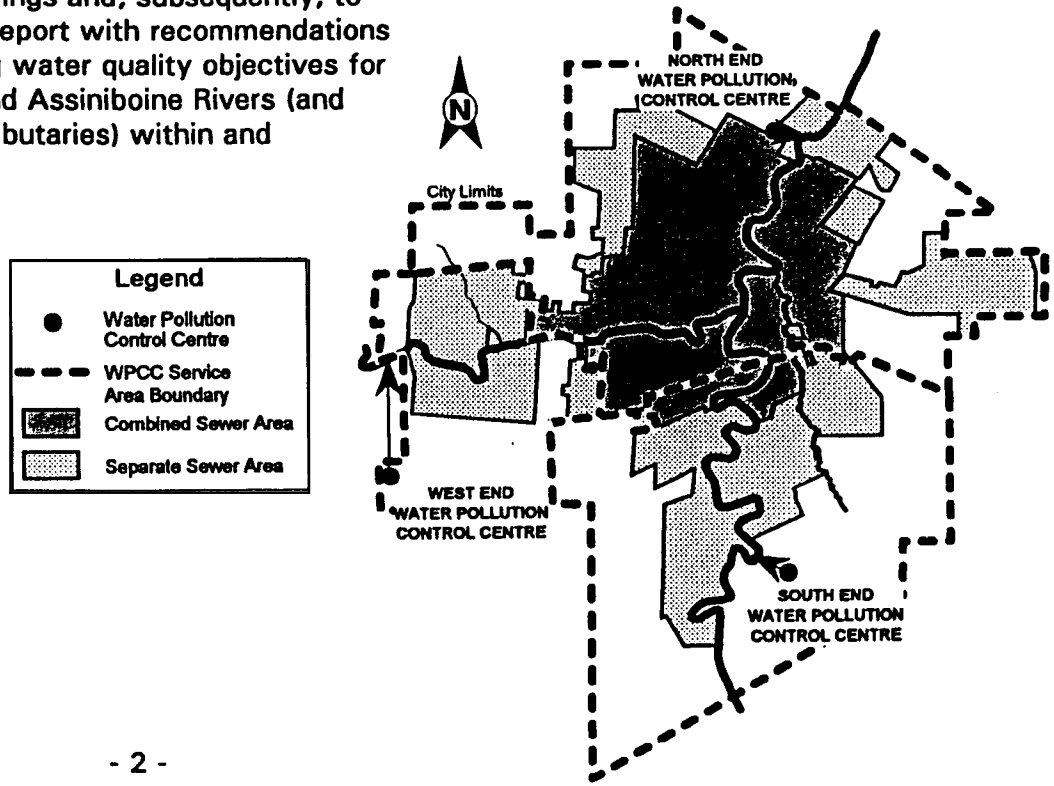
Background

The Red and Assiniboine Rivers comprise an important natural amenity and historic resource for the City of Winnipeg. Until recently, the responsibility for protecting water quality in the Red and Assiniboine Rivers in the Winnipeg area was delegated to the City by the Province of Manitoba through Order-in-Council. The City developed its own pollution control program in accordance with broad guidelines accepted by both jurisdictions.

Since the 1930s, the City has applied an ongoing program of pollution control for the discharges to the rivers. Due to City of Winnipeg initiatives, the scope of this pollution control program has progressively increased over the years so that currently all wastewater receives primary and secondary treatment under dry weather conditions, at the three Water Pollution Control Centres (WPCCs). Treatment is not provided to all wet weather discharges, such as CSOs or land drainage.

With the passage of the Manitoba *Environment Act* in 1987, existing developments which have environmental impacts are subject to licensing. In the case of the WPCC, and related discharges to the rivers, the Province indicated that licences would be issued after consideration of broader surface water quality issues for the Red and Assiniboine Rivers within and downstream of Winnipeg.

On November 14, 1989, the Minister of Environment asked the Clean Environment Commission (CEC) to hold public hearings and, subsequently, to provide a report with recommendations concerning water quality objectives for the Red and Assiniboine Rivers (and relevant tributaries) within and downstream of the City of Winnipeg. CEC hearings were convened in the fall of 1991 and reconvened in the winter of 1992 to deliberate, with public input, on the types of beneficial river uses that are appropriate for the River and the associated water quality objectives that will be recommended to protect these uses. From these considerations, the Province will determine control and licence requirements for discharges from the City of Winnipeg and others.



The CEC completed the task and submitted their report titled "Report on Application of Water Quality Objectives for the Watershed Classification of the Red and Assiniboine Rivers and Tributaries Within and Downstream of the City of Winnipeg", in June 1992. The CEC made numerous recommendations, including the protection of recreational uses of the rivers during dry weather flow, which would imply that disinfection of the effluents of the WPCCs will be required. At this time, the City has not yet been ordered to disinfect these effluents.

With respect to **CSOs** the CEC recommended that specific studies be undertaken to determine water quality impacts, as well as formulation of remedial measures, with recommendations to be available before July 1997. The implication is that water quality objectives for the rivers under wet weather conditions will be considered after the completion of the CSO study.

The CEC recommendations were accepted by the Minister of Environment on November 19, 1993. The City's scope of work for this **CSO Management Strategy Study** incorporates the requirements of the CEC recommendations and has been expanded to include:

- an assessment of the significance of various sources and types of pollution;
- a review of water quality impacts on Lake Winnipeg in addition to the Red and Assiniboine Rivers; and
- the integration of the **Basement Flood Relief** program and future sewer rehabilitation requirements into the implementation plan.

The CSO Management Strategy Study will provide the basis for technical submissions at public hearings, which the CEC has recommended to be held subsequent to completion of the study, presumably in 1997.

The study period will provide an opportunity to assess the site-specific nature and extent of CSO impacts, predict the effectiveness and benefits of various alternatives and propose an environmentally responsible and cost-effective plan for mitigation of CSOs.

Manitoba Surface Water Quality Objectives

The Manitoba Surface Water Quality Objectives (MSWQO) define the minimum levels of quality which will protect various beneficial river uses. These Objectives are used by government agencies to assist in developing effluent discharge limits for industrial and municipal discharges. The Province states that compliance with the Objectives should protect organisms or a community of organisms, designated river uses, and public health to an adequate degree of safety. The Objectives are intended to apply to conditions caused by man's activities and are to be considered on a site-specific basis as a management tool to protect surface water quality.

The MSWQO describe a number of "General Requirements" in the form of narrative statements, relating to floating material, nutrients, etc. describing conditions that should be avoided, and set out numerical objectives for over eighty substances within different classes of river use.

The application of objectives to specific locations is intended to include consideration of several factors, including the nature and suitability of local river uses, the natural water quality, the nature and magnitude of discharges to the specific waterbody and the costs and benefits of control technologies available to improve water quality. All of these considerations will be addressed in the Combined Sewer Overflow Management Study as they will be important in defining the long-term control plan.

CEC Recommendations for River Use Protection

RIVER USE CLASSIFICATION	RED RIVER	ASSINIBOINE RIVER
Raw water for domestic consumption	✓	✓
Aquatic life and wildlife	✓	✓
Industrial Consumption	✓	✓
Agriculture (Irrigation)	✓	✓
Recreation a) primary b) secondary	 ✓ ✓	 ✓

Urban Discharges That Affect River Water

While combined sewer overflows (CSOs) are the focus of this study, their impact on water quality must be considered in the context of the upstream water quality and the effects of other discharges to the river.

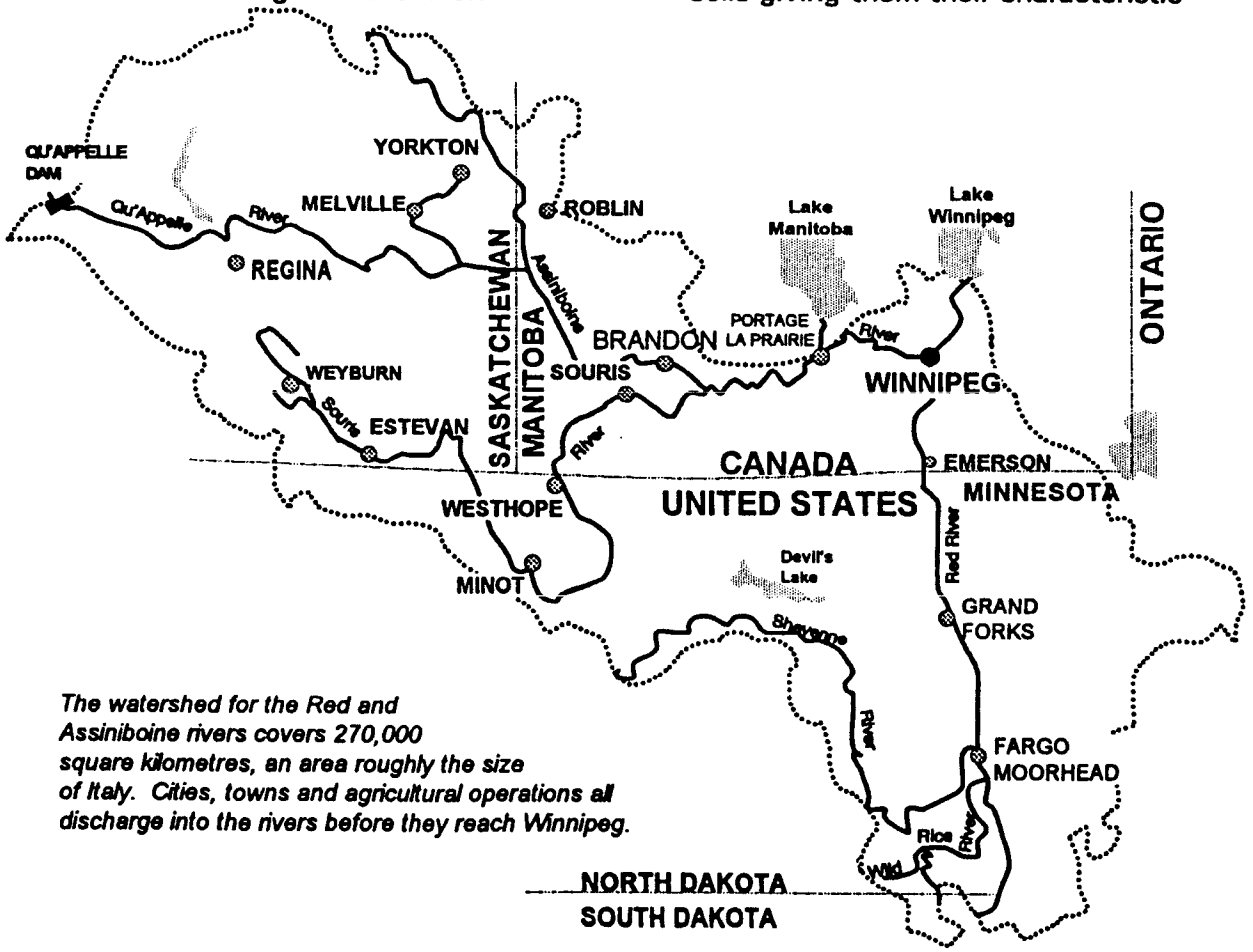
UPSTREAM WATER QUALITY

The water quality of the Red and Assiniboine rivers as they enter Winnipeg is already affected by human activities and natural conditions. These rivers carry large volumes of suspended soils giving them their characteristic murky brown appearance. Before reaching Winnipeg, the rivers cross intensively-used agricultural land, from which fertilizers, pesticides and organic materials enter the rivers in runoff.

Upstream water quality usually meets the MSWQOs for fish and other aquatic life. However, the combination of natural and human upstream activities create conditions that do not meet some aspects of the MSWQOs before the rivers reach Winnipeg. None of the following conditions are met upstream of the City:

- phosphorus content;
- physical conditions for recreation (suspended solids and clarity); and
- aesthetic characteristics for drinking (taste, odour and water hardness).

These characteristics, as a result of upstream conditions and activities, are beyond the City's control.

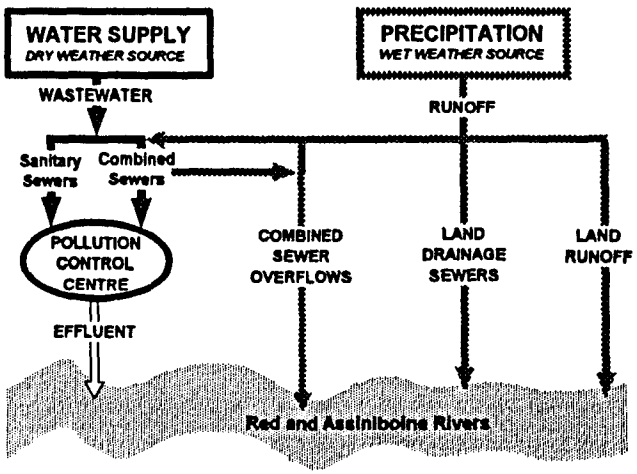


The watershed for the Red and Assiniboine rivers covers 270,000 square kilometres, an area roughly the size of Italy. Cities, towns and agricultural operations all discharge into the rivers before they reach Winnipeg.

Once the Red and Assiniboine Rivers reach the city, the concentration of a large population further affects river water quality, mainly resulting from wastewater and land surface drainage that change the biological and chemical characteristics of the rivers. This wastewater comes from the city's Water Pollution Control Centres (WPCCs), CSOs and land drainage sewer runoff during rainfall and snowmelt.

Dry weather flows (DWF) occur year round and generally result from expended potable water from domestic and industrial use. Wet weather flows (WWF) arise from precipitation or snowmelt.

URBAN DISCHARGES TO OUR RIVERS



TREATED WASTEWATER FLOWS

The City of Winnipeg's pollution control program has focussed on the provision of primary treatment and secondary treatment of DWF. There are three treatment plants, designated as the North End, South End and West End Water Pollution Control Centres (NEWPCC, SEWPCC, and WEWPCC).

All three Centres have recently undergone expansion and upgrading, involving an investment of over $200 million in a 15 year period. These plants are considered to be "state-of-the-art" secondary treatment facilities.

Primary treatment removes settleable solids, grit, litter and scum from the water. Secondary treatment removes over 90 percent of organic matter in the form of plant and animal wastes that need oxygen to decay into simpler compounds.

If these wastes went directly into the rivers without treatment, they would take oxygen from the water as part of their natural decay process. This would lower the river's oxygen content to levels that would not support fish and other aquatic life.

Before secondary treatment facilities were built, low oxygen content was a problem in the rivers. A healthy fish population was not able to survive. Secondary treatment now maintains adequate oxygen supplies for fish.

The treatment system also results in the reduction of bacteria levels by about 90 percent, even without a disinfection process. Conventional secondary treatment does not remove nutrients like phosphorus and nitrogen that are present in wastewater from human activities.

WET WEATHER DISCHARGES

The discharges to the river during wet weather (snowmelt or rainfall) depend on the type of sewer system in place. There are two types of sewer systems in the City of Winnipeg; a combined sewer system and a separate sewer system. Illustrated are the major differences between the handling of storm flows by a combined sewer system as compared to a separate sewer system.

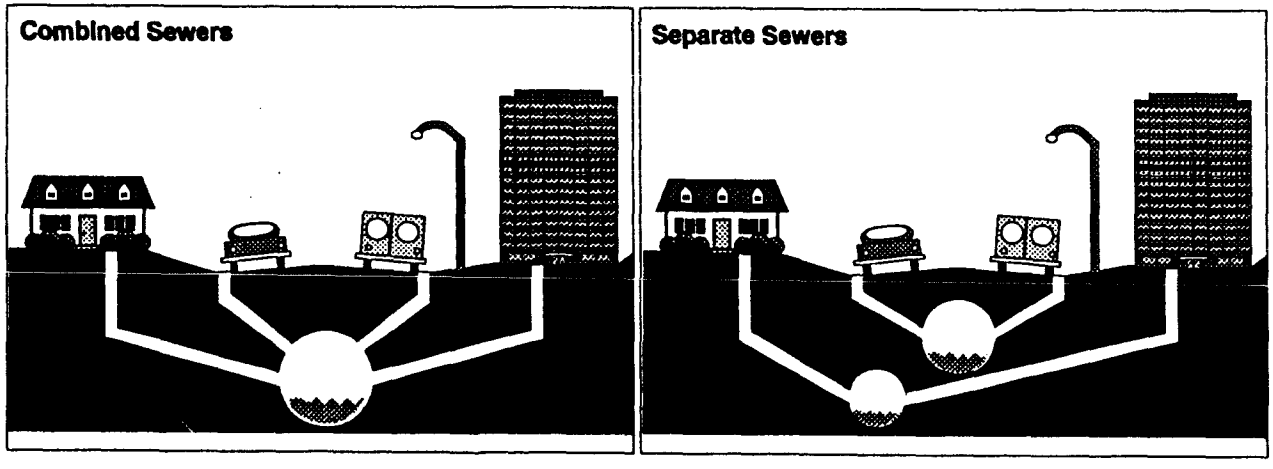
Combined Sewer Overflows

In older areas of Winnipeg, single-pipe, combined sewers carry both domestic wastewater and stormwater runoff. Most other Canadian cities, including the Manitoba communities of Brandon and Selkirk, have combined sewer systems in parts of their older built-up areas. This situation exists in about 40 percent of the City's developed land.

Separate Sewer System

In newer parts of the City, a two pipe, separate sewer system handles domestic wastewater and stormwater. In these areas, all wastewater goes directly to the wastewater treatment plants. During rainfall, land surface runoff is collected by storm sewers and drains directly into the rivers. Even though this water is essentially rain or meltwater, it does pick up surface pollutants as it flows to the sewer system. Contaminants include:

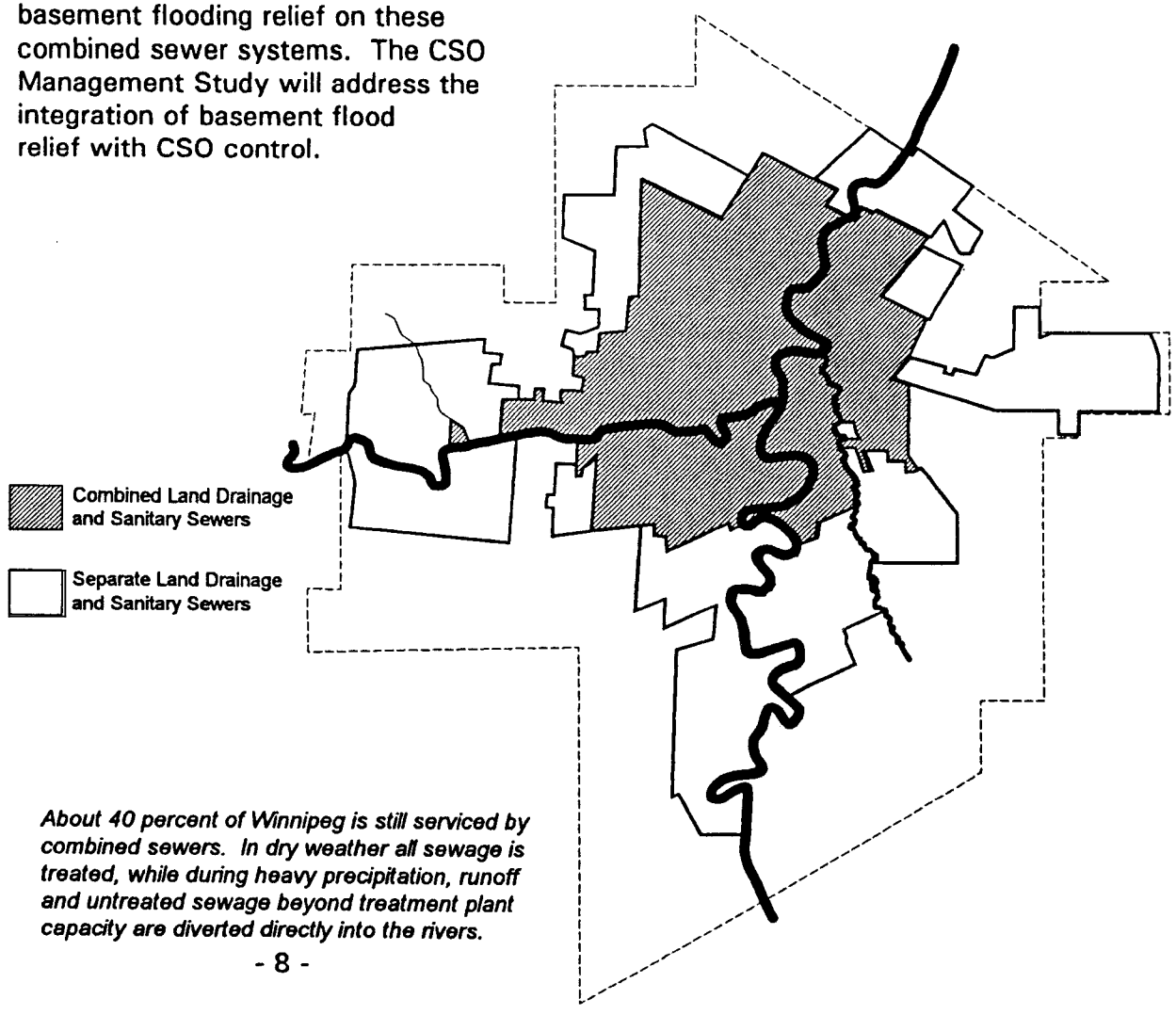
- bacteria from animal wastes;
- decaying plant and animal materials that will consume oxygen from the rivers as they decompose;
- street litter that will float when it enters the rivers; and
- urban street deposition, such as metals, dirt, grease and oil from automobiles or industrial runoff.



During dry weather, all wastewater goes to the treatment plants. However, during rainfall and snowmelt, the amount of runoff entering the combined sewer system is greater than the capacity of the sewer conveyance system and the wastewater treatment plants. Volumes in excess of this capacity overflow directly into the rivers.

Combined sewers typically overflow a dilute mixture of runoff and wastewater about 30 times per year. This overflow contains untreated domestic and industrial sewage, diluted by stormwater. This results in higher levels of pollutants entering the rivers than would be found in stormwater alone. In addition to this sewage component, combined sewers convey the floating material and debris normally discharged by separate land drainage sewers.

These older combined sewers were not designed for the current urban development and have limited capacity to carry runoff. As a result these systems have been plagued with basement flooding problems. The City has a continuing program for basement flooding relief on these combined sewer systems. The CSO Management Study will address the integration of basement flood relief with CSO control.



About 40 percent of Winnipeg is still serviced by combined sewers. In dry weather all sewage is treated, while during heavy precipitation, runoff and untreated sewage beyond treatment plant capacity are diverted directly into the rivers.

River Uses Potentially Affected by Combined Sewer Overflows

The Red and Assiniboine Rivers support a number of natural and human activities within and downstream of Winnipeg. They provide habitat for a variety of fish species, and allow for recreation, industrial irrigation uses and a use as a source of raw drinking water. These activities can be affected by the rivers' water quality.

River water characteristics, which are affected by treated and untreated wastewater and stormwater runoff flowing into the rivers, include:

- oxygen content (as it relates to fish and other aquatic life);
- ammonia content (as it relates to fish and other aquatic life);
- bacteria content (as it relates to recreation and irrigation); and
- aesthetic appearance (as it relates to both active and passive recreation).

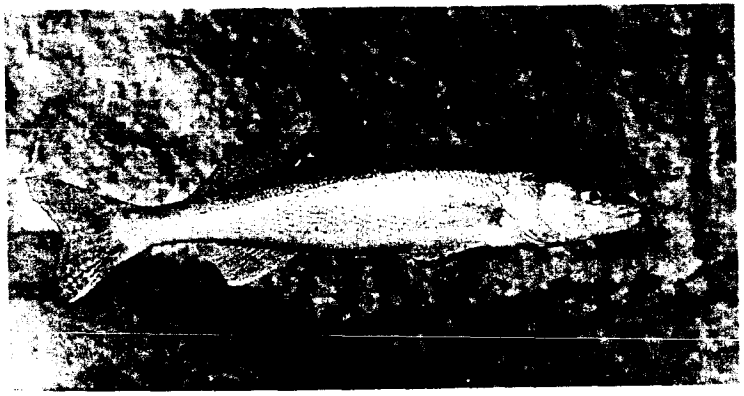
Of these conditions, **combined sewer overflows (CSOs)** are most relevant to **bacteria content** and **aesthetic appearance.** As outlined in the following discussion, they are not the only discharges affecting these conditions and related river uses.

HABITAT FOR FISH AND OTHER AQUATIC LIFE

In their natural state, rivers support aquatic plants and animals. Generally, conditions that support a healthy fish population indicate good conditions for other aquatic life. The Red River represents a highly-valued sports fishery.

In 1993, over 1,300 master-angler awards were given for 12 species of fish caught in the Red River.

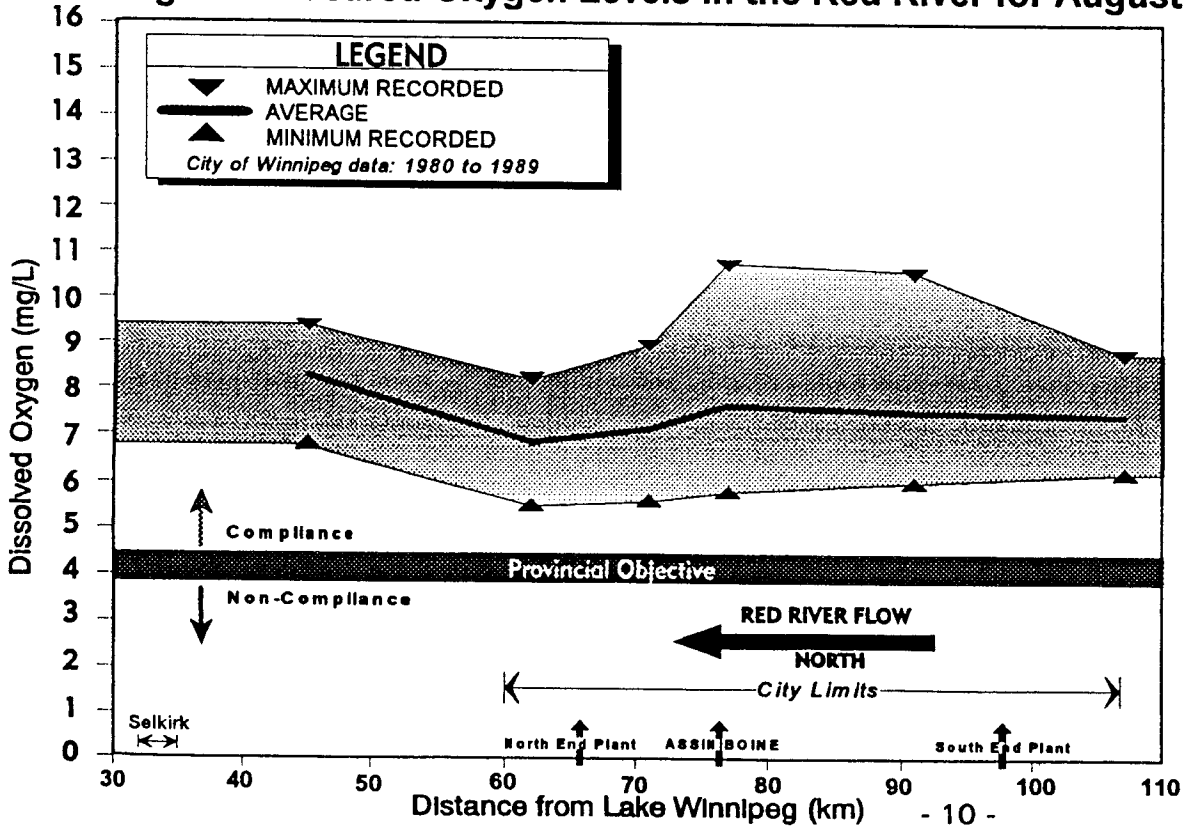
Discharging treated and untreated wastewater can change conditions in the rivers and affect their ability to support aquatic life. The provincial objectives set desired minimum or maximum levels for substances related to wastewater that can affect fish populations, with dissolved oxygen and ammonia content being the two most important.



Extensive water sampling over several years indicates oxygen levels consistently higher than required by the MSWQOs. Adequate oxygen levels for fish are maintained, even with wastewater entering from **combined sewers**, demonstrating the effectiveness of the City's secondary wastewater treatment program.

Projections of future oxygen content indicate levels will remain above those specified in the provincial objectives, even during adverse conditions like low-water flows. **CSOs are not a significant factor in maintaining healthy oxygen levels in the Rivers.**

Range of Measured Oxygen Levels in the Red River for August

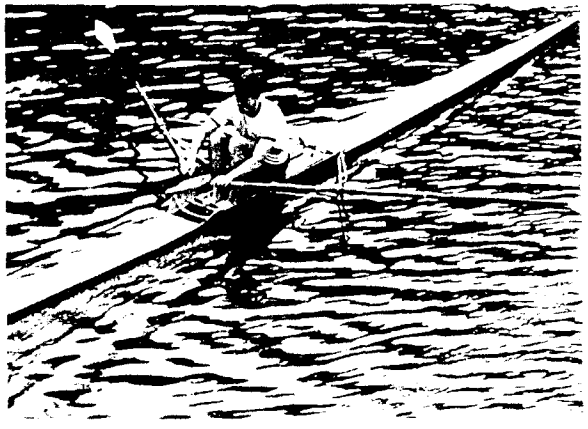


Occasionally, ammonia levels in our rivers do not meet the MSWQOs ("ammonia" refers to the un-ionized portion of ammonia which is toxic to fish). Human waste contains nitrogen which is converted into ammonia. Ammonia enters our rivers with treated wastewater because conventional secondary treatment does not remove much of it. **CSOs are not a significant factor in ammonia levels in the rivers.**

The Clean Environment Commission (CEC) recommended that studies be done on the impact of ammonia on local river fish to determine if the MSWQOs are appropriate to aquatic conditions in this province. These studies would determine if further specific action is required for the protection of fish. The City intends to undertake these studies independently of the CSO Management Study. Any additional actions for ammonia would not involve combined sewer overflows.

RECREATION AND IRRIGATION

More than any other use, water-related recreation exposes the largest number of people to the rivers.



Secondary recreation like rowing, boating, fishing, camping and hiking bring the most people in contact with the rivers. Primary recreation such as swimming and water skiing are considered unsafe because the rivers do not meet guidelines for colour or clarity as a result of naturally occurring conditions and other factors such as currents and slippery, muddy banks.

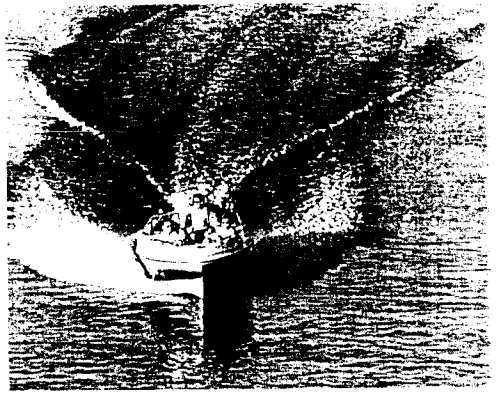
Such recreation is divided into primary and secondary uses. ***Primary recreation*** involves activities in the water like swimming and waterskiing where immersion in the water is probable. ***Secondary recreation*** covers activities like fishing, boating, hunting, camping and hiking where immersion in the water is not necessary.

Swimming activities are limited because of the unattractiveness of the rivers' natural muddy appearance. In addition, the steep and muddy banks are unappealing to swimmers and pose safety hazards.

Waterskiing is more frequent than swimming and is attributable to a small core of regular users. This group is estimated to be about 500 people. Most skiing occurs in southern Winnipeg near the Fort Garry Bridge. Little skiing occurs downstream of the City or on the Assiniboine River where it is banned by City bylaw.

Secondary recreation is much more extensive, with power boating being the most popular. Estimates range between 11,000 and 70,000 boaters on the rivers with about 60 percent thought to be regular river users who moor their boats at private docks or marinas. Power boating is most common between the floodway entrance control structure at St. Norbert and Selkirk.

Up to five commercial river cruise boats ply the rivers regularly. Canoeing is estimated to involve between 170 and 1600 users annually. About 200



competitive rowers also use the river as a club activity.

The Canadian and Manitoba primary recreation guidelines for water colour and clarity are not met due to the natural river conditions. Poor visibility, currents and the slippery banks also make the rivers unsuitable for primary recreation. For these reasons, the City's Medical Health Officer considers the rivers unsafe for swimming and waterskiing. The CEC has recommended that the Red River be protected for primary recreation during dry weather. The main water quality issue subject to control is bacterial content.

Using our rivers for primary recreation has some health risk as measured by fecal coliform levels which indicate a potential for gastro-intestinal illness (GI) (e.g., stomach cramps, diarrhea) and possible skin and eye infections. The MSWQO call for counts below 200 fecal coliform per 100 millilitres of water for primary recreation and below 1,000 fecal coliform for secondary recreation. The degree of risk to swimmers increases as fecal coliform levels increase. Studies of bathers indicate that the incidents of GI increases according to the following:

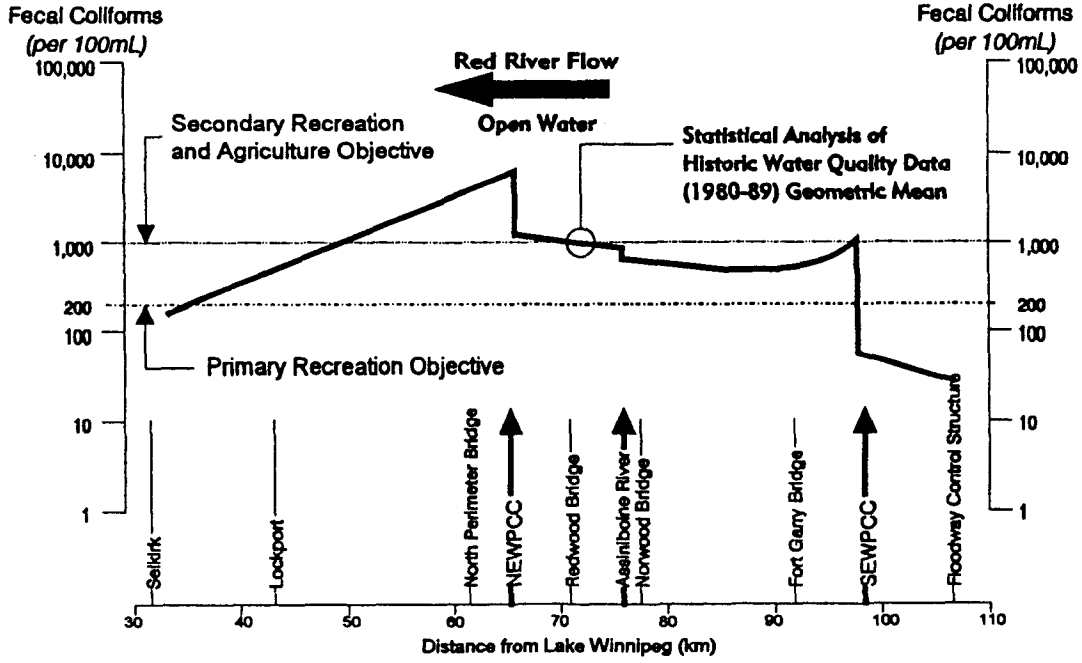
FECAL COLIFORM LEVELS (per 100 mL)	PREDICTED CASE OF GI (per 1000 immersions)
200	10
2,000	19
20,000	28

Bacterial content is also an issue with regard to the use of river water for irrigation. Maximum fecal coliform levels in water are set to protect public health where irrigated fruits or vegetables may be consumed raw and to protect irrigation workers who are directly exposed to the river water.

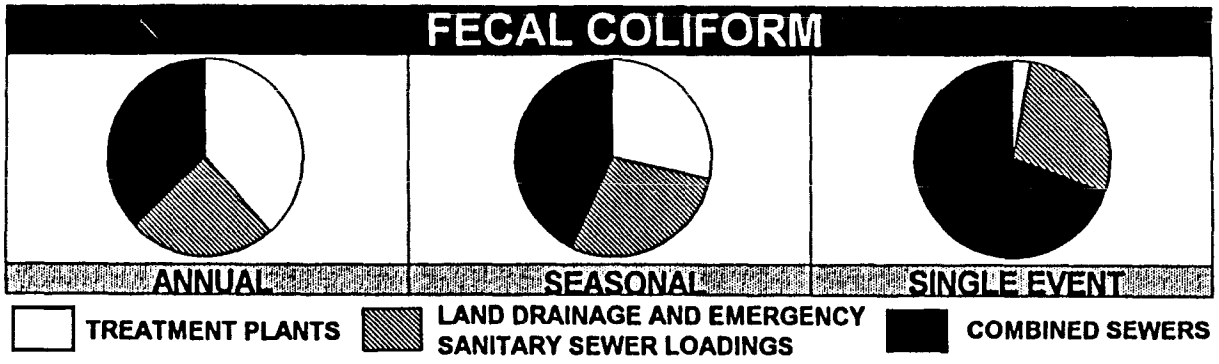
Treated wastewater, land drainage and CSOs raise bacteria counts above the specified levels in the rivers through the City and downstream. On average, bacteria counts usually meet primary recreation objectives upstream of the City, but rise considerably as a result of the City's treated effluent entering the rivers.

In the Red River, flows from the South End WPCC raise bacterial counts to slightly more than secondary recreation objectives. Further downstream, bacteria counts fall below secondary recreation objectives until they rise considerably where the North End WPCC effluents enter the rivers. Counts decrease downstream and usually meet objectives for primary recreation at Selkirk.

Red River Fecal Coliform Profile



Relative Importance of Projected 2011 River Loading

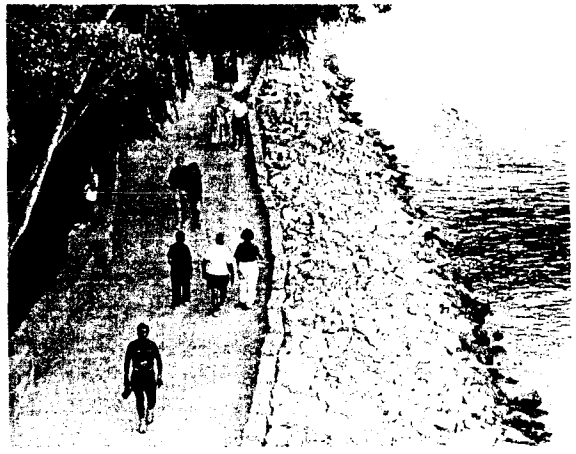


Significant rainstorms result in large discharges, from both CSOs and land drainage, and peak loading in a short period of time. These discharges can completely dominate the effects of treatment plant loadings during such episodes. Wet weather flows, particularly CSOs, will comprise a dominant factor in fecal coliform densities on an annual and seasonal basis in the year 2011. They overshadow treatment plant discharges on a single event basis.

RIVER APPEARANCE

Riverbank use has been promoted in the last few years, particularly with the development of The Forks and the construction of walking paths on the riverbanks. The Rivers and their banks are used extensively in Winnipeg for walking, photography, cycling, etc. For these uses, the aesthetic appearance of the water is important.

The MSWQOs provide descriptive rather than quantifiable objectives related to appearance. These statements essentially require that surface waters should be free of constituents attributable to sewage or other human-induced discharges such as floating debris, scum, oil and grease and excessive plant nutrients.



With greater access to Winnipeg's rivers, people have become more aware of the river's appearance. New environmental regulations will require a closer look at how we want to use and protect our rivers and at the costs involved.

During dry weather, the City of Winnipeg discharges to the Red and Assiniboine Rivers are insignificant factors in the appearance of the rivers. During wet weather, however, the land drainage sewers and CSOs discharge some floating debris, oil, grease, street litter, scum and other floatables attributable to sewage. **CSOs are the main source of sewage-related constituents in the wet weather discharges** to the Rivers.

MANAGING BACTERIAL CONTENT

Since bacteria levels potentially affect primary recreation and irrigation, one issue to be decided is whether existing low levels of these uses justify protection, considering the costs involved. If protecting these activities becomes necessary, will maintaining low bacteria levels be required at all times or only during periods of dry weather? The high cost of providing protection during wet weather is an important question. **These are important factors in defining the level of CSO control appropriate to our local situation.**

The minimum requirement needed to reduce bacterial levels would be installation of disinfection equipment at the three WPCCs. Installing such disinfection equipment is estimated to cost up to $20 million to build and almost $700,000 every year to operate.

Bacteria levels would still exceed MSWQO, and reach current levels during rainy periods when **combined sewers overflow** and carry untreated sewage into the rivers. Reducing these levels would require removing suspended solids from the CSOs and then providing disinfection at those points where the sewers discharge into the rivers.

If the combined sewers were separated, or their overflows intercepted and disinfected, the rivers would meet bacteria objectives for primary recreation most of the time. Disinfection would not improve the appearance of river waters.

Separating combined sewers has been estimated to cost more than $1 billion. Alternatively, installing treatment and disinfection for about 70 combined sewer outlets would also be costly, ranging from $400 million to $700 million. Riverbank land acquisition for these installations as well as related environmental concerns would make implementation of these control methods difficult.

The benefits of disinfection relate to three areas:

- reducing illness from contact with the river water when swimming or waterskiing;
- reducing health risk from eating unwashed, irrigated fruits and vegetables; and
- improved public perception that our rivers are cleaner.

Controlling bacterial content in the rivers is a complex environmental policy issue, particularly as it relates to CSOs. Disinfecting treatment plant discharges, without disinfecting CSOs will only improve conditions during dry weather, this may be acceptable to society.

The Rivers are not well-suited for primary recreation such as swimming and waterskiing. Low levels of primary recreation, and estimates of few cases of illnesses resulting from immersions in river water, raise questions as to whether the large commitment of funds required for CSO control is justified. Options for CSO control will need to be carefully studied and the public will need to be consulted on these important policy decisions.

MANAGING AESTHETIC APPEARANCE

Reducing the amount of floating materials and litter from combined and land drainage sewers is a complex and expensive undertaking because of the many pipe outfalls and the large volume of flow involved. If CSO control measures were implemented for reduction of bacterial content, the control technology would include measures that would improve the aesthetic qualities of the CSOs. For example, disinfection facilities at combined sewer outlets, if provided, would likely include screening equipment to remove floating materials. Costs, as identified earlier, could range up to $1 billion for addressing combined sewers alone. This action would not, however, address quantities of such materials that enter from many other sources such as land drainage, boats, river traffic and shore dumping.

To handle materials entering from storm sewers, other control measures may be more appropriate and cost-effective such as preventing litter from entering the sewer systems through better litter control on land and streets throughout the City. Imposing litter and sewage dumping regulations on boat users is also necessary to contribute to a better river appearance.

The reduction of floating materials from combined sewers needs to be studied as part of the larger issue of managing combined and storm sewer discharges and floating material originating from other sources.

The CSO Management Study

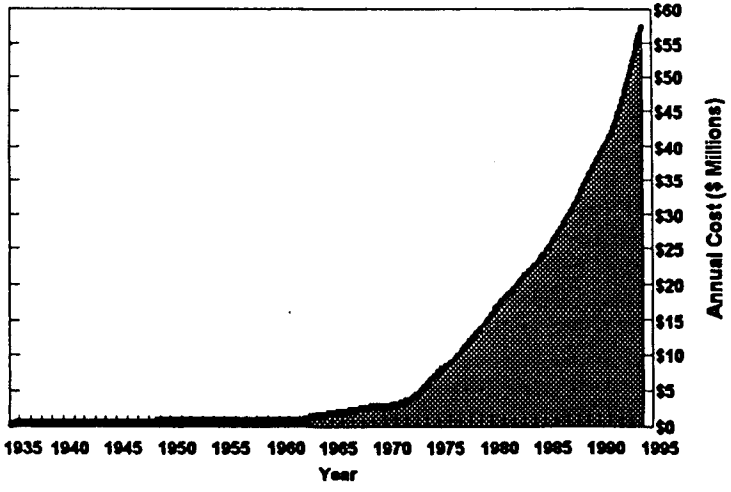
The Combined Sewer Overflow (CSO) Management Study will raise difficult technical and policy issues. There is a wide range of technical options for mitigating CSO impacts with a correspondingly wide spectrum of associated costs, practicability, and differences in water-quality related benefits. A complication characterizing the Winnipeg situation, is the fact that the effects of CSOs on ***beneficial river uses***, chiefly water-based recreation and aesthetic enjoyment, are not readily quantifiable. Further, conditions in the Rivers which may relate to CSO effects are also impacted by discharges from Water Pollution Control Centres (WPCCs), land drainage sewers and sanitary sewer overflows. The situation is further complicated by the ambient conditions of the rivers upstream of the City.

The study will involve much more than difficult technical issues. Its product will be a ***management strategy document***. Winnipeg citizens have expressed a desire for "cleaner" rivers and the regulatory agencies, including the Clean Environmental Commission (CEC), have served notice that they will apply water quality objectives with greater stringency.

The City believes that maintaining appropriate water quality standards for users of the rivers is important. The City also wants to ensure that any large expenditures produce meaningful results and the benefits justify the costs. The City must balance its responsibility for ensuring suitable river water quality with the interests of local residents and what they can afford to pay to ensure that quality.

Winnipeggers already face large increases to the sewer portion of their quarterly water/sewer bills to pay for the extensive upgrades to the three WPCCs to maintain a high level of secondary treatment. Accordingly, providing opportunities for public discussion of these CSO issues and their costs and benefits relative to the CSO control strategies are extremely important.

Growth of Investment in Winnipeg's Water Pollution Control Program

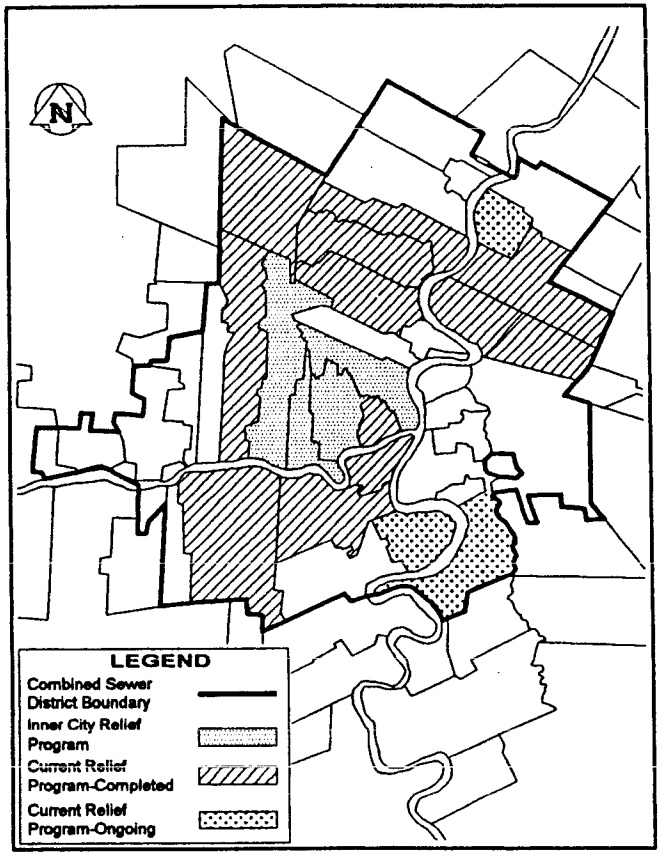


Since the mid 1970's the city's annual investment in wastewater treatment programs has been increasing at an accelerating pace. Higher water quality standards would mean even greater annual expenditures with corresponding increases on water and sewer bills.

The CSO Management Study will also need to integrate another pressing issue related to combined sewers, their general inadequacy to convey storm runoff of significant storms (5 to 10 year return frequency) and the resulting **basement flooding problems.**

Adding flood relief piping is very expensive, the City has spent $280 million (1994 $) in the last 32 years on flood relief in combined sewer systems. While this program alleviates basement flooding, it does little to mitigate water quality concerns.

Separation of these old combined sewer systems, as is often advocated, is extremely costly, disruptive to residents and does not address the water quality concerns related to urban storm runoff. Separation in selective areas can be effective and has been done in Winnipeg. Area-wide separation is rarely implemented in other cities with similar problems. CSO control measures and basement flood relief programs will need to be integrated and priorized in the overall strategy.



Combined Sewer Areas Relieved to Date

The CSO Management Study will develop a **comprehensive technical and policy analysis** to assist in defining objectives of Wet Weather Flow (WWF) management strategies, developing the **appropriate balance** between costs and benefits, and to defining the priorities in the ultimate program. The implementation plan must be practicable and must fit the available resources and priorities of the community.

The CSO control options will evolve as information on the practicability of alternatives are developed. This information will include costs, physical requirements, interrelationships with other objectives (such as basement flooding relief), the effect on beneficial uses of the rivers, and environmental policy implications. Specific objectives will ultimately be set as a result of the review of all the relevant information by elected officials, regulators, and the public.

STUDY PHASES

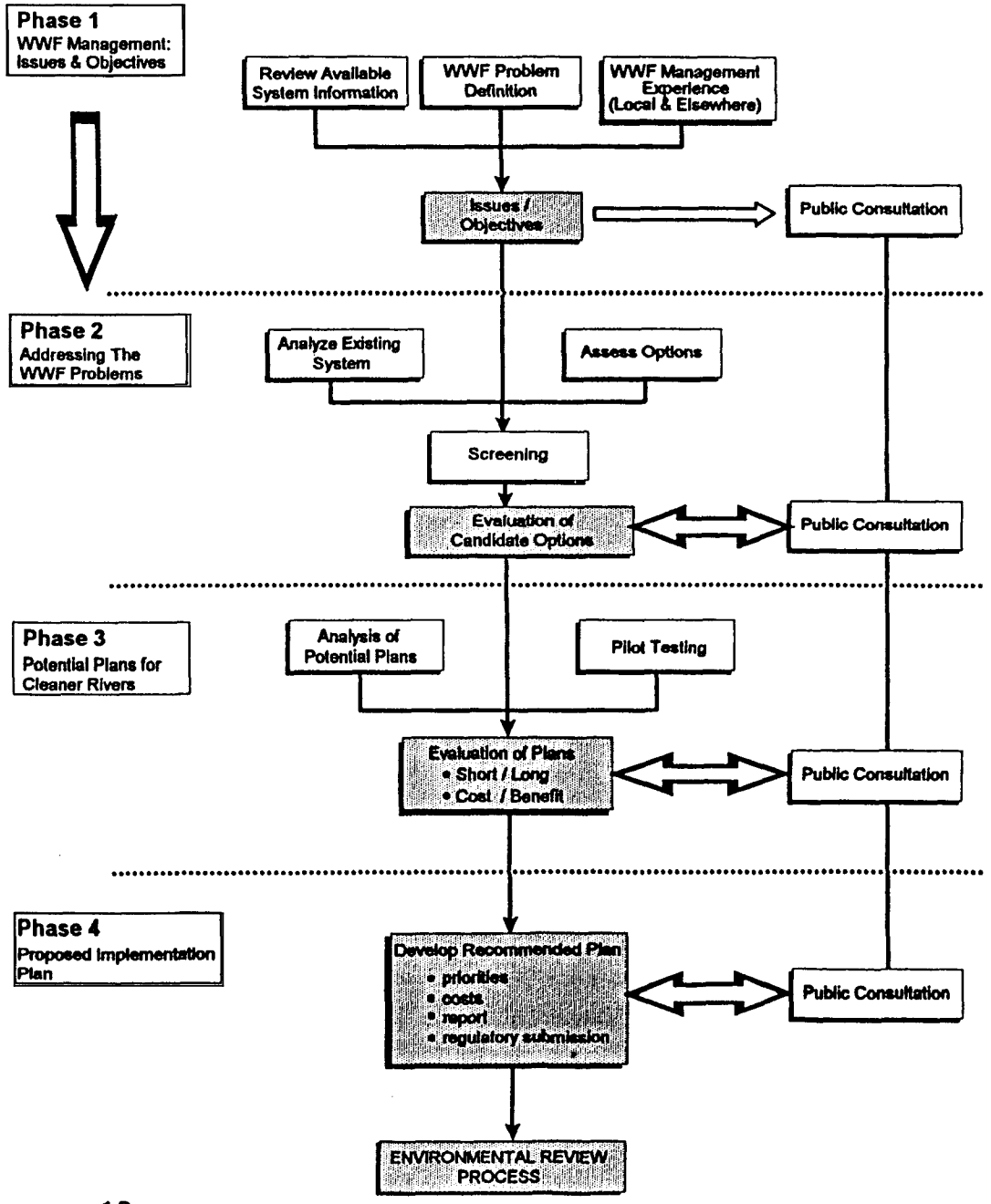
A phased approach has been adopted for the Study. Potential control options will be progressively screened, in response to technical analyses and consultation, to the most appropriate technology for our particular circumstances. The study will be conducted in four phases:

Phase 1: **WWF Management Issues and Objectives**
Phase 2: **Addressing the WWF Problems**
Phase 3: **Evaluation of Candidate Options**
Phase 4: **Proposed Implementation Plan**

The phases will be organized in a logical and coherent plan. Each phase will achieve specific objectives and the phases are organized to facilitate periodic liaison with senior City policy/administration levels, the public and government agencies.

An important goal is to develop and communicate this information to the policy-makers and interested public in a timely, progressive manner to facilitate informed decision-making. Each phase will conclude with a report on the activities involved in that phase.

General Approach



The City is in process of organizing an Advisory Committee, together with Manitoba Environment, which will be provided with information throughout the study and will be invited to provide advice on technical, policy or other issues to guide the Study.

Representatives of the following entities will be invited to serve on this committee:

- Manitoba Environment
- Manitoba Urban Affairs
- Manitoba Health
- Winnipeg Health
- Fisheries (Provincial and possibly Federal)
- Selkirk and District Planning Council
- Manitoba Agriculture
- Manitoba Sustainable Coordination Development Unit

In addition, the City and its consultants will consult widely with the local scientific community and with informed practitioners in the CSO field in North America and Europe to assure that the most pertinent questions are being addressed and the best technology is being used in the Study.

Phase 1 involved an assessment of the current conditions and assembly of the relevant background information. This phase has been completed and a workplan for Phase 2 has been developed.

PHASE 1

Phase 1 activities comprised the assembly and assimilation of the available information on the existing wastewater conveyance and treatment systems, their response to dry weather and wet weather events and a knowledge of the water quality of the City's rivers and their uses. Such an assessment is vital to the development of solutions to WWF problems and the development of long-term CSO control strategies (which will take place in the later phases of the study). The results of Phase 1 are reviewed briefly under the following subject headings.

Dry and Wet Weather Discharges

The study team identified and quantified the dry and wet weather sources of discharges to the rivers and the impacts on the Lake Winnipeg South Basin. The information assembled was used to estimate the impacts of loadings on the Red and Assiniboine Rivers and to place the relative impacts of various sources (i.e., land drainage, CSOs and WPCCs) into perspective. This perspective will be updated in subsequent study phases by considering the temporal and spatial distribution of rainfall across the City of Winnipeg. The combination of areal-distributed rainfall and quality concentrations of dry and wet weather discharges will be used to assess loadings on the rivers and more accurately quantify the fraction of loading on Lake Winnipeg attributable to Winnipeg.

Review of Sewer Systems

In order to develop an understanding of the City's infrastructure, the Study Team assembled and studied background documents dealing with the separate and combined sewerage systems and WPCCs. Particular attention was given to the City's Interceptor Systems, especially the Main Interceptor which conveys flows from 90 percent of the combined sewer area to the NEWPCC. Current understanding of the manner in which various parts of the infrastructure system respond to WWF was documented. This understanding will be developed further

in the Phase 2 investigations. The investigations also included a review of the status of the Basement Flood Relief Program.

River Water Quality

A comprehensive understanding of the quality of the Red and Assiniboine Rivers, and their responses to various discharges, was developed during the course of the CEC hearings, and most particularly through the Wardrop/Tetr*ES* study for these hearings. This understanding was updated during Phase 1, using the results of extensive monitoring done by the City since the hearings. The results of these investigations reaffirmed that dissolved oxygen (DO) is not considered to be a water quality issue in the Rivers and, further, that CSOs do not significantly depress DO levels. **Accordingly, DO is not considered to be a CSO issue. The Phase 1 study concluded that the key river uses potentially affected by CSOs are recreational, aesthetics and, to lesser degree (if any), aquatic life.**

Potential CSO Control Options

A list of conceptual CSO control options for the City of Winnipeg was developed. The selection was based on the range of techniques used in other North American and European cities, as well as information developed by study team members in the course of undertaking investigations for others, and from existing City of Winnipeg basement flood relief studies. The options considered included:

- no action (beyond that already in place);
- non-structural/best management technologies (sewer flushing, roof leader disconnection, public education, etc.);
- minimal structural alternatives (in-line storage of WWF, etc.);
- maximize treatment plant capacity;
- real-time control (e.g., optimize in-line storage);
- off-line storage (basins or tunnels);
- treatment of CSO at the point of discharge to the river; and
- sewer separation.

As a result of a preliminary assessment, it was concluded that all alternatives would need to be evaluated in the ongoing Study. One of the key elements of the Study will be the quantification of the benefits of the various CSO control techniques.

The experience of other jurisdictions in combined sewer overflow management areas was documented in some detail. This was done in order to provide the study with state-of-the-art information on CSO control policies, practices, and technologies in other parts of Canada and the rest of the world. This information will continue to be updated during the course of the study and will be a valuable tool in developing and evaluating CSO control options.

Technical Approach

A series of integrated mathematical computer-based models will be required to simulate system hydrology, pollutant loads, conveyance hydraulics, control options, and resulting changes in river water quality. A single, sufficiently sophisticated computer model does not exist. Accordingly, one of the main elements of Phase 1 was the selection of a group of appropriate models. This task was successfully accomplished. The resultant selection was discussed in some detail with modellers in the study team plus with the experienced modellers in the group of Specialist Consultants.

During the course of all of the above studies, data gaps and monitoring needs were identified.

Public Communication

A key element in any CSO Management Study is public communication. The objective is to inform the public of the nature and direction of the study ***as it proceeds*** and to obtain concurrence and/or feedback as to their interests or concerns. This is particularly true for the Winnipeg situation, where the costs of control could be very high and the benefits relatively modest. The costs will be readily quantifiable but only the public will be in a position to indicate whether or not the benefits justify the investment. Accordingly, an outline of a program of public communication was developed during Phase 1. This included establishing:

- an Advisory Committee of interested government ministries and committees;
- a framework for consultation with key stakeholders; and
- an outline of a public consultation program for the duration of the study.

The program will include:

- public attitude surveys;
- public information events;
- newsletters;
- mailers/bill stuffers; and
- newspaper information advertisements.

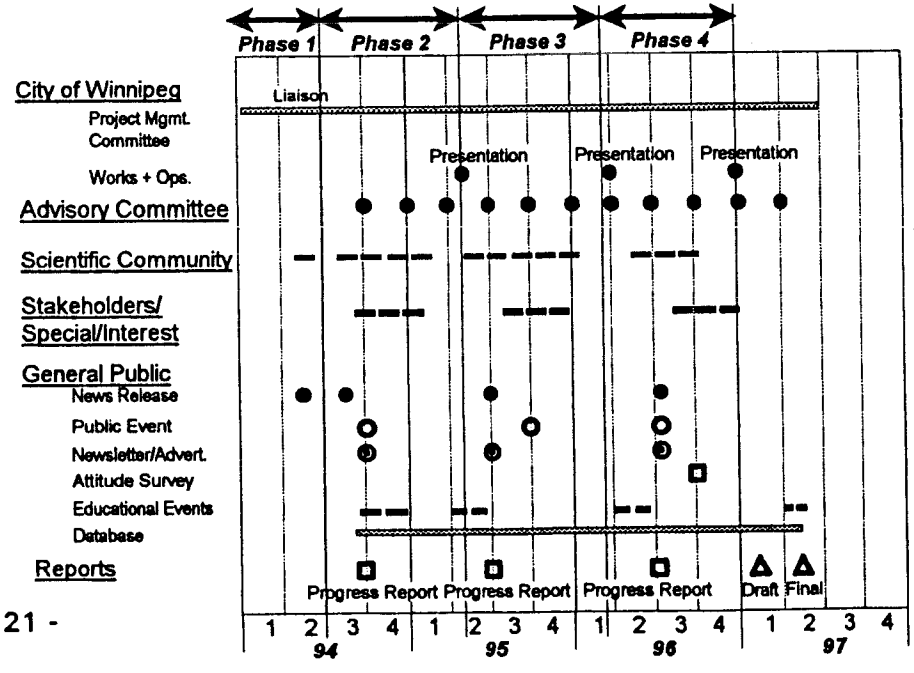
Technical Reports

Technical Memoranda were developed to document the results of Phase 1.

These memoranda and other relevant information were reviewed in a Workshop attended by all members of the Study Team, including the City's Project Management Committee, the Consultant Team Members and the members of the Specialist Consultant Committee. The Workshop attendees confirmed the approach to the study and provided useful insights into the technical and policy analyses. Important guidance was obtained for Phase 2.

CSO MANAGEMENT STUDY

PUBLIC COMMUNICATION PROGRAM



PHASE 2

Phase 2 will continue the technical analysis of **CSO-related water quality issues.** Some of the technical activities include:

- Designing and initiating data-gathering programs.
- Developing a computer-based model of the combined sewer system that will simulate the response of the system to a range of rainfall events. This will permit the study team to assess the means of optimizing the existing infrastructure and to predict the effects of possible control options, in terms of how the CSO volume or quality might change.
- Developing a computer-based model of the rivers' water quality. This will be used to estimate the changes in water quality, for example, bacterial content, along the river as different CSO control options are studied.
- Conceptual analysis of the various CSO control options such as sewer separation, screening/treatment devices at the combined sewer outfalls to the rivers, storage facilities, etc.
- Consultation with scientists on water quality concerns to ensure that adequate data is available to address issues relevant to CSO.

Phase 2 will emphasize public communications. The following efforts are planned to facilitate public dialogue on CSO:

- Offering of the Phase 1 Report to all interested stakeholders, on request, to provide background information.
- Discussion, on an ongoing basis, with the Advisory Committee to obtain input on the conduct of the study.
- A public information event is being considered. A display of information, attended by knowledgeable staff, is planned to be provided on a fall weekend at The Forks. This event will provide background on river quality, river uses and the CSO Management Study to the general public.
- Further follow-up information will be provided to those interested and feedback will be requested.
- Meetings with "stakeholder" groups will be initiated.
- A Phase 2 report will be prepared which will summarize the results of Phase 2 for public disclosure and discussion.

Further Information

The City encourages the public to seek information on this important community policy issue. Further information on the CSO Management Study can be obtained by contacting the Project Manager for the Waterworks, Waste and Disposal Department at the following address:

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Waterworks, Waste & Disposal Dept.
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