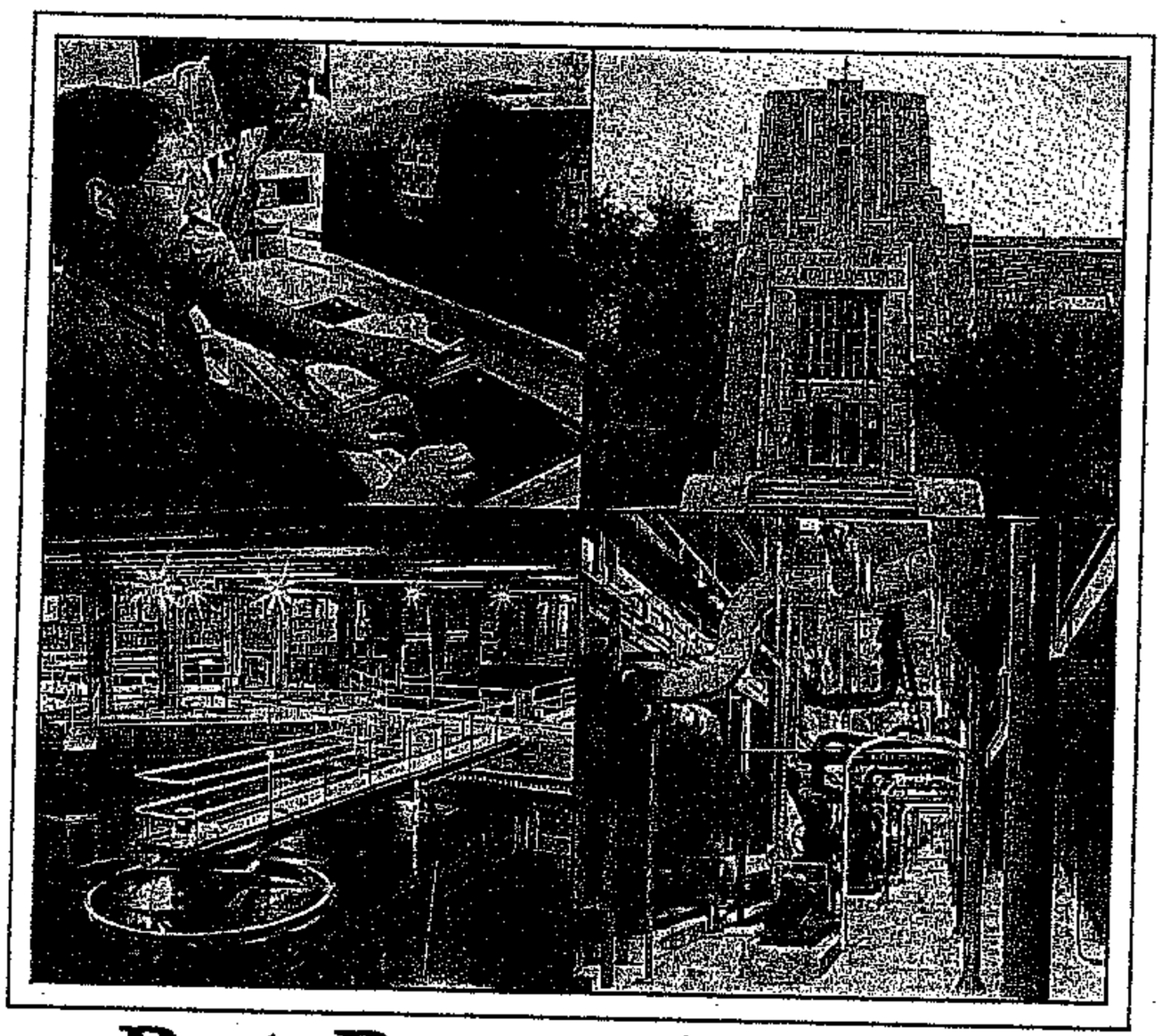
Appendix 9

WINNIPEG'S WASTEWATER TREATMENT PROGRAM, PAST, PRESENT & FUTURE BROCHURE

Winnipeg's Wastewater Treatment Program



•Past, Present & Future•

Works and Operations Division
Waterworks, Waste and Disposal Department

Citizens of Winnipeg:

Thank you for your interest in learning more about Winnipeg's wastewater treatment system which is our frontline of defense in protecting our valuable river resources for the enjoyment of all.

Many city residents associate sewage disposal with our rivers, and attribute their muddy-brown appearance to untreated sewage emptying into them. This is not the case. Almost all wastewater is extensively treated before it is released into the rivers.

The muddy appearance is due to the rivers carrying a heavy load of suspended soils. They appear the same upstream of our city, well away from urban concentrations — the same as they have appeared for hundreds of years. In fact the name Winnipeg is derived from the Cree words "win" meaning "muddy" and "nipee" meaning "water".

This brochure is designed to give you an overview of our high-quality wastewater treatment system, how it evolved, what is comprises, how it works, and what additional improvements are being considered for the future.

I hope this information will reinforce your confidence that Winnipeg is well served by its wastewater treatment system.

William D. Carroll
Director
Waterworks, Waste and Disposal Department

A Brief History of Winnipeg's Wastewater Treatment System

Winnipeg has been actively treating its sewage for more than 50 years with the opening of the North End Sewage Treatment Plant in 1937 and completion of a sewage interceptor system to bring wastewater from surrounding municipalities to the new plant. These facilities were inspired in the early 1930s by public concern about river pollution which was aggravated by low water levels caused by droughts at that time. This concern led to creation of the Greater Winnipeg Sanitary District (GWSD) in 1935 which undertook the sewage interception and treatment installations.

Until that time, all sewage was discharged untreated into our rivers. With a small urban population at the turn of the century, the rivers seemed an adequate disposal method because our rivers diluted the effluent and carried it away.

"Winnipeg's first sewer lines, like those in all other cities in North America, were constructed as "combined" sewers, handling both sanitary sewage and stormwater runoff."

"Winnipeg's first sewer lines, like those in all other cities in North America, were constructed as "combined" sewers, handling both sanitary sewage and stormwater runoff." This method was used until the late 1950s when separate stormwater and sanitary sewer lines were installed in all new urban developments. This separation was undertaken to allow sanitary sewage to be directed to the treatment plants, with the cleaner stormwater directed into retentions basins or into our rivers. About half of Winnipeg is still served by combined sewers, a carryover from those pre-1950s installations.

Since the first treatment facilities were installed, the system has undergone continuous upgrading and expansion, to meet the needs of a growing city, more stringent environmental guidelines, and demands of a more aware and informed public.

Upgrade milestones

1954-61 A major expansion was undertaken at the North End Water Pollution Control Centre to meet the needs of a growing city.

1961 The Metropolitan Corporation of Greater Winnipeg assumed responsibility for wastewater collection and disposal. Its immediate task was to expand treatment capacity to combat river pollution problems which had again become serious due to rapid urban growth.

1961-71 Significant expansion to the treatment system took place under Metro, including construction of lagoons at the West End Water Pollution Control Centre, revisions to the primary treatment processes and addition of secondary treatment to the North End Water Pollution Control Centre at a cost of $14 million. With these improvements, removal of pollutants increase from 40 per cent to 90 per cent.

Design was initiated on the South End Water Pollution Control Centre.

1972 The newly-amalgamated City of Winnipeg assumed wastewater treatment responsibilities, including sewage collection systems operated by the former independent municipalities.

1974 Opening of the $10-million South End Water Pollution Control Centre culminated the 10-year plan to collect and provide treatment to all sewage in the south end of the city.

Winnipeg became one of the first cities in North America to provide both primary and secondary treatment to all its wastewater.

1976 A $2 million expansion to the West End Water Pollution Control Centre was completed.

1978-88 A $77 million upgrade to the North End Water Pollution Control Centre improved all areas of the plant to increase treatment capacity. Additional capacity was needed to handle increasing wastewater flows from areas served by the North End Plant.

Today's facilities

Today's facilities include the three treatment plants, the North End Water Pollution Control Centre located on North Main Street, the South End Water Pollution Control Centre located south of the Perimeter Highway in St. Vital and the West End Plant located west of the Perimeter Highway in Charleswood. These plants are served by 2,140 kilometres of sewers and interceptors, and 96 pumping stations.

The replacement value of the City's wastewater treatment facilities exceed $1 billion. These facilities treat 98 percent of Winnipeg's wastewater. The remaining two percent is wastewater from combined sewers which must be discharged to the rivers during heavy rainstorms since treatment plants cannot handle extreme flows.

How Winnipeg's Wastewater Treatment Processes Work

Wastewater treatment processes used at each of Winnipeg's three facilities are basically the same, although some facilities and installations may vary slightly at each site.

The system is designed to process domestic wastes which are primarily made up of organic plant and animal material from homes and industry. Since older parts of the city do not have separate storm sewers, some runoff from rain and melting snow comes into the treatment plants.

The objective of wastewater treatment is to remove inorganic solids such as sand and gravel and organic (oxygen consuming) materials from the water before it is released into the river.

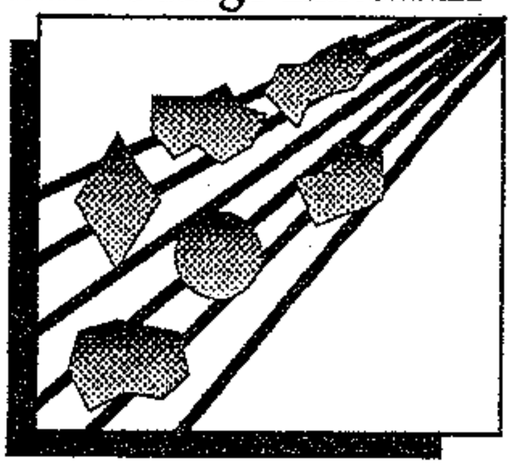
Facilitating a natural process

Treatment of Winnipeg's wastewater borrows heavily from processes in nature, and enhances them to speed up natural decomposition. Just as organic materials like fallen trees and leaves in a forest decompose to their basic elements by the action of oxygen-consuming bacteria, similar processes occur in treating wastewater.

Six Steps to Environmentally Sound Wastewater Treatment

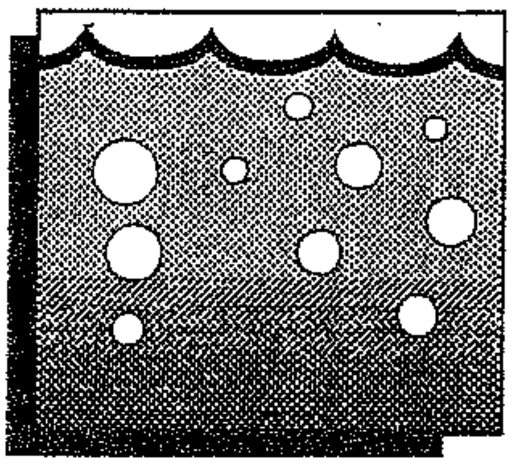
Treatment involves a sequence of six major steps as wastewater moves through the plant.

1. Bar Screening to remove large materials

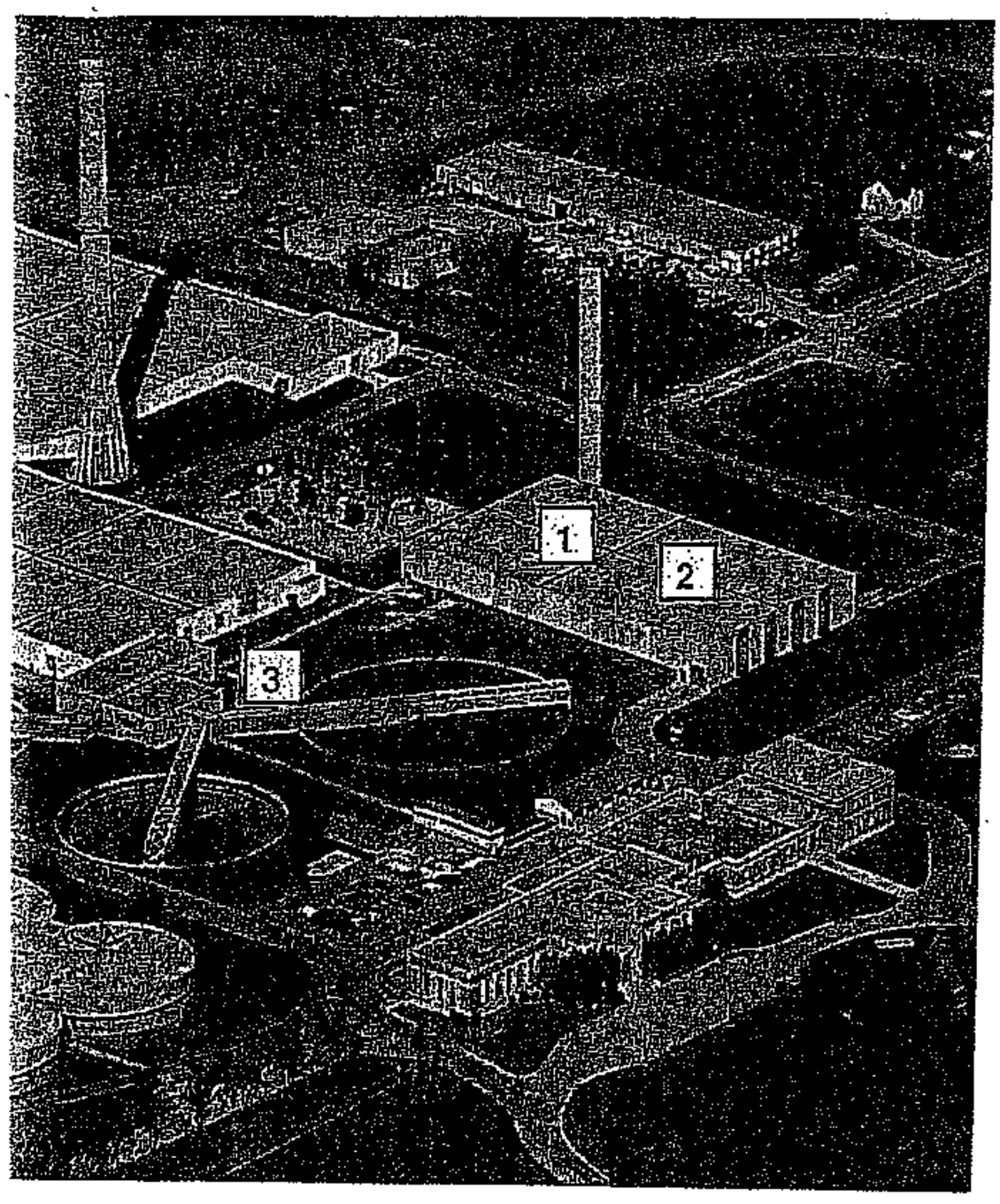


Wastewater first entering the plant passes through bar screens which remove large materials such as sticks and rags which mainly enter the system through catch basins on the streets. This prevents these materials from damaging equipment in the plant.

2. Pre-treatment to remove insolubles and noxious gases

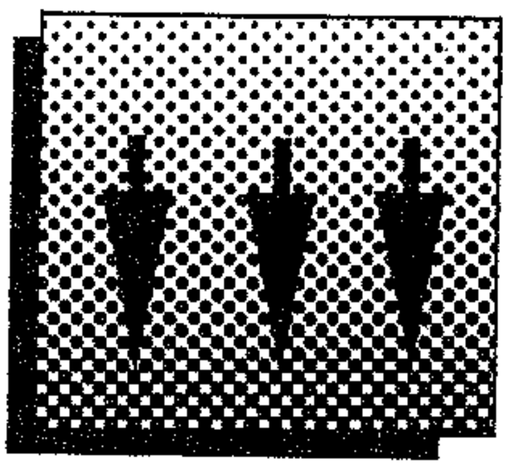


After large materials are removed, wastewater is gently agitated with air to settle out heavier insoluble materials like sand, gravel and coffee grounds which enter with street or household wastewater. Air is



bubbled vigorously through the water (called pre aeration) to remove noxious gases like hydrogen sulfide (rotten egg smell) generated in the sewers from the initial breakdown of organic materials as they move to the plant. These are vented to the atmosphere through tall chimney-like stacks on the site.

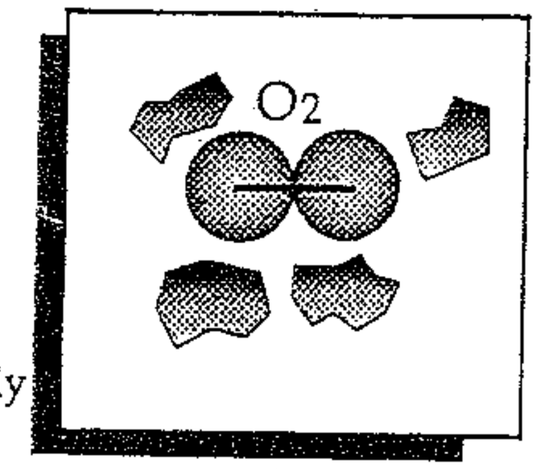
3. Primary Treatment to remove fine suspended solids



Wastewater then flows into large settling tanks to remain for at least two hours allowing about 50 per cent of the fine suspended solids to settle out. These solids, known as sludge, are gathered regularly with large scrapers which move slowly along the bottoms of the tanks.

The sludge is then pumped to sludge digester tanks (described later).

4. Secondary Treatment to speed-up the breakdown of remaining organic solids



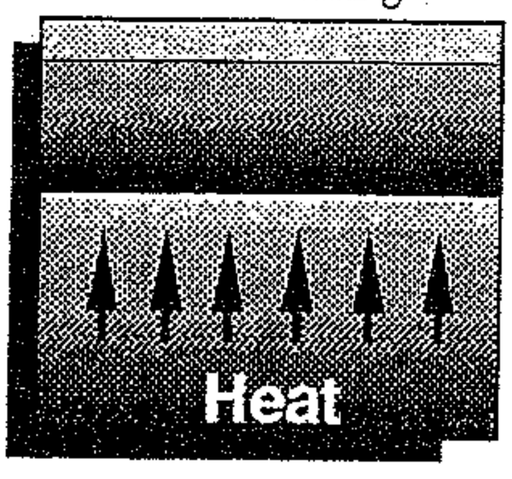
Following primary treatment, the wastewater then passes through oxygen reactor tanks. Here the natural bacterial breakdown of remaining organic materials is actively encouraged by vigorously mixing the incoming wastewater with concentrated bacteria-laden sludge and pure oxygen needed by the bacteria while feeding on the organic materials.

The mixture is again moved into settling tanks known as secondary clarifiers which allow the bacteria-laden sludge to settle to the bottom.

Once settling has occurred, the water, which has 90 to 95 percent of polluting materials removed, is suitable for release into the river.

The bacteria-laden sludge is again scraped from the tank bottoms. Some of it is recycled back to the oxygen reactor tanks to supply the necessary bacteria for that part of the process, while the remainder is collected to undergo sludge digestion.

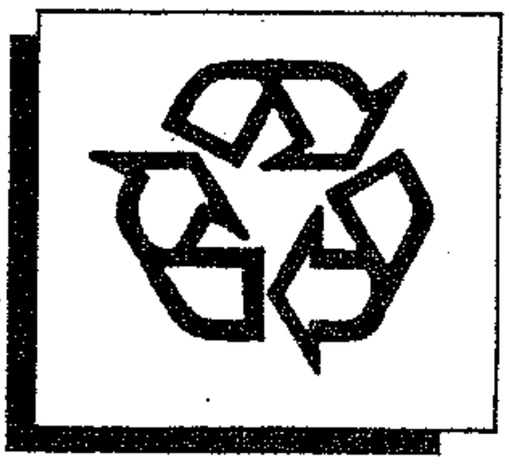
5. Sludge Digestion



Most sludge, along with that settled out during the primary treatment process, is diverted to sludge digestion tanks where other forms of bacteria are introduced and heat is applied in an oxygen-free environment. The bacteria feed on the sludge for a minimum of ten days, reducing the odour and stabilizing the sludge by a further reduction of organic content. Methane gas is produced and used for heating.

The stabilized sludge is pumped to drying beds where the solids settle and remaining moisture is allowed to evaporate.

6. Re-cycling water, materials and other by-products back into the environment



The nutrient-rich dried sludge, which looks like top soil is applied to surrounding farmland to condition the soil and enhance productivity. The treated water, which is 90-95 per cent free of pollutants, is safely released into the river.

Support facilities

To aid the whole wastewater treatment process, other support facilities are located on the grounds. These include:

Oxygen Production Plant
A separate plant to produce pure oxygen for the oxygen reactor tanks is operated on the site under long-term contract by a private company.

Methane Gas Storage
Decomposition of organic materials at the plant produces methane, a flammable gas similar to natural gas. The methane is recovered and stored for use in providing heat for the plant, demonstrating the City's commitment to cost savings and using recyclable by-products.

The importance of treating wastewater

Wastewater emptied directly into Winnipeg rivers would undergo a similar decomposition process as in the treatment plant, but under uncontrolled conditions. The breakdown of organic materials would draw the needed oxygen from the river rendering it unable to support fish and other aquatic life requiring oxygen. The decomposing organic materials would give off unpleasant odours which are now intercepted at the treatment plant and vented harmlessly to the atmosphere.

Winnipeg's Current Wastewater Treatment Upgrade Program

Winnipeg is currently engaged in several specific facility upgrade projects. In addition, the city has been and continues to implement improvements to its general procedures and installations on an ongoing basis.

Continuing Improvements to the North End Plant
With the completion of the $77 million upgrade in 1988, the next phase is installation of a $26-million sludge dewatering plant. This facility will mechanically dry the solids removed from the wastewater treatment process from all three treatment plants and replace drying beds in West St. Paul. A major intent behind installation of this facility is to eliminate unpleasant odours in areas surrounding the drying beds.

Expansion of South End and West End Water Pollution Control Centres
This five-year project is now underway at a cost of $70 million to increase treatment capacity and efficiency in those facilities. The South End facility will double in size while the West End plant will be completely replaced, increasing capacity by 19 per cent.

Separation of Combined Sewers
As mentioned earlier, sewers installed prior to the 1950s were "combined" sewers handling both sanitary sewage and stormwater. Prior to installation of sewage treatment facilities, this was satisfactory since all wastewater flows went into the rivers. However, since the introduction of sewage treatment, combined sewers present problems at times because sanitary sewage needs extensive treatment while stormwater does not. During heavy runoff, the two are mixed.

Sewage interceptor lines installed to carry the wastewater to the sewage treatment plants were basically designed to handle sanitary wastewater volumes. Similary, sewage treatment plants are only designed to handle sanitary sewage capacities. (The cost of additional treatment capacity to handle occasional peak stormwater flows would be excessive.)

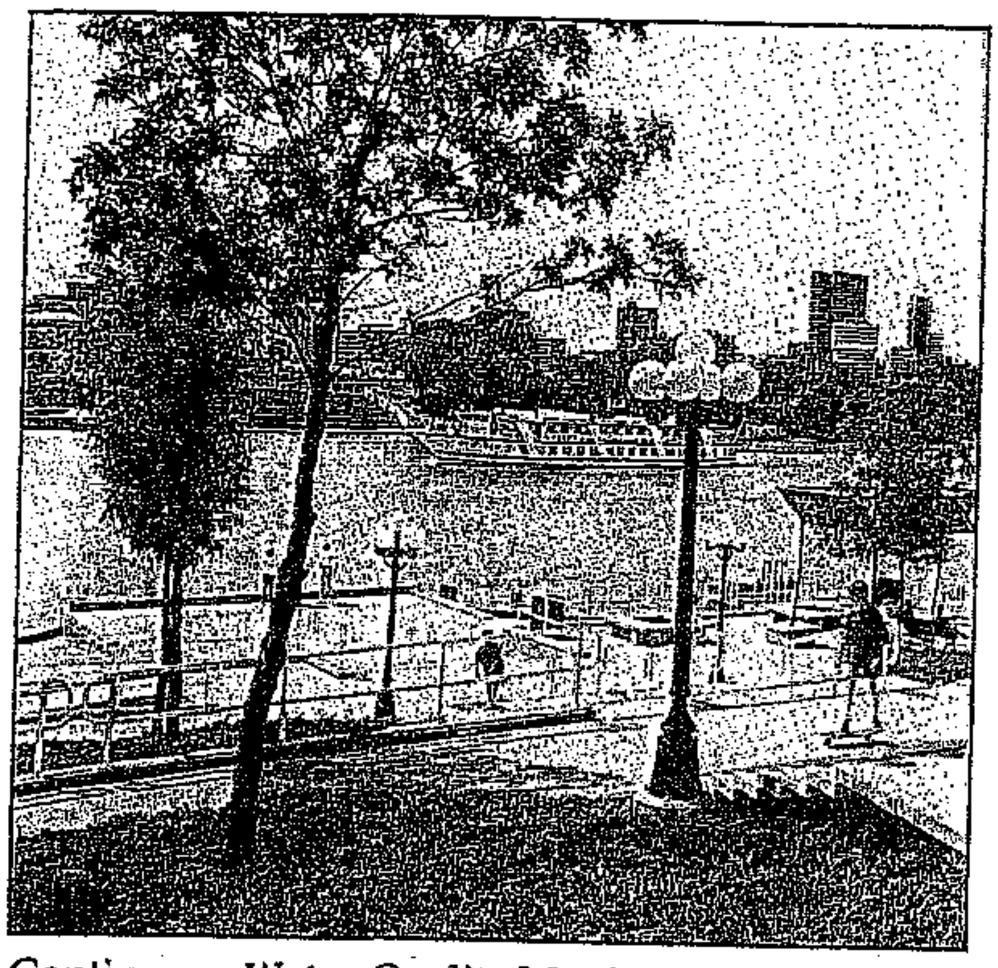
During heavy runoff, when water volumes exceed treatment-plant capacity, excess wastewater must then be discharged directly to the rivers without treatment. Annually, this occurs about one per cent of the time, resulting in the two per cent of untreated wastewater entering our rivers.

Currently, combined sewers comprise about 50 per cent of Winnipeg's sewers, a situation shared with many other large Canadian and American cities including Halifax, Montreal, Toronto, Edmonton, Vancouver, New York, Boston, Detroit, and Chicago.

Since 1960, Winnipeg has replaced some combined sewers with separate lines, primarily in St. Vital and St. Boniface where sewers emptied into the Seine River.

In addition, part of Winnipeg's $100-million basement-flooding relief program involves installation of separate sewers, where economically feasible, to reduce untreated wastewater entering our rivers.

Installation of Retention Ponds
In many of our newer subdivisions, stormwater retention ponds have been installed to capture runoff from our stormwater sewer systems prior to it being released into our rivers. These not only add attractive amenities to our city, they also provide a valuable role in reducing river pollution. The ponds reduce suspended solids in rainwater by 80 percent, biochemical oxygen demand by 65 per cent and bacteria by 68 per cent. There are more than 50 such ponds throughout the city.



Continuous Water-Quality Monitoring and Assessment
The City of Winnipeg diligently monitors the portions of river within its jurisdiction. This program includes numerous studies on river-water quality and the impact urban wastewater discharges have on our rivers. An extensive database on river-water quality has been collected over the years.

Using state-of-the-art, computerized water-quality models, the City not only examines existing water quality conditions, but also simulates the effects of water pollution control measures the City may be considering for future improvements to our system. This enables the City to examine the potential benefits of many alternatives in relation to the costs of each, to assist in choosing the most cost-effective measures of pollution control.

Results of our wastewater treatment program

Have Winnipeg's half century of wastewater treatment efforts produced results? Undoubtedly! The City's monitoring program indicates our rivers are healthy and capable of sustaining a wide variety of aquatic life. In 1988, during one of our driest summers which created record-low river flows, the dissolved oxygen content of the rivers — a benchmark of a river's health — was maintained well above provincial water-quality guidelines.

As a result of Winnipeg's wastewater treatment efforts, our rivers maintain healthy fish populations, which did not exist in the 1930s prior to the first sewage treatment programs. In 1986 the Red River produced 834 master angler awards for 11 species of fish, with channel catfish and walleye being the most prominent.

These impressive results are achieved using affordable, state-of-the-art technology which is among the best of any used in North America.

Future Treatment Improvement Alternatives

Improvements in wastewater treatment technology and changing environmental standards mean the City must continually explore alternatives to upgrade our existing wastewater treatment system. Three specific alternatives are being explored including: additional combined sewer separation, disinfection of treated wastewater, and alternative methods of advanced wastewater treatment.

Additional Combined Sewer Separation
Some Winnipeg residents call for separation of all combined sewers because they perceive that discharges into the rivers from combined sewers during heavy runoff grossly pollute our waterways. In fact, only two percent of all wastewater generated in the City goes into the river untreated.

Separating all combined sewers is technically possible. While the City has undertaken some sewer separation over the past several decades, where economically feasible, several factors have prevented large-scale sewer separation.

The two per cent of sewage entering our waterways untreated is a very small proportion of wastewater generated by the city. To separate the 50 per cent of Winnipeg's sewers which are still combined in order to capture this small proportion would cost about $1 billion which is almost three times the $375 million spent for all in-place treatment facilities handling the other 98 per cent.

Unfortunately, capturing the additional two per cent of untreated sewage would not eliminate pollution entirely, since stormwater runoff from the land surface contains many of the same contaminants but in lesser concentrations. These pollutants come from decaying vegetation material, fertilizers and other pollutants entering the sewer system with rainwater from our streets and yards. Separating sewers would make no discernable difference in river appearance after a rainstorm, and the improved biochemical characteristics could only be detected with special testing.

Timing is also a factor. Even if the decision were made to go ahead immediately, full sewer separation would take about 20 years to complete.

Disinfection of Treated Wastewater
This process involves chlorinating treated wastewater to kill bacteria prior to discharge into the rivers, a process similar to treating drinking water. These bacteria pose a risk of gastrointestinal infections for swimmers and water skiers who may accidently swallow some water.

Installing chlorination equipment at Winnipeg's three plants would take about two years at a cost of about $8.4 million. Annual operating costs would be about $400,000.

Opinions differ on the need for disinfection. Differences focus on the likelihood of the public coming into direct contact with river water containing treated wastewater during recreation activities. Because of our rivers' natural dirty appearance and mud bottoms, they are not considered attractive for water-contact recreation where the greatest potential for infection would exist. The frequency of swimming and water skiing is considered minimal relative to the city's population.

A joint city and provincial study was undertaken by MacLaren Engineers in 1985, to assess needs for disinfection. The study projected that the annual number of cases of gastrointestinal illnesses would drop by only 12 cases, from 78 to 66 cases, with disinfection based on current estimated use of the river for swimming and other water-contact uses. This compares to an estimated 720,000 cases of such illnesses from all other sources experienced annually throughout the city.

Another concern is Selkirk's use of river water for drinking water.

The study concluded the reduced risk to Selkirk's drinking water supply would be negligible, since the water must be fully treated for drinking to comply with guidelines applicable to surface water supplies. The study estimated that the current risk of illness in Selkirk posed by the river as a source of drinking water is one case in 35 years.

Advanced Wastewater Treatment
Even though current treatment processes remove most organic materials, and considerable amounts of inorganic materials, potential exists for additional treatment. Available processes include:

Nitrification. This process involves converting ammonia content in wastewater to less harmful nitrate. Ammonia can be toxic to fish, especially during low natural river flows. Nitrification also assists in keeping oxygen levels in the river at acceptable levels.

Nitrification is under consideration as Winnipeg's next step in upgrading wastewater quality to meet provincial environmental guidelines. However, some factors must be explored first. Ammonia levels in river water entering the city upstream during periods of heavy runoff already exceed current provincial standards. This would undermine City efforts to decrease levels in its own wastewater discharges since the river itself cannot be treated.

In addition, the effects of algae which use ammonia must be determined. Their natural ability to reduce ammonia levels is not fully known. Algae could use substantial quantities of ammonia which, in turn, would naturally reduce the level of ammonia in our rivers.

Thriving sport fishing exists downstream of Winnipeg suggesting that current ammonia levels do not have considerable detrimental impacts.

Total implementation costs would be about $70 million, and would take about three years to install. Annual operating costs would amount to $10 million.

Nutrient Removal. Phosphorous and nitrogen in wastewater can promote excessive algae and aquatic weed growth, particularly where wastewater is discharged into a lake. However, sanitary wastewater is not the only source of these nutrients. Agricultural and forest runoff and stormwater contribute considerable quantities. Studies indicate only six per cent of phosphorous and five per cent of nitrogen volumes entering Lake Winnipeg originate from Winnipeg's treated wastewater.

Phosphorous removal installations would cost $15 million plus $3 million annually to operate. Installation of required facilities would take about two years.

Nitrogen removal installations would cost about $145 million and $10 million in annual operating costs. Design and implementation would take about five years.

Because of the small proportion of nutrients which Winnipeg's treated wastewater contribute to the rivers, installing nutrient removal facilities is reasonable only if efforts are made to control nutrients in the entire river basin.

Effluent Filtration This process involves filtering treated wastewater through sand and other filters similar to methods used in drinking-water treatment. Effluent filtration removes remaining suspended solids and organic materials to produce high-quality treated wastewater. The system is usually used where wastewater makes up the largest proportion of the water volume of the rivers into which the wastewater is discharged.

Red River flows in Winnipeg are ten times Winnipeg's treated wastewater flows, making filtration largely unnecessary here. In addition, filtration would produce treated wastewater of much higher quality than our rivers' natural conditions.

Filtration installations would cost $30 million and implementation would take about three years. Annual operating costs would be about $1 million.

Our continuing commitment

Winnipeg's half century of dedication to provide City residents with the most cost-effective, up-to-date wastewater treatment program continues unabated today and into the future. The City's current treatment program is well under control providing good value for the money invested.

Our ongoing goal is to meet changing environmental needs and expectations of an increasingly aware and concerned public by keeping in step with efficient new treatment technologies. Of course, we are ever mindful that treatment levels must be reasonable relative to the natural conditions of our rivers. We must also be conscious of what Winnipeggers can afford to pay.

We will continue to work to apply the highest standards providing the best possible results, to maintain public confidence in the safety of our waterways.

City of Winnipeg, Waterworks, Waste and Disposal Department, 1500 Plessis Road