Undertreated sewage contributes to harmful algae blooms

An affordable retrofit to Winnipeg's north end sewage treatment plant will ensure the city meets provincial licence requirements to protect Lake Winnipeg

Victoria Beach; Photo: Jeope Wolfe

Excess phosphorus is causing potentially toxic algae blooms on Lake Winnipeg. To restore the health of Manitoba's great lake, we must reduce phosphorus loading from all sources – including undertreated sewage from urban centres.

Winnipeg's North End Water Pollution Control Centre (NEWPCC) is the single largest point source of phosphorus flowing into Lake Winnipeg and the fourth largest phosphorus polluter among all wastewater treatment facilities in Canada.

An October 2018 Probe Research poll found 65 per cent of Manitobans agreed that upgrading the NEWPCC should be "a very urgent priority."

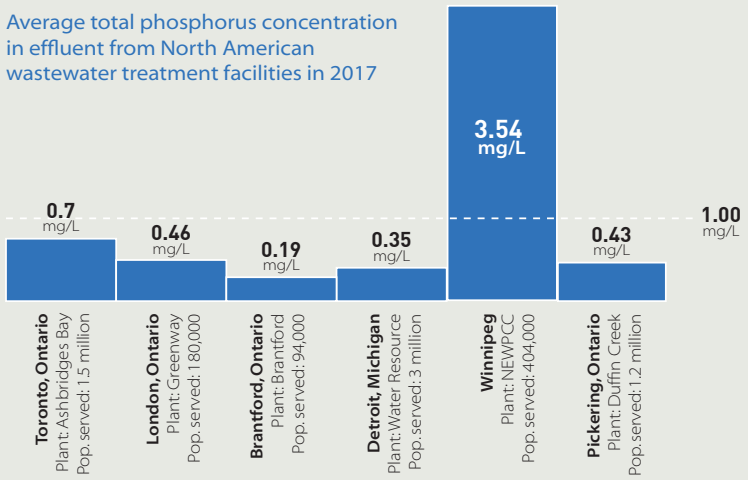
While the City of Winnipeg is planning to fully upgrade the plant, the latest cost estimates are now pegged at $1.8 billion, and nutrient-reduction efforts are not projected to start for at least another 10 years.

In the interim, a simple retrofit to the NEWPCC could be implemented quickly for an initial startup cost of only $5 million, reducing the plant's phosphorus contribution by 70 per cent.

THE PROBLEM: To meet its provincial licence requirements, the City of Winnipeg must reduce phosphorus in NEWPCC effluent to 1 milligram per litre (mg/L) by Dec. 31, 2019. Currently, total phosphorus in NEWPCC effluent is on average three-and-a-half times higher than this limit.

The NEWPCC is the largest of Winnipeg's three sewage plants, treating approximately 70 per cent of the city's wastewater. A chemical called ferric chloride, a type of iron salt, is used during the treatment process to reduce odour and keep pipes clean. Ferric chloride is not currently used at the NEWPCC as a phosphorus-removal agent.

In contrast, jurisdictions around Lake Erie use ferric chloride to remove phosphorus as part of their wastewater treatment. This process enables them to meet the 1 mg/L phosphorus limit - with some plants now aiming for a limit of 0.3 mg/L.



NEWPCC: CURRENT TREATMENT PROCESS

Preliminary treatment: Screens are used to remove debris.

Primary clarification: Fine materials and sludge settle to the bottom while grease and oil to float to the surface. Settled sludge is sent to digesters.

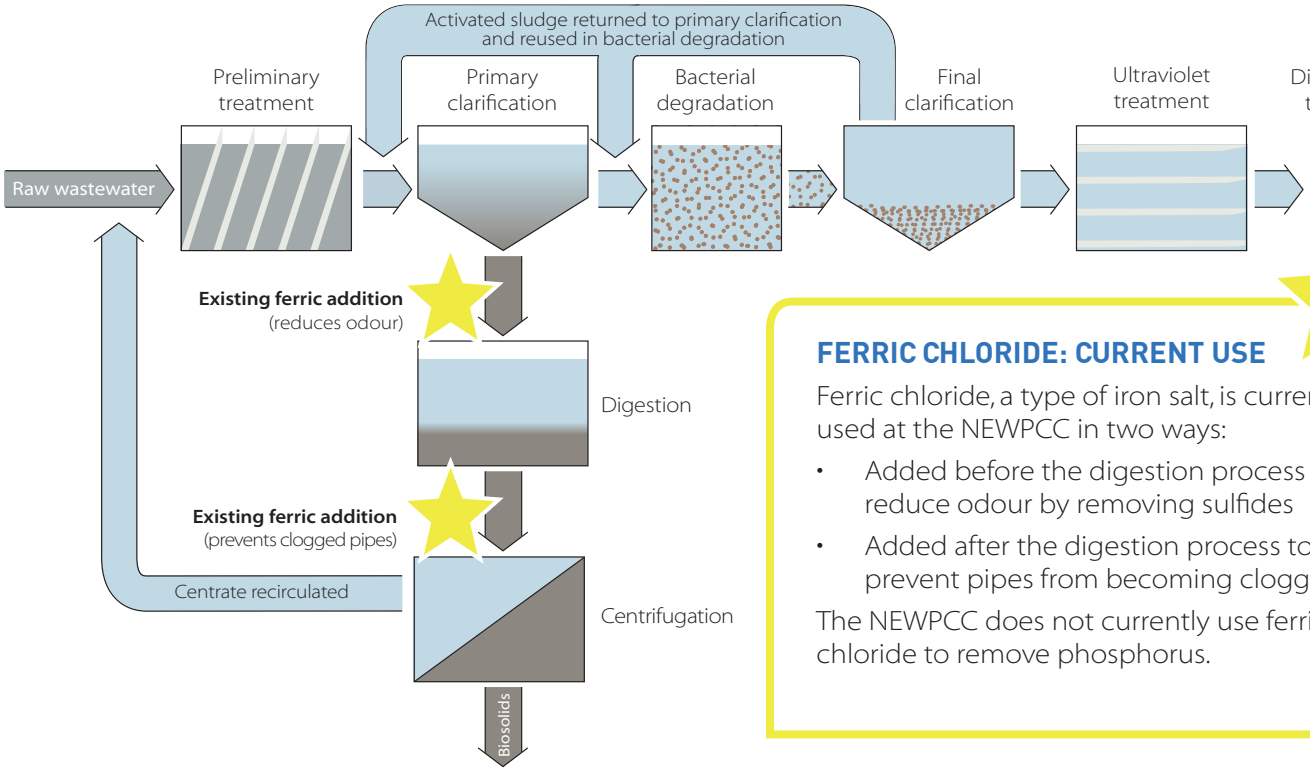
Digestion & centrifugation: Bacteria break down sludge from primary clarification. Excess liquid is removed from the sludge using high-speed centrifuges.

Dewatered biosolids are trucked to Winnipeg's Brady Road landfill for beneficial reuse and disposal. The excess liquid (or "centrate") is returned to the front end of the plant.

Bacterial degradation: Wastewater flows into bioreactors which contain a mix of bacteria and other micro-organisms called "activated sludge" that feed on impurities.

Final clarification: Activated sludge settles to the bottom. Some sludge is reused in bacterial degradation and some is sent back to primary clarification.

Ultraviolet treatment: Treated wastewater is disinfected using UV light. Now called "effluent," it is discharged into the Red River.



FERRIC CHLORIDE: CURRENT USE

Ferric chloride, a type of iron salt, is currently used at the NEWPCC in two ways:

- Added before the digestion process to reduce odour by removing sulfides
- Added after the digestion process to prevent pipes from becoming clogged.

The NEWPCC does not currently use ferric chloride to remove phosphorus.

THE SOLUTION: By adjusting the timing and dose of ferric chloride in the treatment process, phosphorus in NEWPCC effluent could be reduced by 70 per cent. This simple interim retrofit to existing NEWPCC infrastructure could be completed at low cost by Dec. 31, 2019, meeting the provincial phosphorus limit.

Together, the Lake Winnipeg Foundation and the International Institute for Sustainable Development are proposing an interim retrofit to the NEWPCC. This retrofit involves a simple adjustment to the timing and dose of ferric chloride such that it also functions as a phosphorus-removal agent.

Modelled on treatment methods successfully applied in many jurisdictions around Canada's Great Lakes, this retrofit would achieve a 70 per cent reduction in phosphorus loading from the plant.

This interim solution will ensure the city can meet the Dec. 31, 2019, provincial phosphorus deadline and protect Lake Winnipeg until permanent upgrades to the NEWPCC can be completed.

ADDING IT UP

While costs for a full plant upgrade are pegged at $1.8 billion, the interim retrofit represents a cost-effective solution to ensure the city is meeting provincial phosphorus requirements to protect Lake Winnipeg.

Cost considerations for the retrofit include:

- **One-time construction costs: $3 million**
- **Annual operating costs: $2 million**

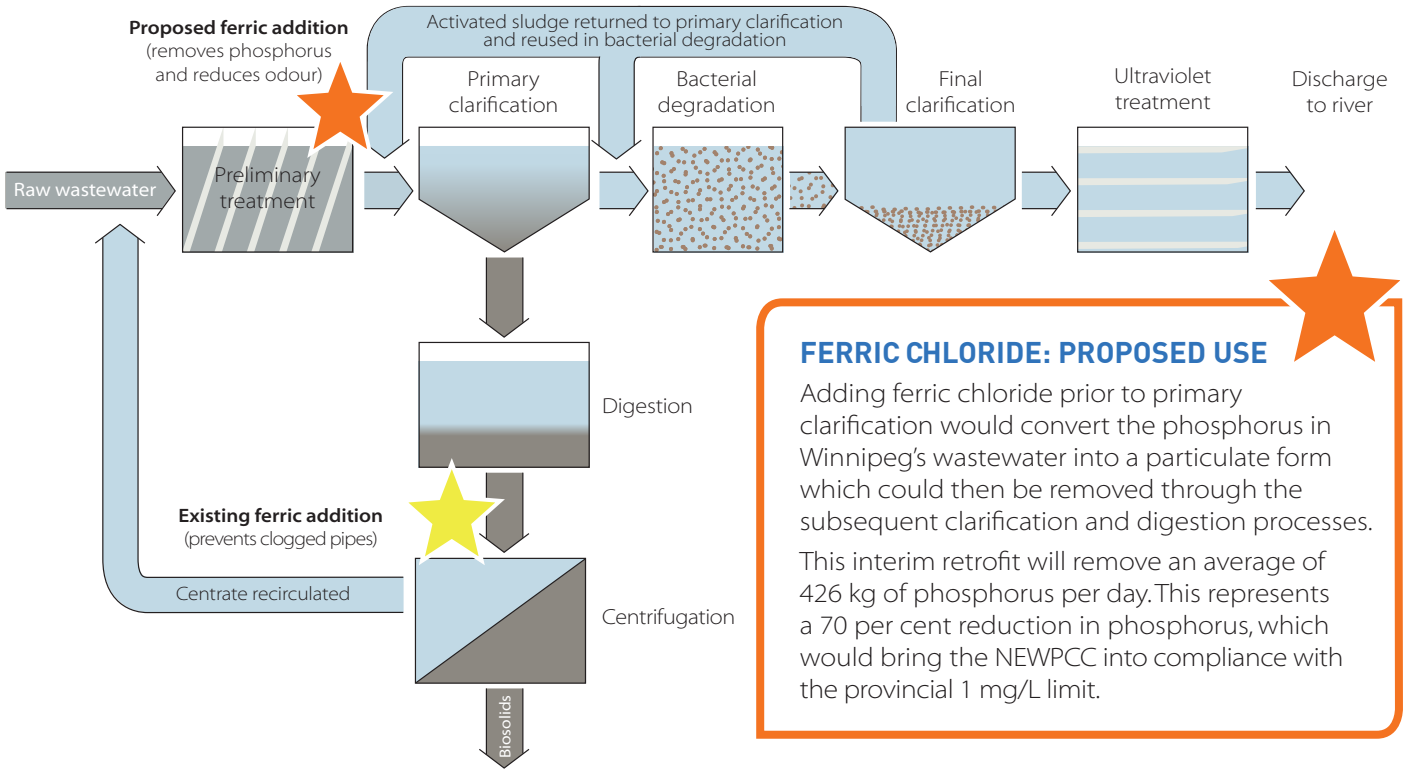
NEWPCC: PROPOSED INTERIM RETROFIT

Preliminary treatment to primary clarification:
Ferric chloride is added here to bind to phosphorus so that it settles out of the waste stream into the sludge.

Primary clarification to digestion:
Ferric chloride no longer needs to be added here since it will already exist in the sludge which settles out from primary clarification.

Digestion & centrifugation:
There is a potential 11 per cent increase in sludge production with the retrofit. Existing infrastructure will need to be optimized to handle this increase.

Though ferric chloride will still need to be added prior to centrifugation, less will be required as the new addition earlier in the treatment process will have already supplemented the overall quantity in the system.



FERRIC CHLORIDE: PROPOSED USE

Adding ferric chloride prior to primary clarification would convert the phosphorus in Winnipeg's wastewater into a particulate form which could then be removed through the subsequent clarification and digestion processes.

This interim retrofit will remove an average of 426 kg of phosphorus per day. This represents a 70 per cent reduction in phosphorus, which would bring the NEWPCC into compliance with the provincial 1 mg/L limit.

A WIN-WIN-WIN SOLUTION

Interim phosphorus-reduction measures at the NEWPCC can be implemented before the licence deadline of Dec. 31, 2019, ensuring compliance and fulfilling long-standing commitments to protect Lake Winnipeg.

The City of Winnipeg will demonstrate civic leadership by protecting Lake Winnipeg for future generations of Winnipeggers, while also complying with provincial phosphorus requirements in a cost-effective, efficient manner.

The Province of Manitoba will fulfill its responsibility to safeguard Lake Winnipeg, providing effective regulatory oversight while maintaining a focus on value-for-money.

Lake Winnipeg will benefit from a significant reduction in phosphorus loading from the single largest point source of this algae-causing nutrient. Water-quality improvements will benefit the families, communities and industries that rely on this beloved lake.

"Ferric chloride is commonly used as a phosphorus-removal agent across the Great Lakes region and beyond. Installing an interim ferric system at Winnipeg's north end plant would result in a substantial reduction of phosphorus right away. When you're talking about bang for your buck, this is a quick fix for a quick win."

– DR. GLEN DAIGGER, professor of Engineering Practice at University of Michigan and researcher with the Great Lakes Water Authority

SETTING THE STANDARD FOR WASTEWATER TREATMENT

The water we use to flush our toilets ends up in Lake Winnipeg. It's our collective responsibility to ensure it's clean when it gets there. Improving wastewater treatment requires investment in proven technologies and enforcement of effective regulations.

The Lake Winnipeg Foundation (LWF) advocates for change and coordinates action to improve the health of Lake Winnipeg. LWF's flagship initiative, the Lake Winnipeg Health Plan, is a set of eight evidence-based actions to reduce phosphorus loading. By addressing the root causes of potentially harmful algae blooms, the plan provides a blueprint for cost-effective decision-making and long-term, adaptive freshwater management. Learn more at lakewinnipegfoundation.org.

The International Institute for Sustainable Development (IISD) is an independent think tank championing sustainable solutions to 21st-century problems. IISD's work affects economies, communities, ecosystems and lives in nearly 100 countries. IISD's team includes chemists and biologists, economists and engineers, editors and reporters. Part scientist, part strategist, IISD delivers the knowledge to act. Learn more at iisd.org.

LWF LAKE WINNIPEG FOUNDATION

IISD International Institute for Sustainable Development