

**North End Sewage Treatment Plant
Environment Act Licence 2684 RRR**



**Interim Phosphorous Reduction and
NEWPCC Upgrade Plan Update**

Submitted by the Project Steering Committee
September 30, 2020

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Executive Summary

The City of Winnipeg's North End Sewage Treatment Plant (NEWPCC) requires upgrading to meet the effluent quality limits specified in its Environment Act Licence No. 2684 RRR and in The Water Protection Act. Effluent limits are intended to mitigate impacts on water quality in the Red River and further downstream in Lake Winnipeg and beyond.

The Licence issued in 2005 required the NEWPCC to be upgraded by 2014. In 2014, a Notice of Alteration was approved by the province to extend the upgrade completion date to December 31, 2019. In recognition that the City would not comply with the Environment Act Licence requirements by December 31, 2019, on January 23, 2019 the Province requested the City provide a detailed analysis and schedule for the full biological nutrient removal upgrade and interim phosphorous removal in advance of the full upgrade. The City responded on July 31, 2019 asking for an extension to December 31, 2021 to allow time for an interim compliance plan, to secure funding opportunities, to integrate SEWPCC Nutrient Facility in the City's sludge treatment system and to study and test partial chemical trimming at NEWPCC. On December 5, 2019 the Province denied the City's request for extension and in the absence of an approved plan ordered the formation of a Project Steering Committee and a Project Advisory Committee

A Project Steering Committee consisting of representatives from the City of Winnipeg and several departments of the Province of Manitoba has been created and tasked with developing and overseeing the implementation of the Interim Phosphorous Reduction Plan and Nutrient Removal Implementation Plan (January 2020 Implementation Plan). A Project Advisory Committee consisting of external stakeholders in addition to City and Provincial representatives was also created to provide feedback to the Project Steering Committee as work proceeds.

This report is an update to the January 2020 Implementation Plan. The plan to reduce phosphorous and achieve licence compliance for the NEWPCC consists of two components:

- Objective 1 Interim Phosphorous Reduction Plan: a chemical-based interim phosphorous reduction phase and
- Objective 2 NEWPCC Upgrade Plan: NEWPCC Upgrade with biological nutrient removal for full licence compliance.

In January 2020, the province and City agreed to the first year of work outlined within the January 2020 implementation plan (i.e., 2020) and committed to further work on reviewing timelines with an objective of bringing the NEWPCC into compliance as quickly as possible. The Project Steering Committee met regularly throughout 2020 to implement the January 2020 Implementation Plan, advance work related to identifying options for an interim phosphorous reduction plan, and to work toward refining the timelines for the project. The Project Advisory Committee also met monthly except for May, July and August to review the work of the Project Steering Committee and provide advice. The May meeting was canceled due to the COVID-19 Pandemic. Meetings were not held in July and August due to scheduling conflicts.

The completion of the NEWPCC Upgrade will result in the construction of biological nutrient removal facilities at the NEWPCC, which will be capable of meeting all effluent licence conditions.

Interim phosphorous reduction is a plan that will reduce phosphorous in NEWPCC effluent through chemical addition until such time as the NEWPCC Upgrade is completed and operational.

Objective 1 Interim Phosphorous Reduction Plan

An alternatives analysis was carried out to determine if continuing to use ferric chloride, which is currently used at the NEWPCC, is the best option for interim phosphorous reduction at the NEWPCC. Several alternatives were assessed and it was recommended that ferric chloride be used for further assessment of interim phosphorous reduction processes.

Three scenarios were studied through computer modeling and simulation for the NEWPCC plant. Scenarios 2 and 3 include Scenario 1 with additional dosing points as noted below:

1. Scenario 1: Side-stream chemical phosphorous removal by dosing ferric chloride into the sludge treatment system to prevent phosphorous from the South End Sewage Treatment Plant from releasing back into the system. It will also reduce phosphorous-based mineral (e.g., struvite) formation, which is known to coat pumps, pipes, and tanks, causing operational issues and reduced capacity.
2. Scenario 2: Scenario 1 plus chemically enhanced primary treatment to remove additional phosphorous.
3. Scenario 3: Scenario 1 plus chemical phosphorous removal in the high purity oxygen reactors (HPO) and/or secondary clarifiers.

The work planned for 2020 was impacted by the COVID-19 pandemic; however, the scope of the work was adjusted and the report scheduled for December 2020 with recommendations remains on track but the recommendations will require further refinement through 2021. Laboratory testing which was scheduled for spring 2020 was postponed due to the COVID-19 pandemic and started in September 2020. In its place, additional modeling was carried out in the spring. Results from the modeling indicate that some chemical phosphorous removal may be possible for the NEWPCC plant but will be limited due to the size and configuration of the NEWPCC's existing sludge treatment facility and the additional phosphorous load to the NEWPCC from the SEWPCC when nutrient removal comes online in 2021.

A recommendation for Interim Phosphorous Removal cannot be made until laboratory testing has been completed in fall 2020. The computer simulations, while helpful, do not account for the potential toxicity impacts of salts associated with ferric chloride. The implications for pH and alkalinity on the digestion process must also be verified with laboratory testing. Additional laboratory work to reflect high spring flows will be carried out in 2021 following which the recommendations will be revisited and refined. It is not expected, however, to delay key decisions regarding whether or not to implement interim phosphorous removal.

The interim phosphorous reduction schedule beyond 2021 is preliminary and subject to revision, as it is dependent on the outcome of work that is being done in 2020.

September 30, 2020
Interim Phosphorous Reduction and NEWPCC Upgrade Plan

For Objective 1, the Interim Phosphorous Reduction Plan, the next steps are as follows:

- Receive AECOM 2020 Interim Phosphorous Reduction Summary Report in December 2020
- Submit a Notice of Alteration to the province for implementation of the recommended option
- Submit the recommended option to City Council for approval
- Develop a plan for assessing enhanced interim phosphorous removal in 2021
- Assess additional laboratory work to reflect high spring flows that will be carried out in spring 2021
- Review and revise the schedule for 2022 and beyond as the project develops

Objective 2 NEWPCC Upgrade Plan

The schedule proposed by the City for full nutrient removal includes various phases of work (headworks, biosolids facilities, nutrient removal facilities) that, once completed, will result in the NEWPCC being in full compliance by 2032. This schedule assumes that there is sufficient municipal, provincial, and federal funding for the overall project and that funding is available before the various projects are scheduled to start.

Two parts of the work, the Headworks Project and the Biosolids Facilities Project, are currently being considered for funding under the Investing In Canada Infrastructure Plan (ICIP). Discussions are underway regarding the procurement method to be used. A constructability review scheduled for 2021 will indicate if there are opportunities to accelerate the final aspect of work, the Nutrient Removal Facilities Project, to bring the NEWPCC into full compliance as soon as possible. The constructability review will explore options to mitigate site constraints such as lay down areas, traffic flows, etc. that would allow construction of all three phases of work to be carried out concurrently while continuing to operate the wastewater treatment facility.

Discussions regarding the schedules are ongoing between the province and the City and there is a commitment to determine if there are opportunities to accelerate activities. There is currently not consensus among the Project Steering Committee for the full schedule. In January 2020, the Project Steering Committee agreed to the scope of activities for 2020. The Project Steering Committee has now agreed to a second year of activities; therefore, there is consensus for the year 2020 and 2021.

For Objective 2, Full Biological Nutrient Removal Plan, the next steps are as follows:

- Complete Power Supply project by end of 2020
- Complete the procurement review to determine the most efficient delivery model
- Conduct a constructability review in Q2/Q3 2021 to determine how to complete the project as soon as possible
- Review and revise the schedule as assumptions are validated and/or constraints are realized

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- Attachment 1: Schedule for Interim Phosphorous Reduction Plan
- Attachment 2: NEWPCC Upgrade Schedule

Project Steering Committee Members

Co-Chair: Michelle Paetkau, P. Eng.	City of Winnipeg
Sean Gordon, P. Eng.	City of Winnipeg
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Asit Dey, P. Eng.	Manitoba Conservation and Climate
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Travis Parsons, P. Eng.	Manitoba Central Services
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1. Introduction

The City of Winnipeg's North End Sewage Treatment Plant (NEWPCC) requires upgrading to meet the effluent quality limits specified in its Environment Act Licence No. 2684 RRR and in The Water Protection Act. Effluent limits are intended to mitigate impacts on water quality in the Red River and further downstream in Lake Winnipeg and beyond.

The original Licence issued in 2005 required that the NEWPCC be upgraded by 2014. In 2014, a Notice of Alternation was approved by the province to extend the upgrade completion date to December 31, 2019. In recognition that the City would not comply with the Environment Act Licence requirements by December 31, 2019, on January 23, 2019 the Province requested the City provide a detailed analysis and schedule for the full biological nutrient removal upgrade and interim phosphorous removal in advance of the full upgrade. The City responded on July 31, 2019 asking for an extension to December 31, 2021 to allow time for an interim compliance plan, to secure funding opportunities, to integrate SEWPCC Nutrient Facility in the City's sludge treatment system and to study and test partial chemical trimming at NEWPCC. On December 5, 2019, the Province denied the City's request for extension and in the absence of an approved plan ordered the formation of a Project Steering Committee and a Project Advisory Committee

The Project Steering Committee is co-chaired by the City and Manitoba Conservation and Climate and is responsible for the following:

1. Preparing an Interim Phosphorous Reduction Plan for implementation by February 1, 2020
2. Preparing an implementation plan with realistic timelines for the complete upgrade of the NEWPCC to meet all licence conditions
3. Submitting monthly progress reports on the upgrade process for posting on the Public Registry and the City of Winnipeg website

A Project Advisory Committee (PAC) for the NEWPCC Nutrient Removal Upgrade was also established in December 2019. The Project Advisory Committee consists of representatives from external stakeholders in addition to representatives from the City of Winnipeg and the Province of Manitoba: International Institute of Sustainable Development, Lake Winnipeg Foundation, Lake Winnipeg Indigenous Collective and the South Basin Mayors and Reeves. This committee was tasked with reviewing information provided by the Project Steering Committee and providing advice for the Project Steering Committee's consideration.

The Project Advisory Committee met monthly except for May, July and August. The May meeting was canceled due to the COVID-19 Pandemic. Meetings were not held in July and August due to scheduling conflicts. The Project Steering Committee met regularly throughout 2020, adapting to remote, online meetings in response to the COVID-crisis. Meetings were held on a monthly or weekly basis as required.

The Interim Phosphorous Reduction Plan and Nutrient Removal Implementation Plan (January 2020 Implementation Plan) was submitted in January 2020. In January 2020, the province and

City agreed to the first year of work outlined within the January 2020 implementation plan (i.e., 2020) and committed to further work on reviewing timelines with an objective of bringing the NEWPCC into compliance earlier than the current end date of 2032. A review of the plans was intended for July 31, 2020 so that opportunities to accelerate the schedules and additional funding sources could be explored. Due to ongoing discussions regarding funding, schedule, and complications due to COVID-19 an update to the Interim Phosphorous Reduction Plan and Nutrient Removal Implementation Plan was rescheduled for September 30, 2020. This report presents those updated plans and summarizes the work done to date.

2. Background

2.1 Existing Wastewater Treatment in the City of Winnipeg

The City of Winnipeg Water and Waste Department owns and operates three sewage treatment plants and a sludge treatment plant, as shown in Figure 1.

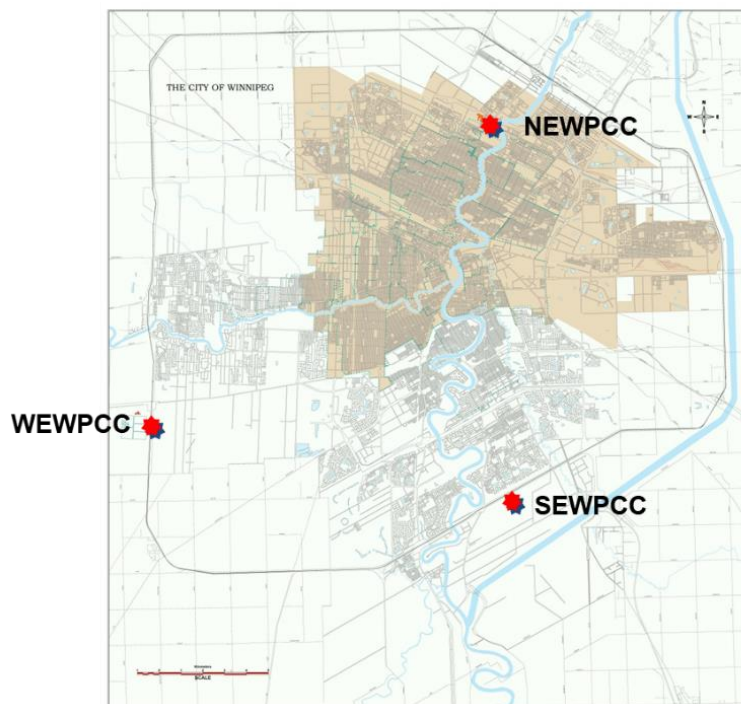


Figure 1 The City of Winnipeg's three sewage treatment plants

The Water and Waste Department is in the midst of an upgrade program to all plants to comply with licence requirements, including nutrient removal.

The City's smallest plant, the West End Sewage Treatment Plant (WEWPC) is licenced under Environment Act Licence 2669 E RR issued June 19, 2009. It treats 10% of the City's wastewater and was upgraded to meet nutrient removal requirements in 2008. It discharges to the Assiniboine River, which eventually flows to the Red River.

The City's middle-sized plant, the South End Sewage Treatment Plant (SEWPCC) is licenced under Environment Act Licence 2716 RR, issued April 18, 2012. It is currently under construction to increase capacity and to meet licence requirements, including nutrient removal. It will start removing total phosphorous to 1 mg/L from its effluent in 2021 and treats approximately 30% of the City's wastewater. It discharges to the Red River upstream of the Assiniboine River.

The North End Sewage Treatment Plant (NEWPCC) is the City's largest treatment plant and treats approximately 60% of the City's wastewater. It discharges to the Red River downstream of the Assiniboine River. The NEWPCC is licenced under Environment Act Licence 2684 RRR, issued June 19, 2009. The licence required the NEWPCC to be upgraded by 2014. In 2014, a Notice of Alteration was approved to extend the upgrade completion date to 2019. The facility is currently not in compliance with this licence.

The Water Protection Act also includes specific requirements related to the NEWPCC including a requirement to meet a 1 mg/L phosphorous limit and monthly ammonia limits along with five requirements related to nutrient removal and reuse:

- Nutrient removal must be achieved primarily by biological methods through application of the best available biological nutrient removal technologies.
- The use of chemical methods to remove nutrients must be minimized.
- If the North End Sewage Treatment Plant is not able to fully remove nitrogen by the date required by subsection (1), it must be capable of being modified to do so with minimal additional costs.
- Nutrients that are removed must be recovered and recycled to the maximum extent possible through application of the best available technologies.
- Biosolids and wastewater sludge remaining after the treatment process must be reused.

All sludge that is generated by the three sewage treatment plants is treated at the NEWPCC. The City is currently implementing a Biosolids Master Plan which was submitted by the City in 2014 and approved by the Province in 2016.

The sludge from the nutrient removal plants is rich in nutrients and some of those nutrients can be released into the NEWPCC plant. The changes to the WEWPCC and SEWPCC will, therefore, impact nutrient levels in the NEWPCC plant effluent. Nutrient removal processes at WEWPCC and SEWPCC remove nutrients from the liquid phase and concentrate them in the solids (sludge). When this sludge is transported to the NEWPCC for further processing, nutrients may be released from the solids back into the liquid phase, which will result in increased total phosphorous concentration in the liquid effluent at NEWPCC unless a form of interim phosphorous removal is established at NEWPCC. In 2008 the NEWPCC was upgraded to reduce nutrients associated with the sludge. These upgrades, while reducing phosphorous, do not meet the 1 mg/L total phosphorous final effluent limit. Furthermore, as upgrades at the SEWPCC come online by January 2022 nutrients in the final effluent at NEWPCC will increase. Interim phosphorous

reduction options may be implemented to mitigate the impact of nutrient rich sludge. These options are discussed further in 'Objective 1 Interim Phosphorous Reduction Plan.'

2.2 The Provincial/Federal Funding Application Process

Investing in Canada Infrastructure Program (ICIP)

For information on the Investing in Canada Infrastructure Program (ICIP) and the project submission and approval process, please see Manitoba's *ICIP Program Guide* available at www.gov.mb.ca/ICIP.

The City of Winnipeg submitted the following two ICIP project submissions under the Green Infrastructure Stream - Environmental Quality Sub-Stream related to upgrades at the NEWPCC:

- **Phase 1 Headworks Facilities**

The project will include upgrades to the Headworks Facilities of the NEWPCC such as raw sewage pumping, screening, grit screening, and grit removal. The scope of this project is necessary for the subsequent Biosolids and Nutrient Removal Facilities projects that will address regulatory requirements. This project will also include replacement of end-of-life equipment. The estimated costs are as follows:

Total Gross Project Costs:	\$356,099,000.00
Total Eligible Project Costs:	\$300,932,000.00
Estimated Federal Contribution:	\$120,372,800.00
Estimated Provincial Contribution:	\$100,300,635.60
Estimated Proponent Contribution:	\$135,425,564.40

- **Phase 2 Biosolids Facilities**

The project will provide Biosolids treatment for Winnipeg's three sewage treatment plants at the NEWPCC, replace end of life equipment and address regulatory requirements regarding the recovery of nutrients and maximizing Biosolids reuse. The scope of this project will include new digesters, thermal hydrolysis equipment, phosphorous recovery equipment and sludge handling facilities. The scope of this project is necessary for the subsequent Nutrient Removal Facilities project. Estimated costs are as follows:

Total Gross Project Costs:	\$552,712,000.00
Total Eligible Project Costs:	\$502,182,000.00
Estimated Federal Contribution:	\$200,872,800.00
Estimated Provincial Contribution:	\$167,377,260.60
Estimated Proponent Contribution:	\$184,461,939.40

On September 30, 2020 City Council approved the transfer of \$321.24M of the City of Winnipeg's federal allocation under the Public Transit Infrastructure Stream to the Green Infrastructure Stream to accommodate the federal share of the above projects.

The Province continues to work with the Government of Canada, the Canada Infrastructure Bank, and the City of Winnipeg to explore the feasibility of utilizing a P3 delivery model to

deliver the necessary upgrades to the City of Winnipeg's North End Water Pollution Control Centre.

- Phase 3 Nutrient Removal Facilities

The project will provide for biological nutrient removal at the NEWPCC and address regulatory requirements regarding effluent quality limits and the minimizing of chemicals. Phase 3 estimated costs are \$828 million. A funding application for Phase 3 the Nutrient Removal Facilities has not been submitted under ICIP. The project completion date is outside of the ICIP funding program end date.

3. Objective 1: Interim Phosphorous Reduction Plan

The Interim Phosphorous Reduction Plan addresses phosphorous removal in the short term while construction activities for both biological phosphorous removal and other licence parameters (solids removal, ammonia removal, etc.) are in progress. Interim phosphorous reduction would also mitigate the increased phosphorous load at the NEWPCC as a result of nutrient removal at the SEWPCC coming online in 2021. Interim phosphorous reduction would utilize the existing and future sludge treatment system; a proposed schedule is presented in Attachment 1. The interim phosphorous reduction schedule beyond 2021 is preliminary and subject to revision, as it is dependent on the outcome of work that is being done in 2020 and subsequent approvals.

The creation of an Interim Phosphorous Reduction Plan started in early 2019 with the development of an Interim Phosphorous Options Report (AECOM, 2019), which described several options for reducing phosphorous at the NEWPCC before all phases of the Upgrade Project are complete. These options were evaluated assuming 2023 annual average flow conditions. The Interim Phosphorous Options Report (AECOM, 2019) concluded that while some phosphorous removal may be possible none of the options would meet the NEWPCC 1 mg/L final effluent total phosphorous limit. This is due to capacity constraints of the existing sludge treatment system which was not designed or built for sludge associated with nutrient removal. However, all nutrient reduction efforts, even if they do not meet the 1 mg/L phosphorous limit, can contribute to improved water quality in the Red River, Lake Winnipeg and further downstream.

Since the completion of the Interim Options Phosphorous Report (AECOM 2019), the City of Winnipeg has been studying the options in further detail, hiring AECOM to conduct laboratory testing and computer modeling for the following scenarios:

1. Scenario 1: Side-stream chemical phosphorous removal by dosing ferric chloride into the sludge treatment system to prevent phosphorous from the South End Sewage Treatment Plant from releasing back into the system. It will also reduce phosphorous-based mineral (e.g., struvite) formation, which is known to coat pumps, pipes, and tanks, causing operational issues and reduced capacity.

2. Scenario 2 (S2): Scenario 1 plus chemically enhanced primary treatment to remove additional phosphorous.
3. Scenario 3 (S3): Option 1 plus chemical phosphorous removal in the high purity oxygen reactors (HPO) and/or secondary clarifiers.

The work planned for 2020 was impacted by the COVID-19 pandemic; however, the scope of the work was adjusted and the report with preliminary recommendations scheduled for December 2020 remains on track. The preliminary recommendations will be confirmed or revised in spring 2021.

3.1 Computer Modeling

The scenarios have been evaluated with computer modeling for both average flow conditions and high-flow conditions. A representative year of 2023 was selected; it was assumed that the SEWPCC Upgrade would be complete and that the SEWPCC would be removing total phosphorous to 1 mg/L in the final effluent. This modeling will be refined following laboratory testing of sludge and wastewater samples. It will be presented in the summary report expected in December 2020.

Preliminary modeling indicates that in average flow conditions, with all components of the plant running, interim phosphorous removal can lower final effluent total phosphorous concentrations at NEWPCC. These conditions are expected approximately nine months of the year. In high flow conditions (i.e., two months in the spring) or when portions of the sludge treatment system are shut down for maintenance (i.e., one month in late summer), interim phosphorous removal would not be achievable because of process and capacity constraints in the system. Preliminary results indicate that the annual average final effluent total phosphorous concentrations would decrease from 3.5 mg/L to approximately 3.2 mg/L for Scenario 1 and to approximately 2.7 mg/L for Scenarios 2 and 3. The estimated phosphorous loads from the NEWPCC to the Red River for each scenario are shown in Figure 2.

For comparison, Figure 3, Figure 4, and Table 1 show the estimated annual total phosphorous loads from the SEWPCC, the NEWPCC, and the WEWPCC to their receiving waters under various scenarios. It assumes that for three months of the year high flow conditions or regular maintenance will result in no interim phosphorous removal at the NEWPCC.

If there is no change in chemical dosing to the sludge treatment system then in 2023 the NEWPCC total phosphorous loads will increase from the baseline of 2019. This increase is due to the release of phosphorous from the nutrient rich sludge associated with the SEWPCC Upgrade (approximately 70%) and due to residential and industrial growth (approximately 30%). The SEWPCC total phosphorous loads will decrease because of its new nutrient removal process. The WEWPCC process currently removes phosphorous to meet the 1 mg/L final effluent total phosphorous requirement; it has a slight increase in 2023, relative to the 2019 numbers, due to residential and industrial growth.

September 30, 2020
 Interim Phosphorous Reduction and NEWPCC Upgrade Plan

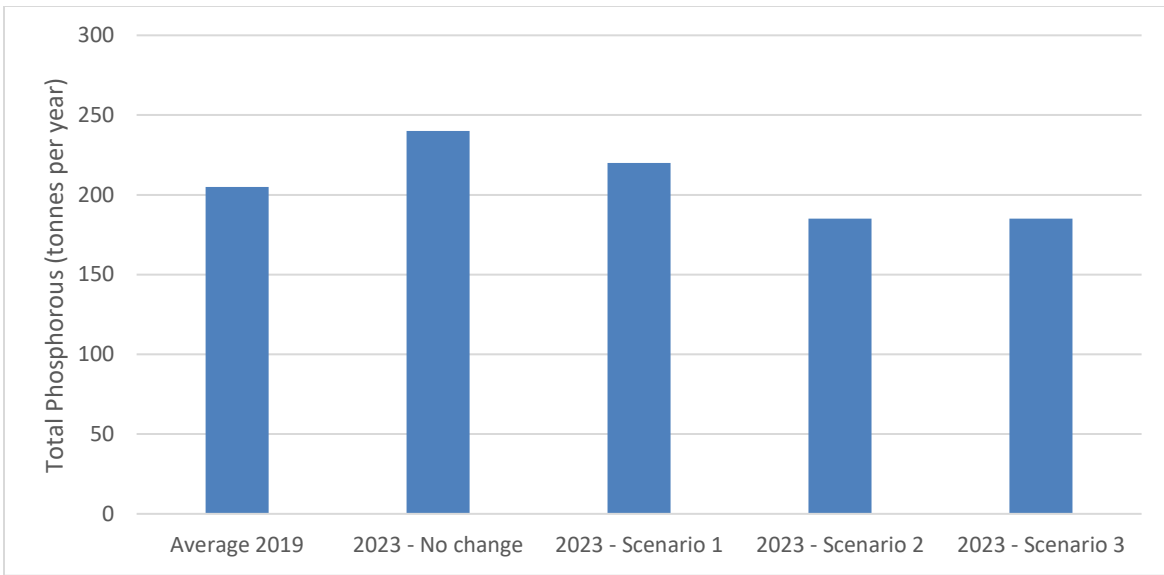


Figure 2 Total Phosphorous Load Preliminary Estimates from the North End Sewage Treatment Plant (NEWPCC)

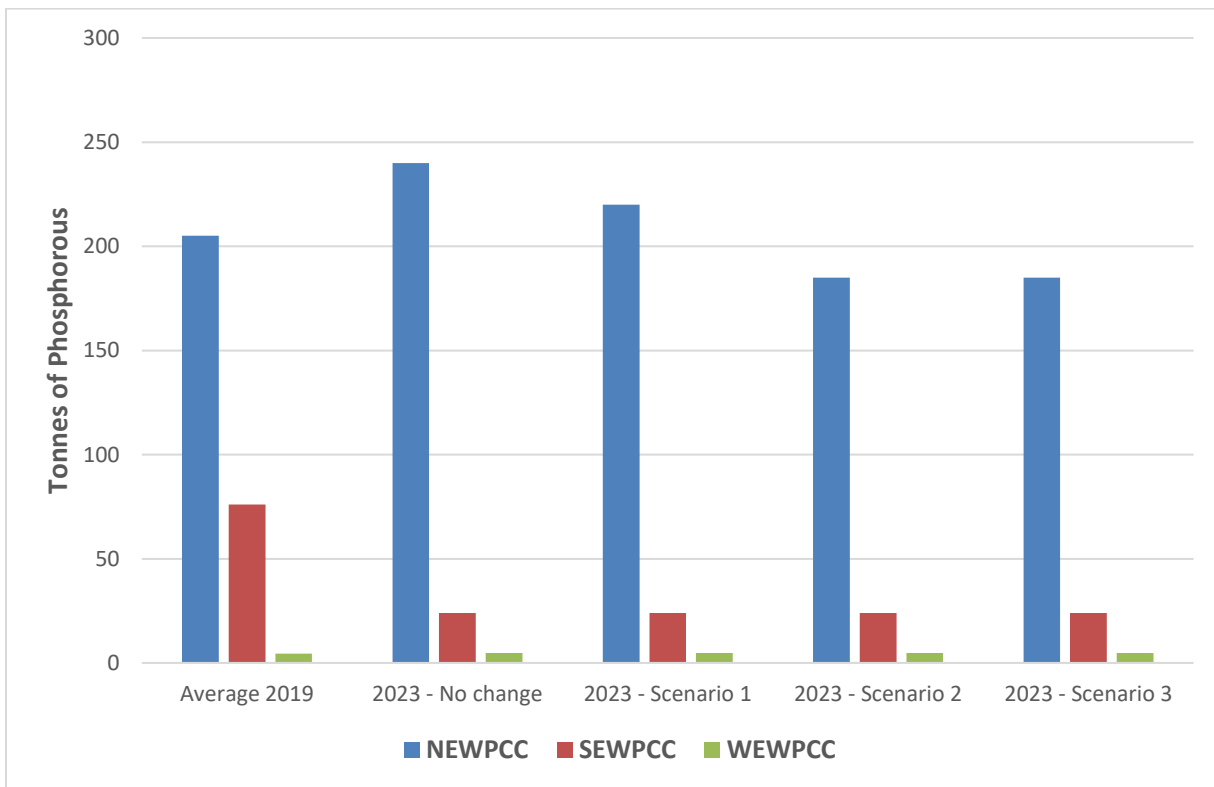


Figure 3 Total annual phosphorous load preliminary estimates (tonnes per year) of various interim phosphorous removal scenarios from the South End Sewage Treatment Plant (SEWPCC), the NEWPCC (North End Sewage Treatment Plant), and the WEWPCC (West End Sewage Treatment Plant) final effluents

Scenarios	Estimated Phosphorous Loads from Winnipeg Sewage Treatment Plants to Receiving Waters (Tonnes)			
	NEWPCC	SEWPCC	WEWPCC	Total
Today (Average, 2019)	205	76	4.5	285.5
2023 - No change ¹	240	24	4.7	268.7
2023 – Scenario 1	220	24	4.7	248.7
2023 – Scenario 2	185	24	4.7	213.7
2023 – Scenario 3	185	24	4.7	213.7

¹Assumes SEWPCC has full biological nutrient removal

Table 1 Summary of preliminary estimated annual total phosphorous loads (tonnes per year) to receiving waters from various interim phosphorous removal scenarios

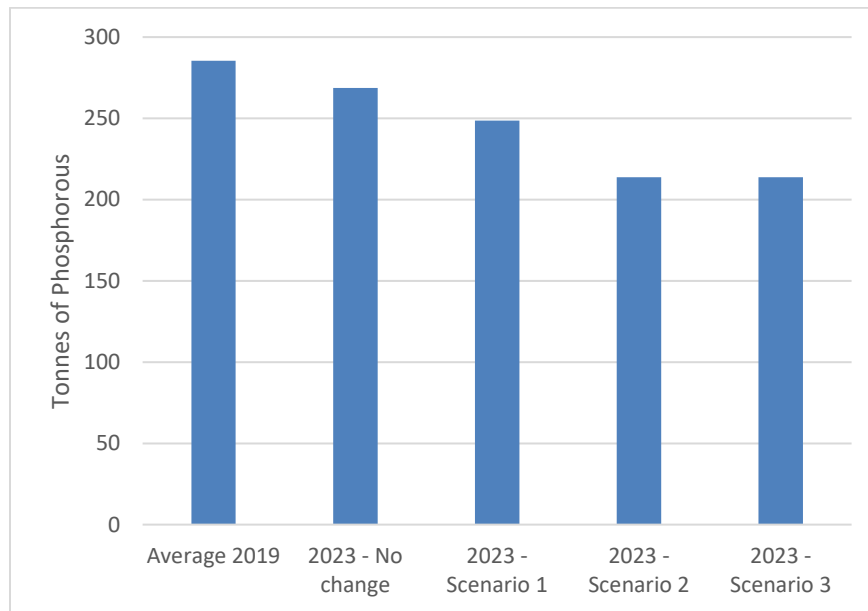


Figure 4 Preliminary annual total phosphorous loads from all three sewage treatment plants under various North End Sewage Treatment Plant (NEWPCC) interim phosphorous removal scenarios to receiving waters (tonnes per year)

Figure 3, Figure 4 and Table 1 show that annual total phosphorous loads to receiving waters are expected to decrease by 2023, due to the SEWPCC Upgrade. The reductions in phosphorous at SEWPCC effluent are greater than the increases in phosphorous at NEWPCC effluent due to the transfer of nutrient-rich sludge from SEWPCC and residential and industrial growth (refer to Figure 4 and Table 1 2023-No change). Interim phosphorous reduction at NEWPCC has the potential to reduce total annual phosphorous loading further.

3.2 Laboratory Testing and Schedule

A recommendation for Interim Phosphorous Removal cannot be made until laboratory testing has been completed in fall 2020. The computer simulations, while helpful, do not account for the

potential toxicity impacts of salts associated with ferric chloride. The implications for pH and alkalinity on the digestion process must also be verified with laboratory testing.

Laboratory testing for the three Scenarios started in September 2020. It was originally scheduled for Spring 2020 but was delayed due to shutdowns associated with the COVID-19 Pandemic. The window for testing spring max flows in 2020 was lost and has been rescheduled for Spring 2021, following which the recommendations will be revisited and refined. The Spring 2021 laboratory testing is not expected to delay key decisions regarding whether or not to implement interim phosphorous removal. The 2021 laboratory analysis may indicate that some interim phosphorous removal is achievable during high flows.

A report summarizing the work and findings for average conditions will also provide preliminary cost estimates and timeframes for construction of an interim phosphorous removal system. It is anticipated in mid-December 2020.

As per the regular environmental licensing process, a recommendation outlining the use of a specific solution based on the December 2020 AECOM summary report will be submitted by the City of Winnipeg to Manitoba Conservation and Climate as a Notice of Alteration request in December 2020. In the first quarter of 2021, the recommendation will also be submitted to Winnipeg City Council for their review and approval to proceed. If approved by both governments, the next phase of work would consist of detail design, followed by construction.

The design and construction schedule (refer to Attachment 1) illustrated for 2022 -2023 is preliminary and will change based on the findings of the December 2020 Interim Phosphorous Reduction Summary Report. There may be opportunities for a phased approach where some interim phosphorous reduction can be started as portions of the facility are being designed/built. This opportunity will depend on the results of lab testing and will be described further in the December 2020 Interim Phosphorous Reduction Summary Report.

3.3 Alternative Chemicals Analysis

AECOM completed a review of alternative chemicals that could be used in place of ferric chloride for phosphorous removal. Six vendors had initially indicated interest and a survey was sent out to each company. Of the six, two responded with proposals: Bishop Water Technologies and RichTerra. Details of those proposals will be provided in AECOM's December 2020 Interim Phosphorous Reduction Summary report.

Bishop Water Technologies suggested an alternative chemical using rare earth metals, as opposed to iron, to bind the phosphorous. It was not recommended because of a lack of case history for plants of similar size and scale and its higher costs, relative to ferric chloride. RichTerra suggested a bacteria/enzyme, which would accumulate phosphorous in its biomass. This phosphorous would, however, still be available for release in the sludge treatment system and was, therefore, not recommended. It also did not have sufficient case history in plants of similar size and scale.

Based on the limited responses from the survey, the lack of case history from proponents, and the relative costs, AECOM recommended that interim phosphorous removal options use ferric chloride.

3.4 Interim Phosphorous Removal to Meet 1 mg/L

The December 2020 summary report will recommend an interim phosphorous removal option for implementation that will be further adjusted in 2021 based on testing during high flow periods. The options are limited in how much phosphorous can be removed due to constraints associated with the existing sludge treatment system. A new sludge treatment plant is anticipated in the future and may allow for an enhanced interim chemical phosphorous removal option to meet the licence limit of 1 mg/L final effluent total phosphorous. It may be possible to meet this limit before biological nutrient removal is fully operational, following completion of Phase 2 Biosolids Facilities. This added scope would require additional design and may increase the cost of the overall facility.

Review and approval of this is required because there may be impacts of this expanded chemical phosphorous removal to 1 mg/L. Examples of such impacts include:

- Its impact on the ability of the new sludge treatment facility to meet Class A low pathogen biosolids.
- Implications for the biosolids reuse program, as this level of ferric chloride may affect the salt content in the resulting biosolids. Biosolids are used as a soil amendment and a fertilizer source for farmers and the salt and phosphorous content may reduce the amount of biosolids that can be reused. Biosolids which cannot be reused in this manner must be landfilled.

An assessment of enhanced interim phosphorous removal will be carried out following the planned December 2020 report. A timeline for this assessment will be developed following receipt of the December 2020 recommendation. Should this result in a recommendation to proceed with the enhanced interim phosphorous removal to 1 mg/L, approvals from both Provincial and City of Winnipeg governments would be sought.

4. Objective 2: Full Biological Nutrient Removal Plan

The schedule for full biological nutrient upgrade is presented in Attachment 2. It is similar to the schedule presented previously in the January 30, 2020 Implementation Plan and assumes that funding for the project is provided by all three levels of government. If funding approvals do not occur as scheduled then there may be further delays to the various phases of work. There is a commitment to determine if there are opportunities to complete the upgrade as soon as possible.

The Project Steering Committee has expanded consensus for the schedule to now include year 2021 in addition to 2020. Several factors will influence the schedule beyond 2021, such as a procurement review, a constructability review, contractor schedule for the Headworks Projects, and progress regarding the funding application process. The constructability review will

determine if some of the previously identified site constraints (lay down areas, traffic flows, construction congestion, etc.) can be mitigated so that the final phase of work, the Nutrient Removal Facilities, can be started earlier. The schedule will continue to be reviewed and updated as new information becomes available and the risks/constraints/assumptions that were used to develop the schedule are realized and mitigated. In addition, the City and Province are in discussions regarding the optimum procurement model to deliver the upgrade as early as possible.

4.1 NEWPCC Site Preparation, Power Supply, and Headworks Project

These aspects of the NEWPCC Upgrade remain as presented in the January 2020 Implementation Plan. The Power Supply Project, which will bring electrical supply to the site to power the upgraded plant, is on schedule to be completed by the end of 2020. The Headworks Project is currently in procurement phase and is scheduled to be awarded in early 2021. This date may be subject to change, however, depending on how funding applications for the work proceed.

4.2 Biosolids Facilities Project

Due to capacity limitations of the current sludge treatment system, the Biosolids Facilities Project is critical to support growth in Winnipeg and the Capital Region. The Biosolids Facilities Project was originally scheduled to start in the second quarter of 2020. This has been rescheduled to the fourth quarter of 2020 so that funding applications could be considered and a procurement review could be conducted. The review will determine if the delivery model of the project, which currently assumes a design-bid-build model, is the most efficient way to deliver the project or would a P3 model realize greater benefit. It will also give time for the project to be considered as part of the Federal Investing in Canada Infrastructure Program (ICIP) program. As a result, the end date of this project has been rescheduled from the first quarter of 2028 to the third quarter of 2028.

4.3 Nutrient Removal Facilities

The January 2020 Implementation Plan shows detail design for the NEWPCC Upgrade Nutrient Removal Facilities project starting in the fourth quarter of 2023. This start date remains the same in the schedule (refer to Attachment 2). The project is not scheduled to start sooner because there must be sufficient time for the detail design and construction of tie-ins from the NEWPCC Upgrade Biosolids Facilities work. There are also site constraints (traffic flow, laydown requirements, existing treatment operations to maintain etc.) which may limit the amount of construction that the NEWPCC site can support. The design start date will be reassessed following the constructability review in 2021.

Even though the start of design of Biosolids Facilities Project has been delayed, the Nutrient Removal Facilities Project has not. It is assumed that there will be opportunities to maintain the overall schedule such that the final end date of mid-2032 remains the same. To facilitate this, a constructability review has been scheduled for the second and third quarter of 2021. At this time the Headworks Project will be fully defined and underway. The Biosolids Facilities Project will have substantial portions of its design complete and the site requirements will be better understood. With this new information the review will confirm when the NEWPCC site can

sustain the construction of the Nutrient Removal Facilities Project.

As with the Biosolids Facilities Project, there will be a period of procurement and funding review, which is currently scheduled for the second and third quarter of 2023. The Nutrient Removal Facilities Project is not eligible for ICIP funding because the project completion date is outside of the ICIP funding program end date, which concludes in 2028 but there may be future opportunities for other funding sources.

5. Assumptions, Risks and Constraints in Developing the Schedule

To develop a construction schedule of this scale and complexity project managers and engineers develop a series of assumptions and constraints that will influence how the projects progress. An assumption is made based on current or expected conditions and experiences, recognizing that those experiences/conditions may change in the future. If an assumption is not valid then it may increase or decrease the length of the schedule.

A constraint is a limitation that is imposed on the project. If the constraint is removed then the time scheduled to complete a project may decrease. If an unidentified constraint is realized then there may be a delay in the schedule.

In project management the risks, assumptions, and constraints are documented and mitigated as the schedule progresses. While there are risks that these assumptions and constraints can lengthen the schedule, corrective action may mitigate their impacts. They may also result in opportunities to accelerate the schedule. Throughout the NEWPCC Upgrade the City will manage the project according to industry best practices. The following are a list of updated assumptions and constraints that were used to develop the construction schedules illustrated in Attachments 1 and 2 for Objectives 1 and 2, respectively.

5.1 Assumptions

1. The 2014 NEWPCC Upgrade Master Plan completed a conceptual and preliminary design of a biological nutrient removal (BNR) treatment process. It is assumed that this is the process that will be constructed and implemented.
2. The Biosolids Facilities Project has a conceptual design with pre-selected equipment approved under the Biosolids Master Plan. It is assumed that pre-selected equipment will not change substantially, following the procurement review.
3. The procurement review will be completed in 2021 and will determine the method that will deliver Objective 2 as soon as possible.
4. That dividing the project into several smaller project components has helped move the overall objectives forward, as it was easier to identify funding and to award contracts for the smaller components.
5. The required funding is available from the City, the Provincial and the Federal governments per the schedule to complete the NEWPCC Upgrade:
 - a. The Nutrient Removal Facilities Project is not eligible for ICIP funding because the

project completion date is outside of the ICIP funding program end date, which concludes in 2028 but there may be future opportunities for other funding sources.

This schedule assumes that there will be sufficient municipal, provincial, and federal funding to support the Nutrient Removal Facilities Project.

- b. Affordability for City of Winnipeg ratepayers must be considered.
6. The Project Steering Committee will look for opportunities to advance the design and construction to facilitate the completion on the NEWPCC Upgrade project. A constructability review has been added to the project schedule to facilitate this.
7. There are sufficient professional consultant resources to design the NEWPCC Upgrades per the schedule.
8. There are sufficient construction resources to build the NEWPCC Upgrades per the schedule.
9. The construction tender pricing remains within the cost estimate for the NEWPCC Upgrade.
10. The City will have internal resources available to deliver the NEWPCC Upgrades, as per the schedule:
 - a. City Engineering staff will be executing the Interim Phosphorous Plan which may limit some staff availability for the NEWPCC Upgrade Project.
 - b. There is limited capacity in the NEWPCC Wastewater Operations staff complement to participate in large projects due to daily operational work schedule.
11. The NEWPCC Sewage Treatment Plant will continue to operate and treat wastewater during the construction schedule:
 - a. Sludge hauling from WEWPCC and SEWPCC will not be impacted by the construction activities per the schedule.
 - b. Biosolids hauling from the NEWPCC for beneficial reuse will continue uninterrupted during construction.
 - c. The Hauled Liquid Waste facility truck traffic into and out of the site will not be impacted by the construction activities per the schedule. The NEWPCC location is the only City of Winnipeg Hauled Liquid Waste facility and must remain in service.
12. The NEWPCC Wastewater Operations staff are available and able to facilitate the needs of the contractors working onsite.
13. A number of other construction projects outside of the scope of the NEWPCC Upgrade are required to maintain treatment plant operations. These projects will be managed such that they do not impact the delivery of the NEWPCC Upgrade.
14. Full digester capacity is available.
15. That the Power Supply Upgrade project will be completed on schedule.
16. Biosolids capacity will be managed to remain within the existing digester capacity until the new Biosolids Facilities are brought into service.
17. Phosphorous rich sludge from the SEWPCC BNR Upgrade will be mitigated by the NEWPCC Interim Phosphorous project.
18. Interim Phosphorous reduction with chemical solution must be submitted by the City to the Province and will be assessed and approved by the Provincial government as a

Notice of Alteration per The Environment Act.

19. The impacts of COVID-19 will not result in further delays or added expense to the project. It is assumed that future COVID-19 outbreaks and isolation safety protocols will not interfere with construction efforts. The City will continue to assess COVID-19 impacts as the pandemic evolves.

5.2 Constraints

1. There is only one sludge treatment (i.e., digestion) process for the entire city. The existing NEWPCC Sewage Treatment Plant has competing load demand on capacity:
 - Annual growth and development (e.g., residential, commercial, industrial)
 - Interim phosphorous generated sludge
 - SEWPCC BNR sludge
 - Capital Region Service Agreements
2. Due to digester capacity it is not possible to achieve final effluent total phosphorous interim reduction to 1.0 mg/L prior to the new Biosolids Facilities being brought into service. Further review and approvals will be required before determining if chemical phosphorous removal to 1.0 mg/L final effluent total phosphorous will be implemented for the reasons stated in this report.
3. The NEWPCC site is very congested and construction lay-down area is very limited and will impact contractor production rates as materials will have to store off site per the construction schedule.
4. The NEWPCC Upgrade project is a very large and complex construction process. The actions of one project can have a cascading impact on other projects and must be actively reviewed and managed to maintain scope, cost, and budget.
5. The existing City of Winnipeg approval process for budgets, awards etc. will be followed. Council is the award authority for contract values in excess of \$5 million.
6. The delivery of the NEWPCC Upgrade Project will occur over a long period of time. During this time the NEWPCC is susceptible to periodic major flooding and/or weather events which could impact the construction schedule.
7. The NEWPCC Sewage Treatment Plant is the oldest City sewage treatment plant. There have been many alterations and modifications to this plant over years. Construction tie-ins from the new facilities to the existing will be difficult due the unknowns with respect to: existing facility records, condition of existing assets, and site geotechnical considerations.
8. The design and construction of the Headworks Facilities, Biosolids Facilities, and Nutrient Removal Facilities must follow in this order because each subsequent project has technical requirements from its predecessor before it can become operational.
9. If there is an outbreak of COVID-19 then operating staff may need to go into isolation. Access to the NEWPCC site may become restricted to protect existing operations and wastewater treatment.

6. Next Steps

The Project Steering Committee has consensus for the year 2021 for Objective 2. Discussions regarding the schedules are ongoing between the province and the City and there is a commitment to determine if there are opportunities to accelerate activities.

For Objective 1, the Interim Phosphorous Reduction Plan the next steps are as follows:

- Receive AECOM 2020 Interim Phosphorous Reduction Summary Report in December 2020
- Submit a Notice of Alteration to the province for implementation of the recommended option
- Submit the recommended option to City Council for approval
- Develop a plan for assessing enhanced interim phosphorous removal in 2021
- Assess additional laboratory work to reflect high spring flows that will be carried out in spring 2021
- Review and revise the schedule for 2022 and beyond as the project develops

For Objective 2, Full Biological Nutrient Removal Plan, the next steps are as follows:

- Complete Power Supply project by end of 2020
- Complete the procurement review as soon as possible
- Conduct a constructability review in Q2/Q3 2021 to determine how to complete the project as soon as possible.
- Review and revise the schedule as assumptions are validated and/or constraints are realized

For both Objectives 1 and 2, updates will continue to be provided in monthly progress reports that are posted to the Public Registry and the City of Winnipeg's website.

ATTACHMENTS

Attachment 1: Schedule for Interim Phosphorous Removal

	2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Interim Phosphorous Options Report																				
Drafting Notice of Alteration Report																				
Manitoba Conservation and Climate Review for Interim P Study																				
Council Review and RFP Development for Interim P Study																				
Protocols and testing methodology																				
Modeling and testing																				
Evaluation and analysis																				
Summary Report																				
Council Review and Approval																				
Manitoba Conservation and Climate Review																				
Interim Phosphorous Implementation																				
SEWPCC BNR Sludge to NEWPCC																				

Legend	
Study, Review, or Pre-selection of Equipment	Yellow
Manitoba Conservation and Climate Review	Light Green
Procurement and/or Design	Red
Construction and Commissioning	Light Green
Winnipeg City Council Review	Purple
SEWPCC BNR Upgrade Milestone	Black

Opportunities to advance the schedule will be reviewed regularly.

	2014				2015				2016				2017				2018			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Approval of the NEWPCC Master Plan																				
Biosolids Master Plan Development																				
Manitoba Conservation and Climate Review Biosolids Master Plan																				
Thermal Hydrolysis System Preselection																				
Struvite Recovery System Preselection																				
NEWPCC Site Preparation Works																				
Power Supply																				
Headworks Facilities																				
Biosolids Facilities																				
Nutrient Removal Facilities																				

	2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Approval of the NEWPCC Master Plan																				
Biosolids Master Plan Development																				
Manitoba Conservation and Climate Review Biosolids Master Plan																				
Thermal Hydrolysis System Preselection																				
Struvite Recovery System Preselection																				
NEWPCC Site Preparation Works																				
Power Supply																				
Headworks Facilities																				
Biosolids Facilities																				
Nutrient Removal Facilities (NRF)																				
Constructability review: determine if NFR can be implemented earlier																				

Legend	
Study, Review, or Pre-selection of Equipment	
Manitoba Conservation and Climate Review	
Conceptual/Preliminary Design	
Detail Design	
Construction and Commissioning	
Funding Applications and Procurement Review	
SEWPCC BNR Upgrade Milestone	

Opportunities to advance the schedule will continue to be reviewed. A constructability review, to determine if the Nutrient Removal Facilities Project can be started sooner, is planned for Q2-Q3 2021, after Headworks and Biosolids are further defined

¹Schedule assumes ICIP funding in place and design-bid-build for Biosolids Facilities and Nutrient Removal Facilities

Attachment 2: NEWPCC Upgrade Schedule¹ (page 2 of 2)

	2024				2025				2026				2027				2028			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Approval of the NEWPCC Master Plan																				
Biosolids Master Plan Development																				
Manitoba Conservation and Climate Review Biosolids Master Plan																				
Thermal Hydrolysis System Preselection																				
Struvite Recovery System Preselection																				
NEWPCC Site Preparation Works																				
Power Supply																				
Headworks Facilities																				
Biosolids Facilities																				
Nutrient Removal Facilities																				

	2029				2030				2031				2032							
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Approval of the NEWPCC Master Plan																				
Biosolids Master Plan Development																				
Manitoba Conservation and Climate Review Biosolids Master Plan																				
Thermal Hydrolysis System Preselection																				
Struvite Recovery System Preselection																				
NEWPCC Site Preparation Works																				
Power Supply																				
Headworks Facilities																				
Biosolids Facilities																				
Nutrient Removal Facilities (NRF)																				
Constructability review: determine if NFR can be implemented earlier																				

Legend	
Study, Review, or Pre-selection of Equipment	Yellow
Manitoba Conservation and Climate Review	Light Green
Conceptual/Preliminary Design	Red
Detail Design	Dark Red
Construction and Commissioning	Light Green
Funding Applications and Procurement Review	Purple
SEWPCC BNR Upgrade Milestone	Black

Opportunities to advance the schedule will continue to be reviewed. A constructability review, to determine if the Nutrient Removal Facilities Project can be started sooner, is planned for Q2-Q3 2021, after Headworks and Biosolids are further defined

¹Schedule assumes ICIP funding in place and design-bid-build for Biosolids Facilities and Nutrient Removal Facilities