CITY OF Thunder Bay
Superior by Nature

2024

WASTEWATER TREATMENT

ANNUAL REPORT

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Introduction

The City of Thunder Bay owns and operates the Water Pollution Control Plant (WPCP) located at 901 Atlantic Ave., on the shore of Lake Superior. The Plant provides primary and secondary treatment, phosphorus and ammonia removal and anaerobic sludge digestion for the entire serviced area of Thunder Bay. Disinfection of the effluent occurs on a seasonal basis, from April 15 to October 15. The treatment facility has a rated capacity of 84.5 million litres per day (MLD).

The Atlantic Avenue WPCP is classified as a Class IV wastewater treatment facility under Ontario Regulation 129/04. This WPCP is operated under **Environmental Compliance Approval (ECA) #6927-9QDM2P**.

This report summarizes the monitoring results for the Atlantic Avenue WPCP required by the ECA and describes the operational performance to ensure production of quality effluent. In 2024, the annual average daily flow to the WPCP was **59 million litres**, which is **70%** of the rated capacity specified in the ECA. The report also provides an overview of a vital part of the City of Thunder Bay's infrastructure.

Wastewater Treatment Process

1. INFLUENT PUMP STATION

Wastewater from the serviced area in Thunder Bay enters the WPCP at the Influent Pump Station (IPS) where five pumps are available to deliver the wastewater to the preliminary treatment process. The wastewater then flows by gravity to the end of the primary treatment process.

2. PRELIMINARY TREATMENT

The Preliminary Treatment Process removes larger objects such as rags, paper, and wood debris. The wastewater enters two aerated grit tanks, where the flow is slowed to allow solids to settle out. Suspended heavier material such as sand and gravel settles to the bottom of the grit tanks, where it is collected and dewatered by grit classifiers. This material is collected and hauled to the City's Solid Waste and Recycling Facility (SWRF). Polymer is added to the grit tanks to foster settling of suspended solids. Aluminum sulphate is also added to help remove phosphorus and suspended solids.

3. PRIMARY TREATMENT

The Primary Treatment Process settles the organic material and dissolved contaminants by gravity in four large rectangular settling tanks (clarifiers). The wastewater flows very slowly through the clarifiers, where the wastewater, now called primary effluent, overflows the outlet weirs. A surface skimmer pushes fats, oils and greases (FOG) to the scum troughs, which then feed the FOG into the scum treatment system. Settled sludge is moved by a scraper along the bottom of the clarifier to a sludge hopper where the sludge is collected and then treated in the anaerobic digesters to allow decomposition by micro-organisms.

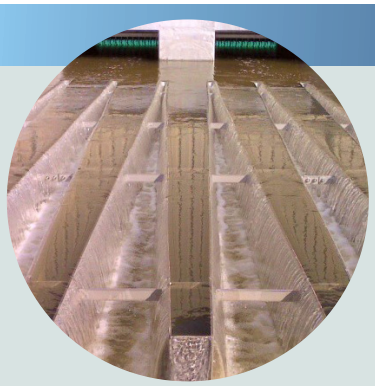
4. SECONDARY TREATMENT

Secondary Treatment is a biological process that uses aerobic bacteria to consume suspended solids and dissolved organic materials in wastewater. The WPCP uses the Biological Aerated Filter (BAF) process. The BAF process removes biochemical oxygen demand, suspended solids and ammonia. In the filters, the primary effluent flows upward through a bed of media. The filters are aerated to satisfy the requirements of the micro-organism population and to maintain biological activity and growth.

Sludge generated in the Secondary Treatment Process is thickened in the Dissolved Air Flotation (DAF) plant before being treated in the anaerobic digesters.

5. DISINFECTION

Treated wastewater is disinfected with ultraviolet (UV) light to destroy pathogenic bacteria. The process utilizes UV light, and therefore has no impact on the chemical composition of the water. UV disinfection is required from April 15 to Oct. 15.



6. DISCHARGE

The final step in the wastewater treatment process is the return of clear treated water to Lake Superior. The effluent from the WPCP is discharged into the Kaministiquia River, approximately 400 metres upstream of Lake Superior.

7. SOLIDS TREATMENT AND COGENERATION

Sludge is produced as a by-product of the wastewater treatment process. Two types of sludge, primary and secondary, are processed in the anaerobic digesters.

Biogas contains approximately 60% methane (the combustible component of natural gas). The cogeneration system converts the biogas to electricity and captures the heat generated from the engine. The biogas can also be used in the plant boilers to generate heat.

Digested sludge is mechanically dewatered using centrifuges to separate the solids from the liquid to create a sludge cake. The centrifuges increase the solids content of the digested sludge from approximately 2% to 25%. The sludge cake is collected in bins and transported to the City's SWRF for final disposal.

The residual liquid (centrate) is returned to the Influent Pump Station for processing.

FINAL EFFLUENT MONITORING AND COMPLIANCE

Ontario's Ministry of the Environment, Conservation and Parks (MECP) sets effluent discharge limits and objectives for all wastewater plants across the province. The limits are set out in the Environmental Compliance Approval (ECA) for each plant. The limits define the maximum concentrations or ranges of parameters such as:

- Total Suspended Solids (TSS), a measure of the amount of particulate matter in the water
- Acidic or alkaline (pH) levels
- Carbonaceous Biochemical Oxygen Demand (CBOD5), a measure of the amount of material in water that will consume oxygen as it decomposes
- E. coli bacteria associated with the wastewater during the disinfection season (April 15 to Oct. 15)
- Total Phosphorus (TP), where high levels can cause increase growth of algae and large aquatic plants
- Ammonia, as the total ammonia expressed as nitrogen. Ammonia has seasonal objectives set under the ECA

Compliance Summary

Throughout 2024, the Atlantic Avenue WPCP met the effluent concentration limits for Total Suspended Solids (TSS), Total Phosphorus (TP), E. coli, and maintained pH within the range of 6.0 to 9.5, as prescribed in the ECA.

The TSS and $CBOD_5$ effluent concentrations remained below the ECA objective and limits for the entire year. See Figure 1 below for the monthly total suspended solids and carbonaceous biochemical oxygen demand.

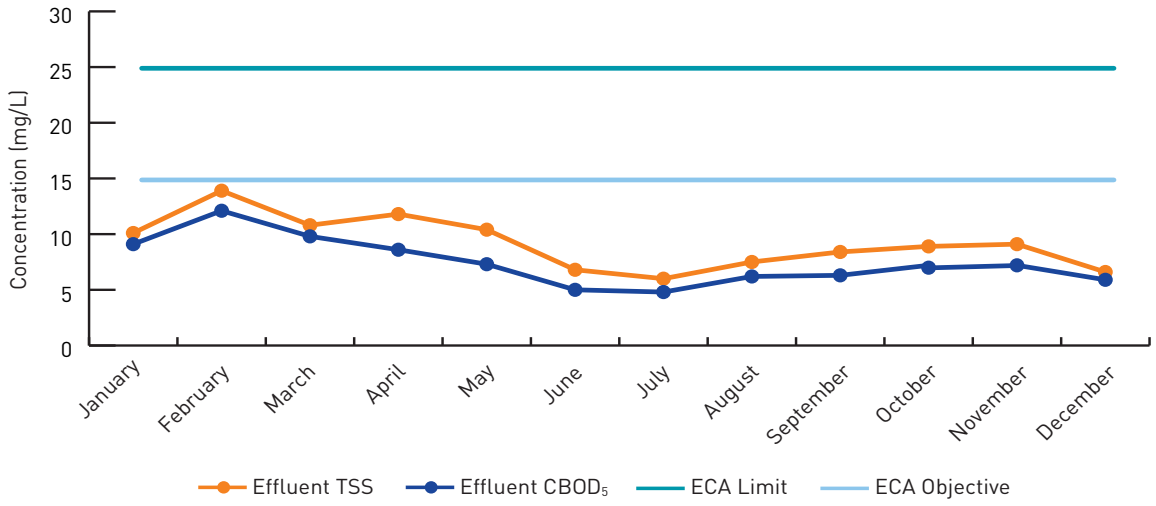


Figure 1: Monthly Effluent Results - TSS and $CBOD_5$

Throughout the year, effluent total phosphorus concentrations remained below the Environmental Compliance Approval (ECA) limits. However, in January, total phosphorus levels reached the ECA objective, and in February, it was exceeded. This temporary increase coincided with the annual wet well maintenance activities, which caused flow surges through the plant. Such surges can contribute to elevated phosphorus concentrations in the effluent. To mitigate this issue, the coagulant dosage was adjusted to counteract the phosphorus increase, while the primary treatment process was closely monitored to ensure compliance. Additional details on operational challenges and corrective actions can be found in Table 1 – Summary of Operating Issues and Actions Taken.

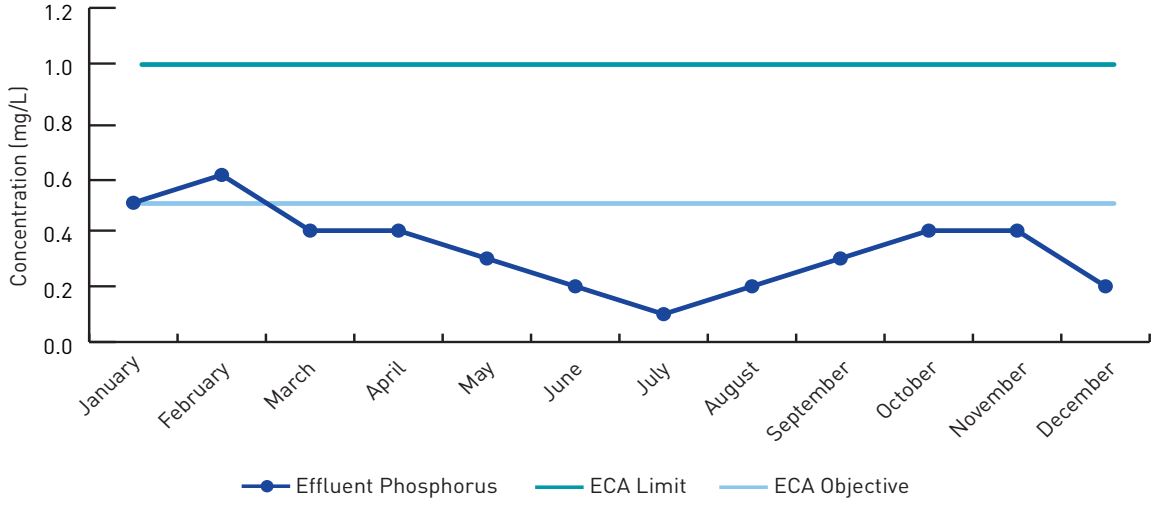


Figure 2: Monthly Effluent Results - Total Phosphorus

The effluent pH for the WPCP remained within the range outlined in the ECA as shown in Figure 3.

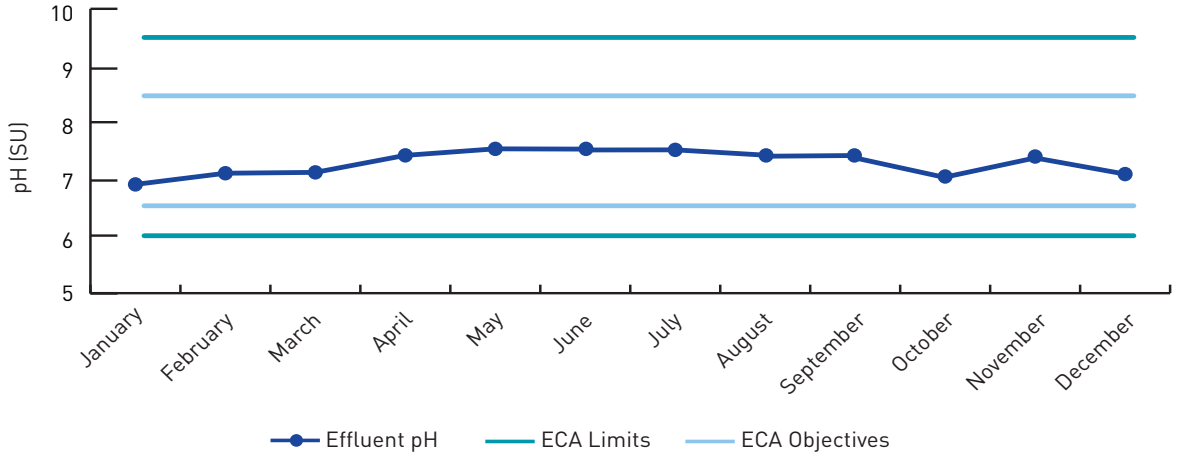


Figure 3: Monthly Effluent Results - pH

In 2024, the effluent exceeded the total ammonia nitrogen (TAN) monthly average Environmental Compliance Approval (ECA) objectives during eight months, primarily in colder seasons. This was due to the reduced nitrifying capacity of the secondary treatment process when wastewater temperatures drop. Additionally, during peak flow events caused by heavy rainfall or spring snowmelt, the facility occasionally operated the Biological Aerated Filter (BAF) in parallel, utilizing only the carbonaceous phase of secondary treatment. While necessary for managing high flows, this operational adjustment can temporarily impair ammonia nitrogen removal. For a detailed overview of monthly ammonia nitrogen levels, refer to Figure 4: Monthly Effluent Results – Ammonia Nitrogen.

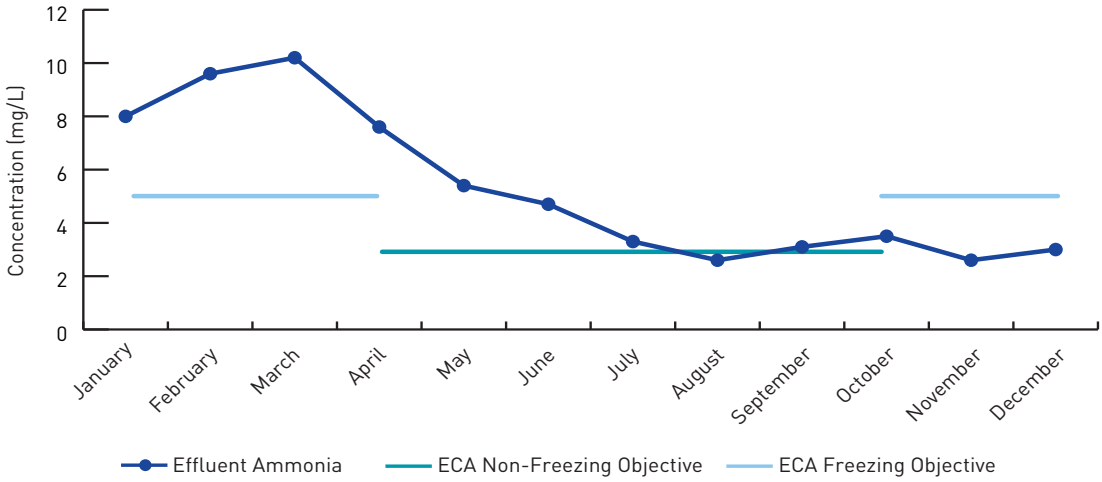


Figure 4: Monthly Effluent Results - Ammonia Nitrogen

BIOSOLIDS SUMMARY

The monthly volumes of dewatered sludge generated in 2024 are presented in Figure 5. Over the year, a total of 7,015 tonnes of biosolids (dewatered sludge) was transported to the City's Solid Waste & Recycling Facility (SWRF) by a contracted waste hauler, where the biosolids were weighed and subsequently buried with other incoming solid nonhazardous waste. This disposal practice will continue in 2025, with the Water Pollution Control Plant (WPCP) projecting an estimated 7,000 tonnes of biosolids for the year, assuming a similar wastewater flow.

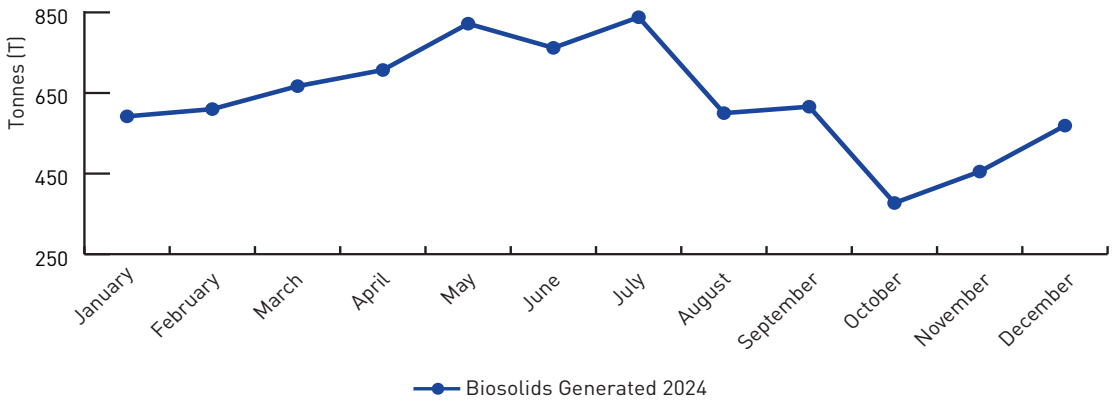


Figure 5: Biosolids Transferred to City of Thunder Bay's Solid Waste & Recycling Facility

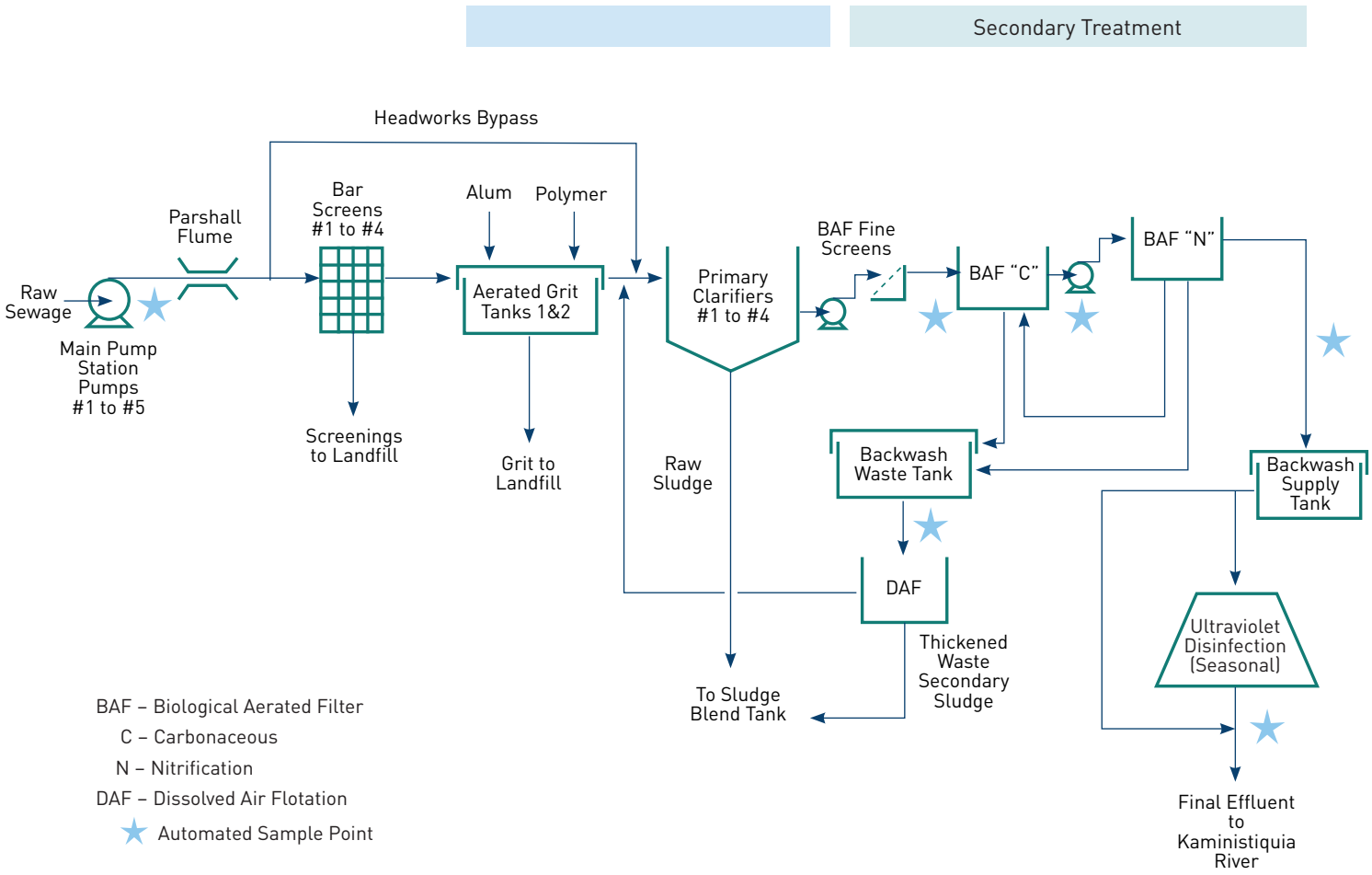
Operating Issues and Corrective Actions

The Atlantic Avenue WPCP operates year-round, 24 hours a day. Occasional operating issues are encountered. Table 1 summarizes operating issues in the reporting period that temporarily affected the process or effluent quality, and lists the corrective actions taken.

Table 1 - Summary of Operating Issues and Actions Taken

Issue	Date	Causes	Corrective Actions
TAN Objective Exceeded	January February March April May June September October	1. Low wastewater temperature, which inhibits nitrification 2. During certain high flow events, the BAF was operated in parallel (without nitrification), to accommodate capacity constraints	1. Reduce nitrification side filtration times for more frequent backwashing 2. Reduce backwash filtration to waste times 3. Ran secondary treatment in 'Winter Mode' to allow for nitrification treatment with increased recycle flow
Total Phosphorus Objective Exceeded	February	1. Wet well maintenance resulted in flow surges	1. Closely monitored primary treatment process 2. Increase coagulant feed
Daily Plant Flow exceeded Rated Capacity	April 17 May 1 - 5 May 22 - 26 June 19 - 20 & 29 Nov 19	Seasonal snow melt and/or heavy precipitation	1. Monitored plant processes 2. Processes were bypassed during the high plant flows

PLANT TREATMENT PROCESS SCHEMATIC



INFRASTRUCTURE PROJECTS

As part of the Environment Division's Asset Management Plan, many projects were carried out during 2024 to protect and improve the equipment and infrastructure.

2024 WPCP PROJECTS

Influent Pump Station (IPS)

- Wet well cleaning and scum removal
- Parshall Flume transmitter verification and calibration

Primary Treatment

- Primary Clarifier #1 baffle replacement

Sludge and Dewatering System

- Overhaul sludge mulcher
- Replace sludge mixing pump and sludge feed pump
- SDB screw conveyor replacements

Biological Aeration Filtration (BAF)

- Upgraded / overhauled Biological Aerated Filtration (BAF) building Boiler hydronic system
- BAF drain valves and actuators replacement

Cogeneration and Gas System

- Cogen hydronic system upgrades / repairs
- Thermal flare access improvements

Heating and Ventilation, Utilities

- SDB Control Room ventilation improvements
- Welding Shop HVAC upgrades / repairs
- Upgraded / overhauled Dissolved Aerated Filtration (DAF) building Boiler hydronic system
- Insulation / cladding repairs and replacement to BAF / DAF and CoGen boiler water piping
- Annual plumbing Backflow Preventers Inspection / Maintenance

Buildings & Grounds

- Upgrades to Administration Building facilities (offices, boardroom, restrooms, change rooms, HVAC)
- Repaired / replaced front entrance – fencing, gate and signage
- Plantwide exterior tower lighting upgrades to LED
- Alum Building lighting repairs / upgrades to LED

Electrical & Instrumentation Systems

- Electrical maintenance switch additions to 5kV, 4160V Breaker line ups to reduce ARC Flash incident energy while performing Electrical maintenance
- Replaced area-velocity flow meter for effluent

Disinfection System

- UV system maintenance and lamp replacement

Remote Stations

- Annual Load Bank Testing and Service for all (Plant Wide and Prince Arthur Landing Station) Emergency Standby Generators
- PAL Station parking lot paving

Wastewater Collection – Pollution Prevention Control Plan

- Separation of 795 m of combined sewers
- Catchbasin disconnects on Christina St, Meek St, Front St, Prospect Ave, and Bay St.

WASTEWATER SYSTEM SUMMARY
2024 ATLANTIC AVENUE WATER POLLUTION CONTROL PLANT

INFRASTRUCTURE

520 km of sanitary sewer

105 metres of combined sewer

Four remote lift stations

Serving over **108,000** people

WASTEWATER TREATED

Over 21 billion

litres of wastewater treated in 2024

Equivalent to over 8,700 Olympic sized swimming pools

Average flow of 59 MLD

RESOURCES

2,000 MWh of electricity generated on-site

Over **85%** of gas generated in digesters was used to generate electricity or to heat on-site buildings

OPERATIONS

1,400+ operational work orders completed

19 licensed operators

Operated **365** days/year

24 hours/day

ENVIRONMENTAL PROTECTION

100% of effluent limits were achieved

Over 90% removal efficiency for:

- Suspended Solids
- Phosphorus
- Carbonaceous biochemical demand

Over **7,000** tonnes of solids removed from effluent stream

Equivalent to the weight of **42** adult moose a day

WASTEWATER SURVEILLANCE

The Wastewater Surveillance Initiative was created in late 2020 by the MECP to coordinate and fund university-led efforts in sewage analysis for COVID-19. Wastewater surveillance provides a non-invasive, anonymous and scalable method of obtaining pooled samples from a population within a geographic area at a point in time, completely independent of clinical testing.
In collaboration with the MECP, weekly sampling for COVID in the influent wastewater began in February 2021. COVID sampling frequency peaked at 5 times weekly into 2024, and dropped to 3 times weekly by June 2024. The program expanded in 2023 to include surveillance for Influenza A and RSV (three times weekly) - this program concluded in August 2024. Surveillance for STI (Sexually Transmitted Infections) started in November of 2024, with sampling three times weekly.

COMPLIANCE & QUALITY CONTROL LABORATORY

The Compliance & Quality Control (C&QC) laboratory supports the process control testing for the WPCP. The testing includes, but is not limited to the following parameters: carbonaceous biochemical oxygen demand ($CBOD_5$), total suspended solids (TSS), total and soluble phosphorous (TP and SP), total solids (TS), volatile solids (VS), volatile acids, ammonia, alkalinity and ultraviolet transmittance (UVT). The laboratory has a quality control and assurance program in place. Additionally, the calibration and verification of the analytical equipment used in the laboratory is confirmed annually.

An external accredited laboratory conducts tests for metals, chemical oxygen demand (COD), ammonia, E. coli and total Kjeldahl nitrogen (TKN). Also, the C&QC laboratory provides analytical support for the SWRF and the Sewer Use Control Program.

CALIBRATION & MAINTENANCE OF MONITORING EQUIPMENT

Calibration and maintenance of the automatic samplers was carried out by the Environmental Inspector and Laboratory Technicians. The influent flow measuring device is verified for accuracy by Plant Electricians on a routine basis and calibrated by a third party on an annual basis. The effluent flow meter is calibrated by a third party on an annual basis.

SEWER USE CONTROL PROGRAM

The Hauled Sewage Monitoring Program recorded a total of 1005 loads of processed water and septic tank wastes, which accounted for 13.6 million litres received and processed at the WPCP in 2024. The WPCP provided sewage disposal services for cruise ships docked at the Pool 6 Cruise Terminal at the Prince Arthur's Landing and Marina.

The Over-Strength Discharge Program, provided through the City's Sewer Use By-law, allows participating industrial users to discharge effluent which contains excess phosphorous, CBOD5, and total suspended solids higher than the limits outlined in the By-law. An additional fee, based on these parameters, and on the actual treatment cost of the loading above the By-law limits, is then applied to these industries. Industries approved to discharge are issued agreements, as required.

SUMMARY OF COMPLAINTS

The ECA requires that all complaints received by the WPCP are logged, investigated and resolved. The City makes every effort to contact residents and address their concerns. There were no complaints received in 2024 related to the WPCP.

BYPASS EVENTS

A **bypass** is a diversion of wastewater around one or more wastewater treatment processes. The bypassed portion of wastewater undergoes part of the treatment process prior to release into the Kaministiquia River at the approved discharge location and sampling point. Final effluent is sampled and tested during bypass events to assess its quality.

Occasional weather events such as heavy rainfall and spring snow melt can result in flow rates that exceed the WPCP design capacity and burden the treatment process. Challenges such as these, power outages, and the requirement for planned, preventative maintenance, may result in a discharge to the environment that has not undergone all treatment processes at the WPCP.

When a planned bypass is required to repair a part of the treatment process, a request is submitted to the federal and provincial governments to perform the bypass, including a plan to minimize its impact.

Total bypassed flow in 2024 was estimated to be 18 ML - all were secondary bypasses, where wastewater received screening, grit removal and primary treatment prior to discharge. During the disinfection season, from April to October, the bypasses received UV disinfection prior to discharge.

Of the bypasses that occurred in 2024, 97% of the volume bypassed was due to power outages.

In addition to the WPCP plant bypasses, there was one bypass at Montreal Street lift station due to a power issue.

All bypass events were reported to the MECP, Environment and Climate Change Canada and the Thunder Bay District Health Unit following established reporting protocol.

There were no combined sewer overflows at the discharge located in the McVicar Creek.

"Island Drive Bridge"
by Sean Randall

Table 2: Plant Effluent Quality

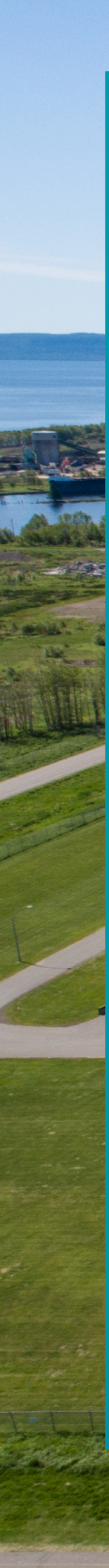
Month	Daily Flow (MLD)	$CBOD_5$ (mg/L)	$CBOD_5$ Loading (kg/day)	TSS (mg/L)	TSS Loading (kg/day)	TP (mg/L)	TP Loading (kg/day)	E Coli (#/100 mL)	TAN (mg/L)	pH (SU)
Objective	N/A	15.0	N/A	15.0	N/A	0.5	N/A	150	Apr 1 to Oct 31: 3.0 Nov 1 to Mar 31: 5.0	6.5 to 8.5
Limit	84.5	25.0	2,112.5	25.0	2,112.5	1.0	84.5	200	N/A	6.0 to 9.5
Compliance Assessment Basis	Daily Average	Monthly Average	Annual Average	Monthly Average	Annual Average	Monthly Average	Annual Average	Monthly Geometric Mean Density	Monthly Average	At all times
January	49.7	9.1		10.1		0.5			8.0	6.9
February	50.5	12.1		13.9		0.6			9.6	7.1
March	51.4	9.8		10.8		0.4			10.2	7.2
April	68.6	8.6		11.8		0.4		21	7.6	7.9
May	79.1	7.3		10.4		0.3		23	5.4	7.5
June	72.7	5.0		6.8		0.2		20	4.7	7.5
July	62.9	4.8		6.0		0.1		27	3.3	7.5
August	53.7	6.2		7.5		0.2		55	2.6	7.4
September	52.8	6.3		8.4		0.3		129	3.1	7.4
October	50.4	7.2		8.9		0.4		14	3.5	7.1
November	57.2	7.2		9.1		0.4			2.6	7.4
December	55.7	5.9		6.6		0.2			3.0	7.2
Annual Average	**58.7**	**7.5**	**440.3**	**9.2**	**540.0**	**0.3**	**17.6**		**5.3**	**7.3**

Table 3: Flows Received

Month	Influent Volume (ML)	Total Precipitation (mm)	Maximum Daily Flow (MLD)	Average Daily Flow (MLD)
January	1,541	25	133	49.7
February	1,464	7	130	50.5
March	1,592	34	100	51.4
April	2,058	47	132	68.6
May	2,453	86	239	79.1
June	2,180	68	141	72.7
July	1,951	34	113	62.9
August	1,665	57	128	53.7
September	1,583	7	121	52.8
October	1,564	27	115	50.4
November	1,717	66	162	57.2
December	1,727	34	110	55.7
Total	**21,495**	**492**		
Average	**1,791**			**58.7**

Table 4: Sludge Dewatering Results

Month	Sludge to Dewatering (m^3/day)	Total Sludge Dewatered (m^3)	Biosolids Generated (tonnes)
January	245	7,585	542
February	240	6,954	560
March	263	8,138	617
April	285	8,559	657
May	292	9,063	772
June	253	7,592	712
July	255	7,919	788
August	233	7,224	550
September	208	6,233	566
October	237	7,337	327
November	228	6,847	405
December	224	6,937	519
Average	**247**		
Total		**90,388**	**7,015**



Staff Organization

Infrastructure and Operations

Commissioner - Kerri Marshall, P. Eng., MBA, FEC, Kayla Dixon, P.Eng., MBA

Policy & Research Analyst – Julie Wiejak, Jessica Strobel

Program Lead - Asset Management - Amy Coomes

Climate Adaptation Coordinator – Jacob Porter

Communications Officer – Ian Kaufman (Acting), Amanda Nason

Technology Management Specialist - Henry Connor

Environment Division

Director – Michelle Warywoda, P. Eng.

Administrative Assistant - Lynae Grace

Program Administrator - Katrina Hotson

Chief Chemist – Ian Morgan, Ph.D., P. Chem., C. Chem.

Manager – Compliance & Quality Control – Gary Person

Planning & Research Analyst – Dan Currie, C.E.T., Jared Kreiner

Process Engineers - Walter Turek, P. Eng., Kirsten Maki, P.Eng.

Training & Quality Assurance Coordinator – Shelby Jaspers

Quality Control & Training Specialist - Marc Leschuk, P.Eng.

Water and Wastewater Engineer – Joshua Daniels, P. Eng.

Water Pollution Control Plant

Plant Superintendent – Lindsay Menard, P. Eng., PMP

Supervisor, Maintenance – Mike Brown, Dan Currie

Supervisor, Operations – Mark Wilson, Rick Sutton

Accounting & Administration Clerk – Kristie Fisher

Electrical Lead – Andreas Makrides, Rob Farwell (Acting)

Project Manager - Mike Brown

Maintenance Lead – Sal Piccolo, Thane Gagnon

Lead Operator – Rick Sutton, Keenan Colosimo

Environmental Inspector – Patrick McGuire

Janitor/Handyworker – Darrin White

Laboratory Technicians - Julie Carlin, Brett Rizzuto

Millwrights – Thane Gagnon, John Hrycyk, Warren Perry, Mat Prien

Operators – Shane Bureau, Philip Kennedy, Cody Lane, Patrick Melanson, Marcus Uliana, Hunter Tollefsen, Joe Pobihushchy, Daniel Jedruch, Jayden McEachern

Plant Electrician – Rob Farwell

Relief Operators – Daniella N de Lima, Reid Stajkowski

Thunder Bay WATER POLLUTION CONTROL PLANT

WATER POLLUTION
CONTROL PLANT

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