Greater Napanee

GREATER FOR MANY REASONS

2024

Annual Report

Napanee Water Pollution Control Plant

300 Water Street W.
Napanee, Ontario
K7R 1X3

Prepared: January 2025

Executive Summary

The quality of effluent released to the Napanee River from the Napanee Water Pollution Control Plant (WPCP) during 2024 complied with the limits stipulated in the plant Environmental Compliance Approval (ECA). The average monthly geometric mean values for effluent bacteriological quality measured as *E. Coli.* met the ECA operational objective (<200 CFU/100mL) in all months of the year. The highest reading was in March 2024 when the monthly geometric mean was 159 CFU/100mL.

Total annual treated flow measured in 2024 decreased by approximately 14 percent when compared to the previous year, with the average day flow representing 74 percent of the plant design capacity. Efforts to detect the inflow and infiltration of potential storm and ground water sources will continue throughout 2025.

Biosolids generated at the facility were temporarily stored at the Sutcliffe Lagoon and were applied to agricultural land during May, September, October and November by GFL Environmental, all-in accordance with the sites Certificates of Approval and Ontario Regulation 267/03.

Maintenance and upgrading activities during 2024 included a new heat exchanger to service the digesters. The department also completed four sewer service repairs in 2024, as well as routine sanitary sewer flushing and camera inspections.

Planning for the upgrade and expansion of the aging and hydraulically limited Water Pollution Control Plant continued in 2024 with a completed design. The project is expected to move forward with a tender release in January 2025. The project is expected to commence in Spring 2025.

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Wastewater Flow Data

The Napanee Water Pollution Control Plant (WPCP) is a conventional activated sludge process, with an average day design flow rate of 9,087 m^3/d, and a peak flow rate of 21,370 m^3/d. The average treated flow during 2024 was 6,702 m^3/d, which is approximately 74 percent of the design capacity. Non-compliance with respect to treatment capacity is defined in the Environmental Compliance Approval as:

"…the introduction of sewage flows in excess of the average daily flow (9,087 m^3/d) for any consecutive period of time greater than one year."

The plant design capacity of 9087 m^3/d was exceeded on 52 days in 2024 which is a decrease when compared to the 82 days experienced in 2023. WPCP flow data collected during 2024 is presented in Table 1.

The hydraulic capacity of the plant continues to be stressed as a result of high flow experienced during heavy precipitation events or during periods of rapid ice and snow melting. The maximum daily flow during 2024 was on January 13, 2024, when 22,416 m^3/d of inflow was measured, including 3,638 m^3 bypassing the secondary treatment process. The following day, on January 14, 2024, the highest volume of bypassed influent was observed, where 5,034 m^3 of influent bypassed the secondary treatment process. Although the Town of Napanee has a separate storm water collection system, improper connections, broken pipes, or faulty joints in sanitary sewers can result in the introduction of ground and storm water into the sanitary collection system. This misdirected hydraulic load on the sanitary system is collectively referred to as inflow and infiltration. Inflow and infiltration is problematic because it occupies treatment capacity that could otherwise be used to treat sanitary wastewater.

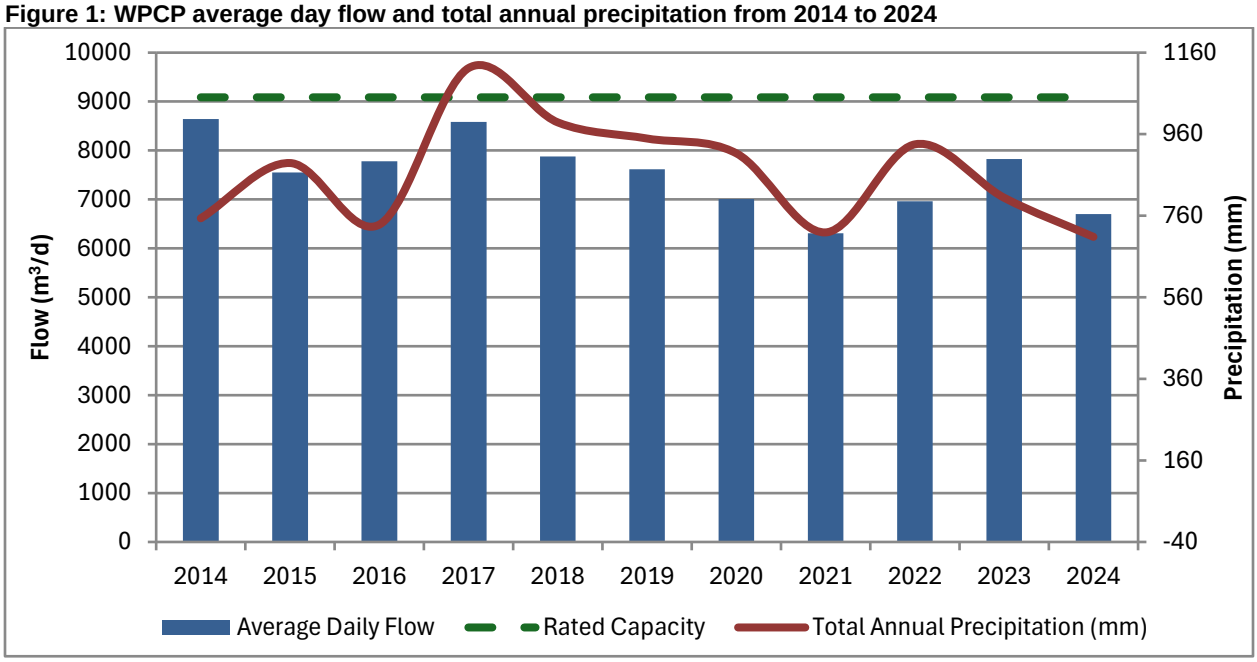
Table 1: Summary of flow data for 2024

Month	Treated Volume			
	Total (m^3)	Average (m^3/day)	Maximum (m^3/day)	Minimum (m^3/day)
January	329554	10631	22416	6826
February	245094	8452	11261	6787
March	260795	8413	12176	6637
April	304704	10157	21385	6538
May	202659	6537	9299	5125
June	182589	6086	10447	4055
July	183613	5883	8687	4577
August	154758	4992	7567	4205
September	144852	4828	8101	4083
October	126975	4096	4759	3803
November	128839	4295	5449	3806
December	187636	6053	12354	4291
Year Total	2452068			
Average		**6702**		
Min / Max			**22416**	3803
C of A Limit		**9087**	**21370**	

The apparent impact of inflow and infiltration over the past several years on the Napanee system is highlighted by trending annual average day flow with total precipitation as shown below in Figure 1.

Dry weather flow, typically experienced during summer months (July through September), is an approximate representation of sanitary wastewater flows exclusive of the effects of inflow and infiltration. Minimum daily flow rates recorded during those months indicate that dry weather flow accounts for 47 percent of the average day design capacity. The 2024 average day treated flow was 74 percent of the design capacity, a decrease from 86 percent in 2023. Inflow and infiltration continue to be problematic and repairs to identified issues will continue throughout 2025.

Figure 1: WPCP average day flow and total annual precipitation from 2014 to 2024



Efforts to identify and control sources of inflow and infiltration have included the following:

- Greater Napanee Utilities retained a consultant in early 2012 to conduct an inflow and infiltration study. Using this study, collection system deficiencies were corrected in 2013 and 2014.
- Flow meters are installed at six of seven sewage lift stations to determine areas of the collection system most impacted by inflow and infiltration.
- Restoration work has been conducted on manhole joints, connections, and benching as problem areas are identified.
- Covers (dishes) have been installed under the lids of several manholes to prevent surface water from entering through holes in the manhole lids.
- Local construction specifications require that new manhole installations include rubber seals.
- A municipal bylaw prohibits the connection of sump pumps and rain leaders to the sanitary sewer. Staff have had great success in removing existing connections through education and outreach, with 58% of known connections disconnected since 2016.

Efforts to reduce inflow and infiltration to optimize treatment reserve capacity will be ongoing.

Primary Bypass / Sewage Spills / Lift Station Bypass

Under all but the most extreme conditions, wastewater entering the plant undergoes preliminary treatment (screening and grit removal), primary treatment (gravity separation of solids by sedimentation), and disinfection. If the influent flow rate exceeds 38,000 m^3/d, the excess will bypass the primary clarifiers, mixing with the primary clarifier effluent prior to flowing to the aeration basins. Bypassing of the primary clarifiers did not occur in 2024.

The discharge of untreated sanitary sewage from the collection system can occur at any of the seven sewage lift stations and/or collection system manholes as the result of flooding events, power outages, pump failures, or sewer blockages. Measures are in place to prevent bypassing/spills which include: multiple (backup) pumps at all lift stations, high level alarms, backup power generation capability, and readily available vacuum truck service.

Secondary Bypass

If the flow of wastewater directed to the aeration basins exceeds approximately 16,000 m^3/d, the excess will pass over a flat weir (located immediately upstream from the aeration tanks), bypassing the secondary treatment process. Secondary bypassing limits the hydraulic loading on the secondary treatment process (aeration tanks and secondary clarifiers) to prevent washout of activated sludge which is essential for maintaining treatment process performance. Wastewater that bypasses the secondary process (which tends to be weak in strength due to dilution from inflow and infiltration) is blended with the ~16,000 m^3/d of secondary clarifier effluent, prior to disinfection and is discharged to the Napanee River.

The volume of secondary bypass discharged during 2024 was less than half of the volume observed in 2023. This reduction can be contributed to a decrease in

precipitation and snow melt, as seen below in Figure 2. In addition, one secondary clarifier train was out of operation in 2023 for an extended period from June to September, increasing the frequency of secondary bypasses. A summary of the secondary bypass events during 2024 is provided below in Table 2.

Table 2: Summary of secondary bypass events during 2024.

Month	Secondary Bypass Events			
	Total m^3	**Events** #	**Duration** hours	**SAC Reference #s**
January	15559	3	155	1-4KXE4N 1-4KPA3F 1-4M8D5W
February	0	0	0	
March	0	0	0	
April	9371	2	137	1-5DF1U6 1-5ODNIC
May	0	0	0	
June	246	1	6	1-8EJABI
July	78	1	22	1-8SNY5U
August	0	0	0	
September	0	0	0	
October	0	0	0	
November	0	0	0	
December	0	0	0	
Annual Total	25254	7	320	

*Ministry policy defines a bypass event as an occurrence separated by a period of more than 12 hours from another occurrence. When a bypass stops, it is considered to be the end of the event. If, however, a bypass begins again within 12 hours, it is considered to be the same event.

The relationship between precipitation and secondary bypass volume is illustrated in Figure 2. Staff will continue to follow trends as more inflow and infiltration issues in the wastewater collection system are addressed.

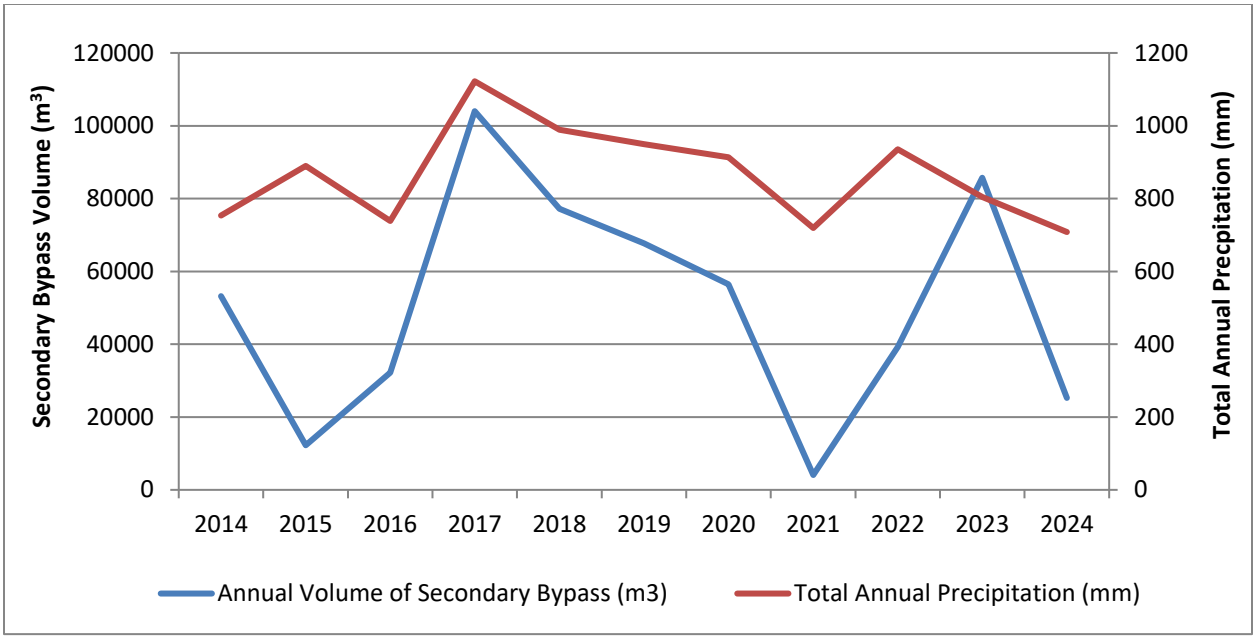


Figure 2: Total annual precipitation and volume of secondary bypass from 2014 to 2024.

BOD_5 and Total Suspended Solids Analytical Data

The removal of biochemical oxygen demand (BOD_5) and suspended solids from municipal wastewater is the primary design function of the Napanee WPCP, which utilizes a conventional activated sludge process. The principal mechanisms of removal include screening, sedimentation, and biodegradation. BOD_5 and suspended solids data collected during 2024 are summarized in Table 3.

Raw sewage entering the treatment process during 2024 was of moderate strength, having BOD_5 and total suspended solids concentrations averaging 140 mg/L and 180 mg/L, respectively. The pollutant removal efficiency of the plant is typical of the conventional activated sludge process with BOD_5 and total suspended solids removals both averaging 96.3 percent. Annual average effluent concentrations and mass loadings of both BOD_5 and total suspended solids were well below the compliance limits of 25 mg/L and 227 kg/d.

Table 3: Summary of average monthly BOD_5 and suspended solids results for 2024.

Month	BOD_5			Suspended Solids		
	Raw Sewage (mg/L)	Final Effluent (mg/L)	Removal %	Raw Sewage (mg/L)	Final Effluent (mg/L)	Removal %
January	90	3.6	96.0	128	8.2	93.5
February	121	3.8	96.9	142	5.9	95.9
March	131	4.5	96.6	136	7.6	94.4
April	122	6.2	94.9	146	8.7	94.0
May	146	5.8	96.1	178	6.2	96.5
June	195	7.8	96.0	211	4.8	97.7
July	160	6.0	96.3	219	5.7	97.4
August	140	4.5	96.8	163	8.4	94.9
September	148	4.5	97.0	198	6.8	96.6
October	173	6.2	96.4	240	4.6	98.1
November	136	6.0	95.6	211	4.0	98.1
December	122	3.2	97.4	182	3.7	98.0
Average (mg/L)	**140**	**5.2**	**96.3**	**180**	**6.2**	**96.3**
Average (kg/d)		**27.2**			**33.2**	
C of A Limit (mg/L)		**25**			**25**	
C of A Limit (kg/d)		**227.2**			**227.2**	

Phosphorus and Nitrogen Analytical Data

Phosphorus is a nutrient that is essential to biological growth. It is typically present in raw sewage at concentrations sufficient to cause excessive plant and algae growth in natural surface waters if released untreated. Excessive growth in surface water deteriorates the aquatic environment when the plants / algae decompose.

Phosphorus is removed from sewage at the WPCP by the addition of ferric sulfate which forms an insoluble precipitate when it combines with phosphorus in the wastewater. The precipitate is then removed by sedimentation. Ferric sulfate is added to the process immediately downstream from the pre-treatment process but can also be added at the aeration tank influent channel, or at the tail end of the aeration tanks.

The annual average concentration of phosphorus in the raw sewage was 4.37 mg/L, while the average effluent concentration was 0.14 mg/L. Effluent quality consistently met the Environmental Compliance Approval Limit of 1.0 mg/L throughout 2024.

Total Kjeldahl Nitrogen (TKN) represents the total quantity of organically bound nitrogen plus ammonia nitrogen which are the forms that most commonly occur in raw sewage. Removal or conversion of the nitrogen species is important because if released in the form of un-ionized ammonia, it can be toxic to aquatic organisms.

In 2024, the annual average concentration of un-ionized ammonia in the process effluent was 0.107 mg/L which is well under the Federal Wastewater Systems Effluent limit of 1.25mg/L.

Analytical data for phosphorus, nitrogen, pH, temperature, and alkalinity are summarized in Tables 4 and 5.

Table 4: Summary of nutrient data for 2024

Month	Total Phosphorus			TKN		NH_3 (Effluent Only)	
	Raw Sewage (mg/L)	Final Effluent (mg/L)	Removal (%)	Raw Sewage (mg/L)	Final Effluent (mg/L)	Total (mg/L)	Un-ionized (mg/L)
January	3.42	0.19	94.3	35.86	17.04	15.18	0.046
February	3.27	0.13	96.0	32.18	18.13	15.85	0.041
March	3.21	0.16	95.1	36.50	18.65	15.88	0.068
April	3.65	0.17	95.4	35.24	18.94	16.88	0.061
May	4.32	0.13	97.0	42.13	22.05	21.10	0.106
June	4.63	0.12	97.4	42.70	23.85	21.93	0.112
July	4.58	0.15	96.8	40.28	19.62	18.84	0.191
August	4.51	0.17	96.2	39.13	21.20	21.03	0.197
September	5.35	0.15	99.8	51.03	25.25	25.38	0.191
October	5.78	0.11	98.0	64.68	26.22	24.32	0.171
November	5.32	0.12	97.7	42.60	15.68	13.90	0.057
December	4.42	0.11	97.6	35.64	13.50	10.07	0.040
Annual Average	**4.37**	**0.14**	**96.6**	**41.50**	**20.01**	**18.36**	**0.107**

*Environmental Compliance Approval limit: 1 mg/L and Bay of Quinte Remedial Action Plan Objective: 0.3 mg/L
Note: All samples were collected as 24-hour composite samples

Table 5: Summary of temperature, pH and alkalinity data for 2024

Month	Final Effluent		
	Temperature (°C)	**pH** (pH)	**Alkalinity** (mg/L)
January	10.44	7.22	232
February	10.14	7.16	220
March	10.73	7.20	244
April	11.45	7.24	248
May	14.59	7.31	239
June	17.68	7.22	239
July	19.79	7.20	240
August	20.76	7.32	249
September	20.73	7.27	233
October	18.76	7.25	216
November	16.51	7.13	166
December	13.20	7.21	168
Average	**15.60**	**7.23**	**230**

Note: All measurements were conducted on daily grab samples, typically collected 5 times per week

Disinfection / Bacteriological Testing

Prior to discharge to the Napanee River, the treated effluent is dosed with a disinfectant (chlorine) to inactivate any potential pathogenic organisms that may remain. Bacteriological testing is conducted each week to evaluate the effectiveness of the disinfection process. Grab samples for bacteriological testing (*E. Coli.*) were collected immediately downstream from the chlorine contact chamber, normally during peak flow conditions (between 8am and 10am) when the treatment process is typically most heavily burdened.

During 2024, all monthly geometric mean[1] values calculated from weekly analyses were below the operational objective of 200 CFU/100mL. The geometric mean value for all samples collected during 2024 was 61 CFU/100mL. Of the 53 samples, there were seven (7) analyses indicating a value above the operational objective.

In response to the Federal regulation requiring the elimination of total chlorine residual

[1] Statistical reduction using geometric mean is consistent with the *Ontario Provincial Water Quality Objectives* and with the U.S. EPA *Bacterial Water Quality Standards for Recreational Waters*.

from municipal wastewater treatment plant effluents, de-chlorination using sulfur dioxide was introduced at the Napanee facility in January 2010. The average total chlorine residual concentration in effluent discharged to the Napanee River has remained at or below 0.02 mg/L since the process was commissioned. There were two recorded dates where total chlorine residual was slightly above the objective, at 0.03 mg/L; on August 12, 2024 and October 23, 2024, however, the monthly averages met the objective.

A summary of disinfectant residuals and bacteriological results for 2024 is provided in Table 6.

Table 6: Summary of disinfection and bacteriological data for 2024

Month	Chlorination				De-chlorination				E. Coli.	
	Mass Applied (kg/mo)	Dosage (mg/L)	Residual (mg/L)	Demand (mg/L)	Mass Applied (kg/mo)	Dosage (mg/L)	Average Residual (mg/L)	Max Residual (mg/L)	Geo. Mean (CFU/ 100mL)	Max (CFU/ 100mL)
January	245	0.82	0.50	0.31	170	0.74	0.00	0.01	149	600
February	179	0.73	0.49	0.24	152	0.84	0.00	0.01	131	1020
March	182	0.69	0.52	0.17	164	0.86	0.00	0.01	159	360
April	222	0.74	0.52	0.22	163	0.77	0.00	0.02	54	200
May	155	0.77	0.47	0.30	174	1.14	0.00	0.01	40	177
June	199	1.09	0.45	0.65	153	1.07	0.00	0.01	141	2040
July	206	1.12	0.38	0.74	166	1.15	0.00	0.01	3	40
August	194	1.24	0.46	0.79	170	1.41	0.00	0.03	18	60
September	167	1.15	0.44	0.71	152	1.36	0.00	0.02	11	20
October	172	1.35	0.40	0.95	150	1.55	0.00	0.03	4	22
November	178	1.38	0.43	0.95	141	1.50	0.00	0.02	2	6
December	217	1.17	0.53	0.64	156	1.18	0.01	0.02	14	14000
2024 Average	**193**	**1.02**	**0.47**	**0.56**	**159**	**1.13**	**0.00**		**61**	
2024 Maximum								**0.03**		**14000**
Total	**2316**				**1910.3**					
Objective			**<=0.5**				**<=0.02**		**<=200**	

Notes: Chlorine is measured as total chlorine residual. All samples are collected as grab samples.

2 Maintenance / Improvements & Plant Upsets

Maintenance / Improvements

Notable maintenance activities and process improvements during recent years include the following:

- In 2011, a Municipal Class Environmental Assessment was completed to assess capacity limitations and to plan for the upgrade and/or expansion of the facility over a 20 to 30-year design horizon. The Environmental Study Report concluded that an additional 25 percent average day flow capacity and approximate doubling of peak capacity is required to meet future needs.
- Following the announcement of federal funding assistance in 2019, the Town completed preliminary design studies exploring both retrofit and new-build design concepts. Detailed design of a project focused on the mitigation of process bypassing and renewal of aging equipment commenced in 2022.
- In August 2024, it was announced that the Town would also be receiving significant provincial funding for the upgrade. The new-build design was finalized in 2024, and the project was released for tender in early 2025. Construction is expected to commence in spring 2025.
- Efforts to detect and reduce inflow and infiltration are ongoing. Flushing and camera inspections of approximately 25% of the collection system takes place each year.
- The 2012 Inflow and Infiltration Study identified several key areas of concern. The targeted areas include infrastructure that has been in service for over 100 years. A considerable amount of infrastructure renewal occurred between 2014 and 2019 with portions of the targeted areas addressed each year. The study has become an integral part of our 10-year capital planning process.
- A new heat exchanger was installed in the anaerobic digesters to replace the old and aging one.
- Two wall mounted gas detection units were replaced in the chlorine room and within

the sulphur dioxide storage building.

- A ferric chemical dosing pump was replaced.

Process Upsets

There were no process upsets in 2024.

3 Biosolids

Biosolids Quality and WPCP Output (Lagoon Input) Volumes

Accumulated solids (sludge), removed from the municipal wastewater through the treatment process are stabilized in the anaerobic digestion process. The digestion process reduces the quantity of solids requiring disposal by converting the volatile fraction to methane gas. The methane gas is then beneficially used in the plant boiler for process and building heat.

Following the digestion process, the resulting stabilized sludge (referred to as biosolids) is hauled to an off-site storage lagoon owned by Mr. Fred Sutcliffe Jr. (Provisional Environmental Compliance Approval S-3712-39) and located on part lots 5 & 6, Concession IV, in the Town of Greater Napanee. The lagoon is leased by The Town of Greater Napanee for the exclusive temporary storage of biosolids generated at the Napanee WPCP.

An average of 19 m^3 of biosolids were hauled from the WPCP by Sutcliffe's Septic Service, Hartin's Services, and GFL to the Sutcliffe Storage Lagoon each day in 2024. A summary of the volumes hauled during 2024 is provided in Table 7.

Table 7: Summary of biosolids hauled to the storage lagoons for 2024

MONTH	LAGOON	
	Loads #	Volume m^3
January	28	478.4
February	24	364.8
March	30	510.4
April	35	610.4
May	30	555.2
June	35	598.4
July	41	781.6
August	38	760.0
September	38	753.6
October	37	740.0
November	28	470.4
December	26	462.4
Total	390	7085.6
Average	19	590

Agricultural Land Application of Biosolids

In 2024, the land application of biosolids took place on May 22nd-24th, September 5th-9th, October 31st-November 5th, and November 27th-29th. A total volume of 6,616m^3 of biosolids were applied by GFL on 73.47 hectares (approximately 182 acres) of land. GFL is contracted to conduct and administer the land application program.

Samples of biosolids were collected each month from the WPCP digester and directly from the lagoon prior to each land application to determine appropriate, compliant rates of application.

The following Tables 8 and 9, summarizes the 2024 land application program.

Table 8: Sites applied with biosolids in 2024

Date 2024	Farmer/Landowner Farm Name	NASM #	Lot	Con	Municipality	Ward	Application Method	Field #	Area Spread (ha)	Total Volume (m3)
May 22-24	MacLean - Chambers Rd.	60884	23-24	4	Town of Greater Napanee	Fredericksburgh	Surface	12-13	27.75	1788
September 5-9	Vermilyea - Gray Farm North	24405	25-27	4	Town of Greater Napanee	Fredericksburgh	Surface	East	19.02	2468
October 31 - November 5	Millspring - South Shore	24326	12-15	2	Town of Greater Napanee	Fredericksburgh	Surface	1	15.2	1520
November 27-29	McFaul - Atkins Rd.	60901	18-19	2	City of Belleville	Thurlow	Surface	1B	11.50	840
									73.47	6616

Table 9: Average biosolids quality for 2024

Metals	Maximum Acceptable Concentration (mg/kg)	2024 Average
As	170	5.2
Cd	34	1.1
Co	340	8.0
Cr	2800	25.2
Cu	1700	655.1
Hg	11	0.50
Mo	94	11.9
Ni	420	26.5
Pb	1100	26.5
Se	34	4.7
Zn	4200	1098.7
E. Coli	**Maximum Acceptable Concentration (CFU/g)**	
	2,000,000	40,757
Liquid Biosolids		
Total P (mg/L)		1418
Ammonia+Ammonium (mg/L)		657
Nitrate+Nitrites (mg/L)		0.76
TKN (mg/L)		2421
Potassium (mg/L)		60
Solids (mg/L)		45363