



2025 Watershed Overview of Wastewater Treatment Plant Performance

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Report Prepared by Simion Tolnai
Grand River Conservation Authority



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Acronyms and Abbreviations

ADF	Average daily flow
cBOD	Carbonaceous 5-day biochemical oxygen demand
CCP	Composite Correction Program
ECA	Environmental Compliance Approval (formerly called Certificate of Approval)
EPA	US Environmental Protection Agency
GRCA	Grand River Conservation Authority
I/I	Inflow/Infiltration
MECP	Ontario Ministry of the Environment, Conservation and Parks
NDF	Nominal Design Flow (listed in plant's ECA)
OCWA	Ontario Clean Water Agency
PWQO	Provincial Water Quality Objectives
TAN	Total ammonia nitrogen
TBOD	Total 5-day biochemical oxygen demand
TKN	Total Kjeldahl nitrogen
TP	Total phosphorus
TSS	Total suspended solids
UIA	Un-ionized ammonia
WMP	Water Management Plan
WWOP	Watershed-wide Wastewater Optimization Program
WWTP	Wastewater treatment plant

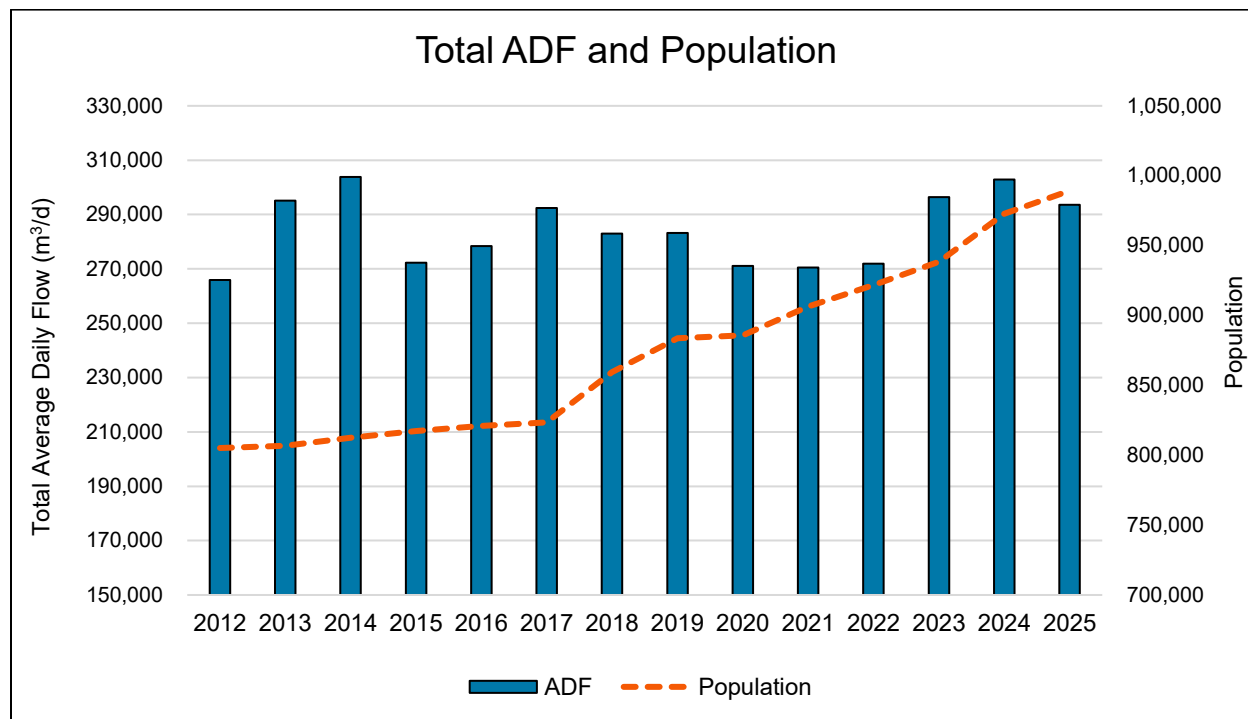
Executive Summary

Since 2010, the Grand River Conservation Authority (GRCA) has been working collaboratively with local partners and the Ministry of the Environment, Conservation and Parks (MECP) to implement a Watershed-wide Wastewater Optimization Program (WWOP). A key program activity is the preparation of an annual report on effluent quality and plant loading for treatment facilities discharging in the Grand River watershed. The first annual report was produced for data collected in 2012. Year-to-year variations are used to evaluate the success of the program and track wastewater treatment plant (WWTP) impacts on the Grand River. Available performance and loading data for 28 of 30 public wastewater treatment plants were voluntarily reported for the 2025 operating year. This report summarizes treatment performance against voluntary effluent targets of total phosphorus (TP) and total ammonia nitrogen (TAN). In addition, data integrity, impacts on the Grand River, plant loading, and bypasses and overflows are summarized and compared to previous years.

Plant Flows

Figure 1 shows the total average day flow (ADF) for all the reporting plants from 2012 to 2025. Additionally, the reported serviced population for each year is also shown on the secondary axis, represented by an orange dashed line on the graph. From 2012 to 2025, the reported population increased by 23% (or approximately 1.8% per year), rising from about 805,200 in 2012 to 989,200 in 2025. Over the same period, total plant flows increased by 10% (or about 1% per year). In addition to community growth, total plant flow is also influenced by variations in precipitation.

Figure 1: Total reported WWTP average daily flow and population from 2012 to 2025



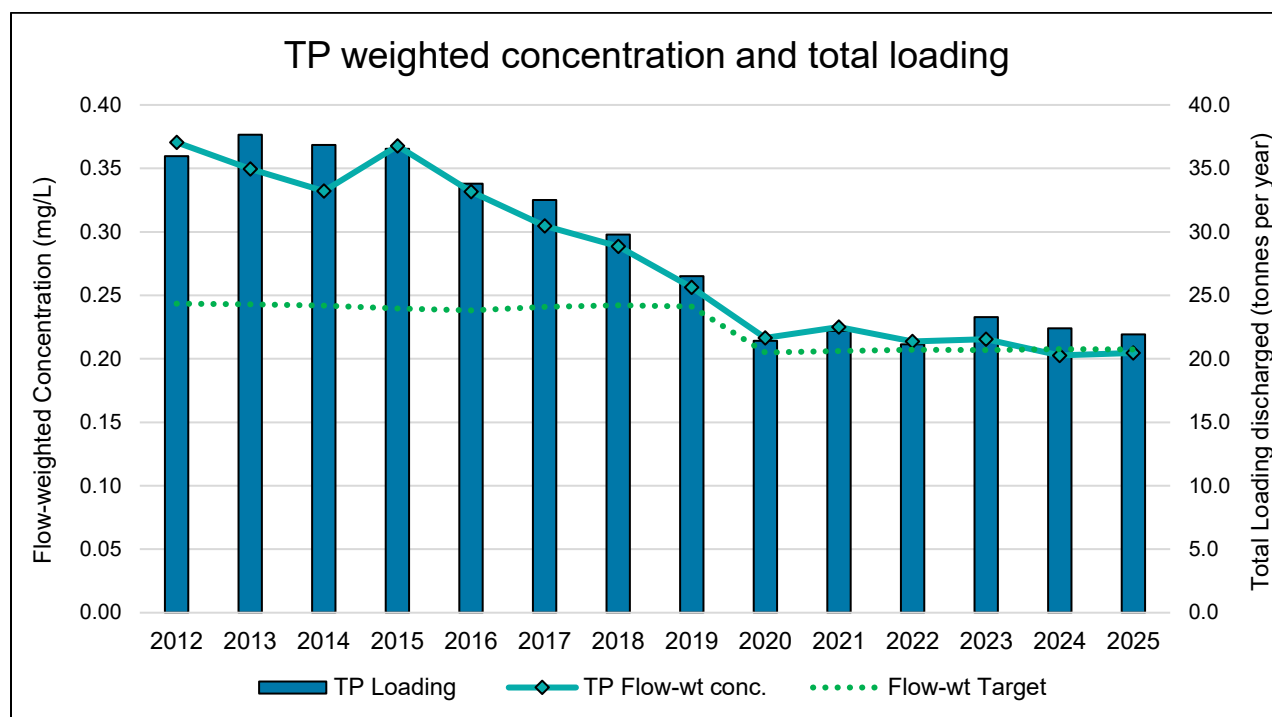
Treatment Performance

Figure 2 and Figure 3 show the final effluent TP and TAN flow-weighted average concentrations and the total loading from 2012 to 2025. The dotted line in Figure 2 represents the watershed-wide flow-weighted concentration target for TP, which is calculated based on each plant's average daily flow (ADF) multiplied by the corresponding TP target with the sum of these values then divided by the total ADF. This target can change year over year as the annual ADF changes.

With respect to the TP concentrations and loads in Figure 2, the following observations can be made:

- From 2024 to 2025, the TP flow-weighted concentration remained similar, at 0.20 mg/L, while the TP load decreased from 22.4 to 21.9 tonnes,
- From 2012 to 2025, the TP flow-weighted concentration decreased from 0.37 to 0.20 mg/L and the TP load from 36.0 to 21.9 tonnes,
- In 2025, for the second consecutive year since the program began summarizing data in 2012, the flow-weighted concentration fell below the watershed-wide target.

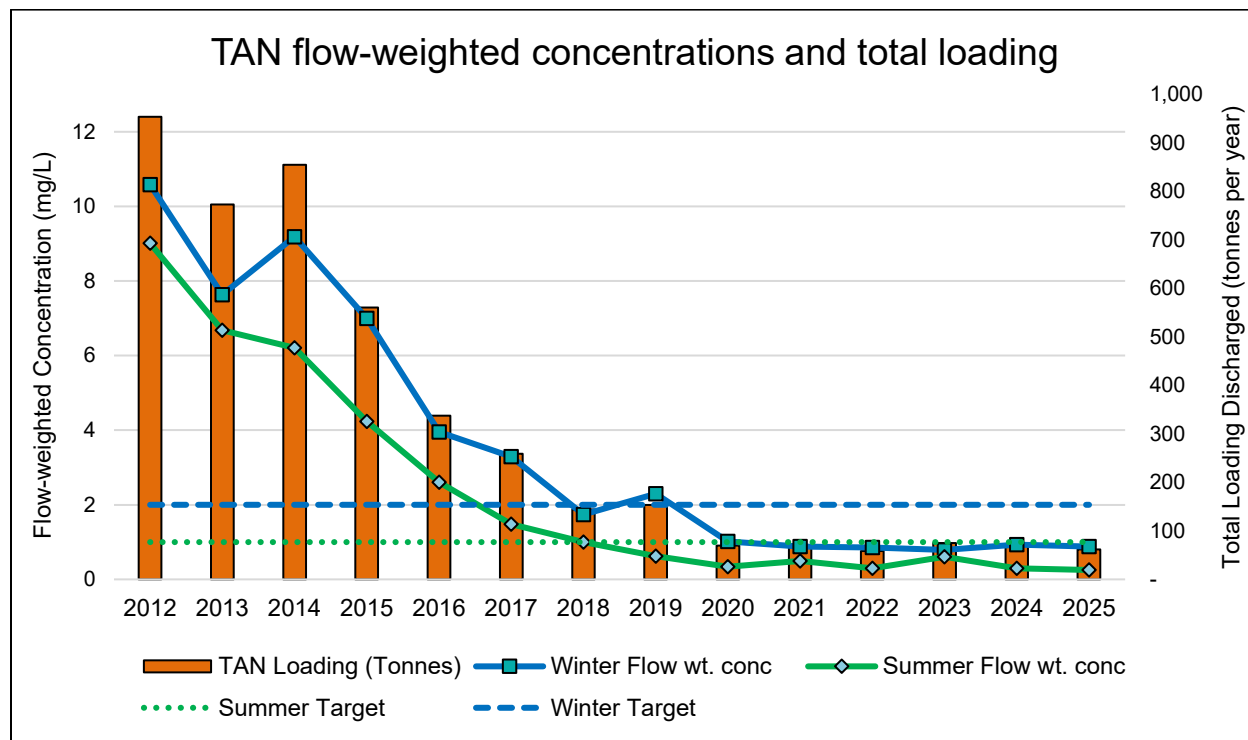
Figure 2: Flow-weighted effluent TP concentrations and total loading



With respect to Figure 3 showing the TAN loads and concentrations, the following notes are observed:

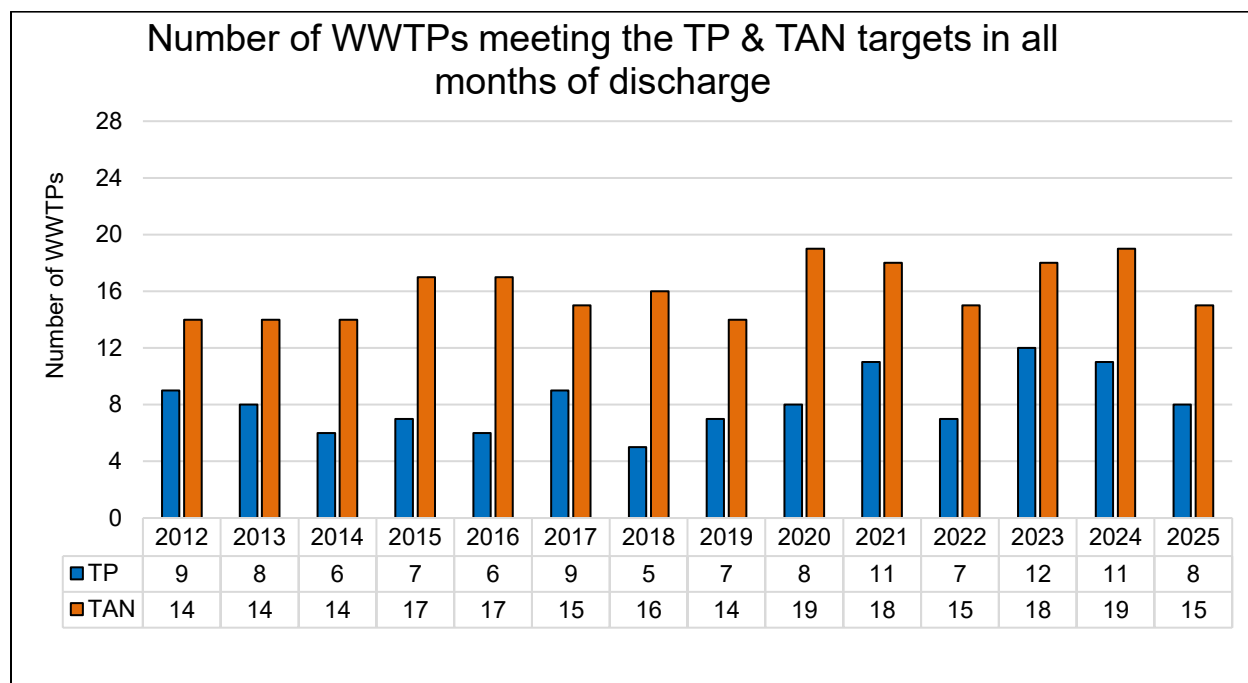
- From 2024 to 2025, the summer TAN flow-weighted concentration remained stable at 0.3 mg/L, while the winter TAN flow-weighted concentration also remained stable at 0.9 mg/L. TAN total loading decreased from 69 tonnes in the previous year to 62 tonnes.
- From 2012 to 2025, the overall total TAN flow-weighted concentration decreased from 9.8 to 0.6 mg/L and the total loading from 954 to 62 tonnes.

Figure 3: Flow-weighted summer and winter effluent TAN concentrations and total loading



The TP flow-weighted concentration in Figure 2 shows that at the watershed scale, treated wastewater effluent has been steadily improving and is now meeting the GRCA voluntary target. Conversely, Figure 4 below shows the total number of plants that have met the GRCA voluntary targets in all months of the year, which shows that over the past three years, fewer plants are consistently achieving the GRCA voluntary targets for TP (blue bars in Figure 4). This finding suggests that some of the larger plants may be over-achieving and the WWOP still has work to do to ensure more plants are consistently meeting those voluntary effluent targets.

Figure 4: Number of plants meeting TP and TAN targets in all months of discharge (2012 to 2025)



Overall, both TP and TAN concentrations and loadings decreased steadily from 2012 to 2020 and have plateaued from 2020 to 2025.

Data Integrity Checks

A sludge accountability analysis compares the annual amount of sludge reported by a mechanical plant to the amount of sludge projected based on plant loadings and removal. Conducting this analysis can help to determine if monitoring is truly representative. In 2025, sludge accountability was reported for all 24 mechanical plants in the watershed. For 15 of the plants, the sludge accountability closed within $\pm 15\%$ compared to 14 plants in 2024.

A water balance analysis compares the annual amount of measured net precipitation on the surface area of a lagoon system to the annual amount of projected net precipitation using lagoon level measurements, total influent, and total effluent flows of a lagoon system. This analysis can help to determine if the flow measurement devices at a lagoon are accurate. In 2025, water balances were completed for all four lagoon systems in the watershed, with two closing within $\pm 15\%$ compared to three plants in 2024.

Grand River Impacts

In 2025, the volume of treated effluent from wastewater treatment plants discharging in the Grand River watershed accounted for 5.0% of the flow in river on an annual average basis. Under low-flow conditions observed in August the proportion increased to 12.7%. These

proportions vary on a year-to-year basis as they are largely a function of precipitation and weather in the watershed in any given year.

The report also summarizes the discharge of total phosphorus in the effluent from wastewater treatment plants to the total phosphorus load discharged at York, the furthest downstream monitoring station on the Gran River. In 2025, the total TP load at York was 284 tonnes of which 21.9 tonnes or 8% was contributed by treated effluent.

Plant Loading

Each plant reports annual average concentrations for four influent constituents: Total 5-day biochemical oxygen demand (TBOD), total suspended solids (TSS), TP and total Kjeldahl nitrogen (TKN). Table 1 summarizes 2025 median values for these averages as well as the medians from previous years and typical values reported in the technical literature. These data give an estimate of typical concentrations for the plants in the Grand River watershed.

Table 1: Summary of 2012 to 2025 Watershed WWTP Raw Influent Concentrations

Raw Influent concentrations	Watershed 2012-2024 (min-max)	Watershed Median 2025	Range of typical concentrations*
TBOD (mg/L)	193 to 251	231	120 to 380
TSS (mg/L)	204 to 264	245	120 to 370
TP (mg/L)	5 to 6	6	4 to 12
TKN (mg/L)	38 to 47	46	20 to 45

* (Metcalf & Eddy, 2003)

Table 2 summarizes key process loading metrics for 2025 as well as typical values and the range of median reported values from 2012 to 2024. Per capita loadings are influenced by sampling, proportion of industry to residential loading and population estimates. The results in the tables enable plant owners and operators to compare loadings at their facilities to those at other plants in the watershed, to determine the impact of industrial discharges and highlight concerns with unrepresentative sampling of raw influent.

Table 2: Summary of 2012 to 2025 Watershed WWTP Loading Metrics

Loading Measure	Watershed Median 2012-2024 (min-max)	Watershed Median 2025	Typical Value**
Per capita flow (L/person/day)	280 to 351	290	350 to 500
ADF as % of Nominal Design	55% to 62%	58%	N/A
Peak day: Annual average flow	2.20 to 3.54	3.10	2.5 to 4.0
Per capita TBOD* loading (g/person/day)	63 to 77	71.7	80
Per capita TSS loading (g/person/day)	69 to 93	80.8	90
Per capita TKN loading (g/person/day)	13 to 14	13.5	13
Per Capita TP loading (g/person/day)	1.6 to 2.0	1.8	2.1
Raw TSS:TBOD ratio	1.01 to 1.25	1.09	0.8 to 1.2
Raw TKN:TBOD ratio	0.17 to 0.23	0.19	0.1 to 0.2

*Some previously reported data was based on cBOD and may be less reliable. Research indicates that cBOD measurements of raw wastewater underestimate organic loading by 20 to 40%.

** (US EPA, 1989)

Year-to-year variations in per capita flow, the average day flow as a percentage of the design flow, and the ratio of the peak day to average day flow from Table 2 are largely due to differences in inflow and infiltration (I/I) related to precipitation.

Bypasses and Overflows

Bypasses and overflows are terms used to describe events that result in untreated or partially treated sewage reaching natural water bodies (Grand River Municipal Water Managers Working Group, 2009). Bypasses occur when parts of a treatment process are bypassed and partially treated wastewater discharges to the environment via the WWTP effluent outfall. Overflows occur when sewage enters the environment at a location other than the effluent outfall.

Bypasses/overflows can be classified as low, moderate, or high risk according to the level of risk to downstream users. Overall, the total number of bypasses and overflows increased slightly

from 46 events in 2024 to 50 events in 2025. However, the total bypass volume decreased substantially, from 471,096 cubic meters in 2024 to 166,139 cubic meters in 2025. Several low and moderate-risk bypasses recorded in 2025 occurred in March, April, and December and were associated with weather conditions that generated high peak-day flows to the WWTP.

In June 2025, the GRWWOP launched a high-flow inflow/infiltration (I/I) survey to gather information from municipalities on the tools and procedures used to manage high-flow events. These included sampling and testing, operational procedures, staff coverage, funding and plant capability such as side-stream management, step-feed processes, bypass systems, equalization tanks, and disinfection capabilities. Responses were received from 12 of the 30 WWTPs discharging effluent to the Grand River or its tributaries, representing a 40% response rate. While the survey provided valuable insight into high-flow preparedness at participating facilities, the relatively low response rate limits the extent to which the results can be considered representative of conditions across the watershed. A short summary of the survey findings is presented in the High Flow Preparedness Study subsection of the Bypasses and Overflows section of this report (Tolnai, Irvine, & Matthews, High Flow Preparedness Study: Grand River Watershed Wastewater Treatment Plants, 2025). Key findings from the High-Flow Inflow and Infiltration Survey include:

- 75% of the facilities have plans to address I/I issues through process optimization, capital expenditure, collection system I/I studies and ongoing implementation of study findings.
- 92% of the respondents indicated adequate funding and staffing to support high flow management.
- Most plants reported achieving the effluent quality requirements during high flow events and 42% of the plants carry out additional sampling and testing during high flows.
- The level of concern regarding high-flow events among participants was high, rating their concern as 7 out of 10.
- The level of preparedness expressed by survey participants was higher, with a rating of 8 out of 10, indicating that although they are concerned, most feel prepared to manage high-flow events.

2025 Optimization Activities and Studies

In addition to annual reporting, studies were completed in 2025 aimed at improving plant performance and monitoring plant impacts on the Grand River. The GRCA WWOP continued to support watershed-wide optimization efforts in 2025 through reporting on municipal initiatives, surface water quality monitoring, and high-flow preparedness activities. Surface water monitoring conducted by the Region of Waterloo and a 2025 study by LGL Limited identified measurable impacts from some larger WWTPs, particularly during low-flow periods, with elevated TP and TAN concentrations observed downstream of major facilities.

Municipal optimization initiatives included capacity and process assessments at facilities in Haldimand and Oxford Counties, while a high-flow inflow and infiltration survey provided insight into municipal preparedness, indicating that most responding facilities have strategies, resources, and operational practices in place to manage high-flow events.

Overall

Effluent quality in the Grand River watershed has improved significantly since 2012, driven by facility upgrades and ongoing optimization. These efforts have led to major reductions in total phosphorus (TP) and total ammonia nitrogen (TAN) discharged to the river.

While the Grand River watershed population has continued to grow, treatment performance has steadily improved. Although 2023 saw a rise in both TP and TAN loadings, 2024 and 2025 showed a return to lower flow-weighted concentrations and loadings. Between 2012 and 2025, flow-weighted TP concentrations fell from 0.37 to 0.20 mg/L, and TAN from 9.8 to 0.6 mg/L.

Annual reporting has been key to the success of the watershed-wide wastewater optimization program. Tools such as per capita flows, sludge accountability, and flow-weighted averaging, highlighted in this report, may benefit other organizations managing multiple treatment plants.

The program's success relies on the voluntary engagement of operators and managers. WWOP remains committed to supporting this community through knowledge sharing and collaboration, helping ensure a healthy, sustainable watershed for future generations.

Introduction

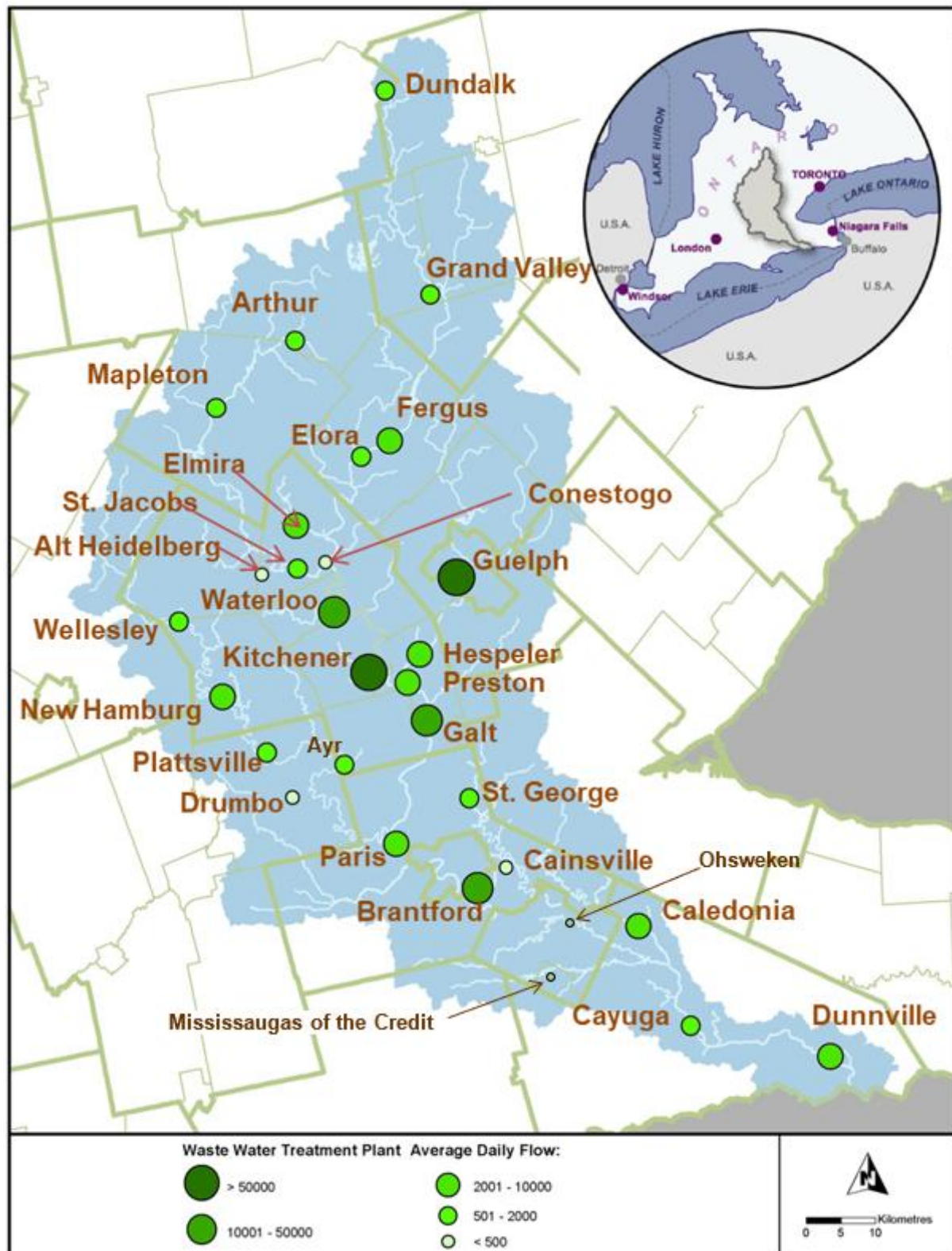
The Grand River watershed has a population close to 1 million that is expected to reach 1.5 million by 2051 (GRCA, 2024). Based on data reported to the Grand River Conservation Authority (GRCA), wastewater from a total population of about 989,200 is treated by 30 municipal and First Nations-owned facilities in the watershed as shown in Figure 5. The remainder of the population is serviced by other means such as private septic systems. Significant population growth will result in more wastewater treatment plant (WWTP) effluent being discharged into the Grand River and its tributaries.

The organizations listed below are responsible for their operation:

- Township of Southgate
- Town of Grand Valley
- Township of Mapleton
- Township of Wellington North
- Township of Centre Wellington
- Region of Waterloo
- City of Guelph
- Oxford County
- County of Brant
- City of Brantford
- Haldimand County
- Six Nations of the Grand River
- Mississaugas of the Credit First Nation

The following report describes the background and objectives of the Grand River Watershed-wide Wastewater Optimization Program (WWOP) and provides a summary of performance data from 2012 to 2025 voluntarily reported by the program participants.

Figure 5: Map Showing Locations of WWTPs in the Watershed



Background

The Grand River, located in southwestern Ontario, traverses approximately 310 kilometres from its source near Dundalk to its point of discharge into Lake Erie at Port Maitland. The river and its tributaries serve as drinking water supply for four communities in the watershed in addition to providing other uses including a world-renowned brown trout tail-water fishery, active and passive recreation opportunities and productive agricultural lands (Anderson, Cooke, Rae, Mungar, & Chapman, 2011). Because of its cultural heritage and outstanding recreational opportunities, the Grand River and its major tributaries (Nith, Conestogo, Speed and Eramosa) were designated as a Canadian Heritage River in 1994 (Canadian Heritage Rivers System, 2017). 30 wastewater treatment facilities discharge treated effluent to the Grand or its tributaries.

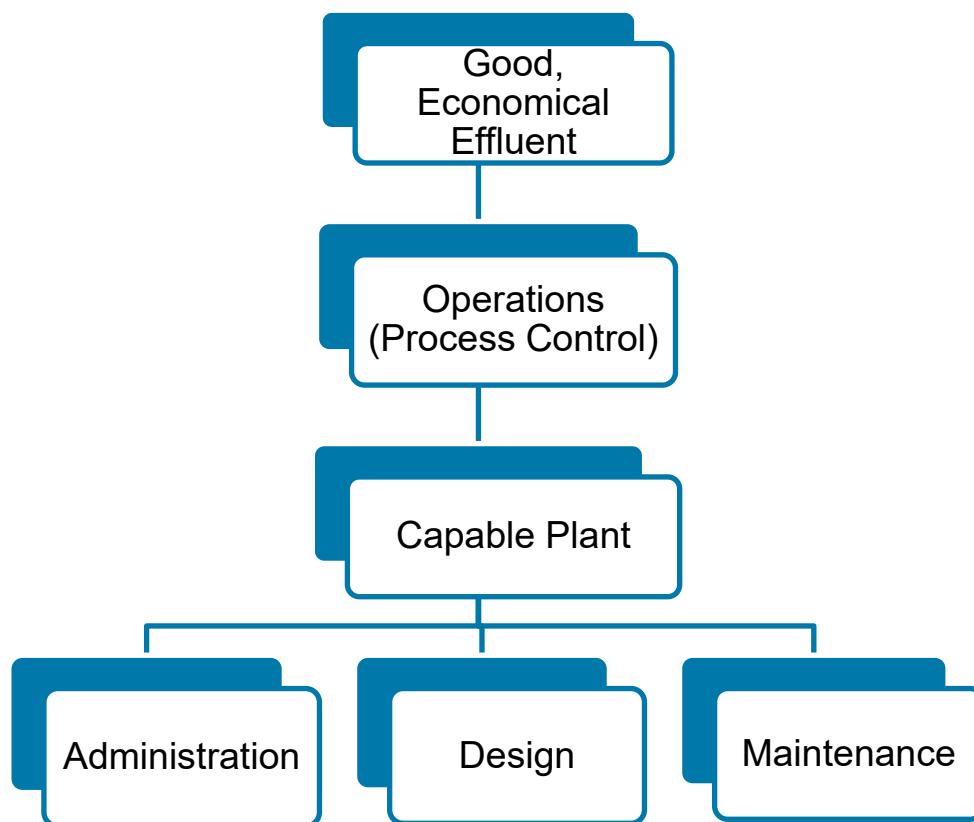
Since 2010, GRCA has been working collaboratively with municipal and First Nations partners and the Ministry of the Environment, Conservation and Parks (MECP) to develop a Watershed-wide Wastewater Optimization Program (WWOP). The program supports maintaining and improving water quality in the Grand River, as identified in the Grand River Water Management Plan (WMP) (GRCA WMP Project Team, 2014). The program is voluntary, focused on skills development, knowledge transfer and capacity building within the watershed. The objectives of the program are to:

- Improve water quality in the Grand River and its tributaries as a direct result of improving wastewater treatment performance,
- Improve the water quality of Lake Erie,
- Tap the full potential of existing wastewater infrastructure and promote excellence in infrastructure management,
- Reduce vulnerability to climate change,
- Build and strengthen partnerships for wastewater optimization,
- Enhance partner capability and motivation,
- Leverage and learn from existing area-wide optimization programs in the United States (US), and
- Demonstrate strategies that can serve as a model for other areas of Ontario.

WWOP promotes optimization across the watershed by encouraging the adoption of the Composite Correction Program (CCP). The US Environmental Protection Agency (EPA) developed the CCP as a structured approach to identify and systematically address performance limitations to achieve a desired effluent quality (US EPA, 1989). The CCP was adapted for Ontario and documented in the handbook, “The Ontario Composite Correction Program Manual for Optimization of Sewage Treatment Plants” (PAI & WTC, 1996). Additionally, the WMP suggests that adopting the CCP will help to reduce the overall loading of total phosphorus (TP) to the Grand River and, ultimately, to Lake Erie.

The CCP is based on the model shown in Figure 6. Good administration, design, and maintenance establish a “capable plant” and, by applying good process control, operators achieve a “good, economical” effluent.

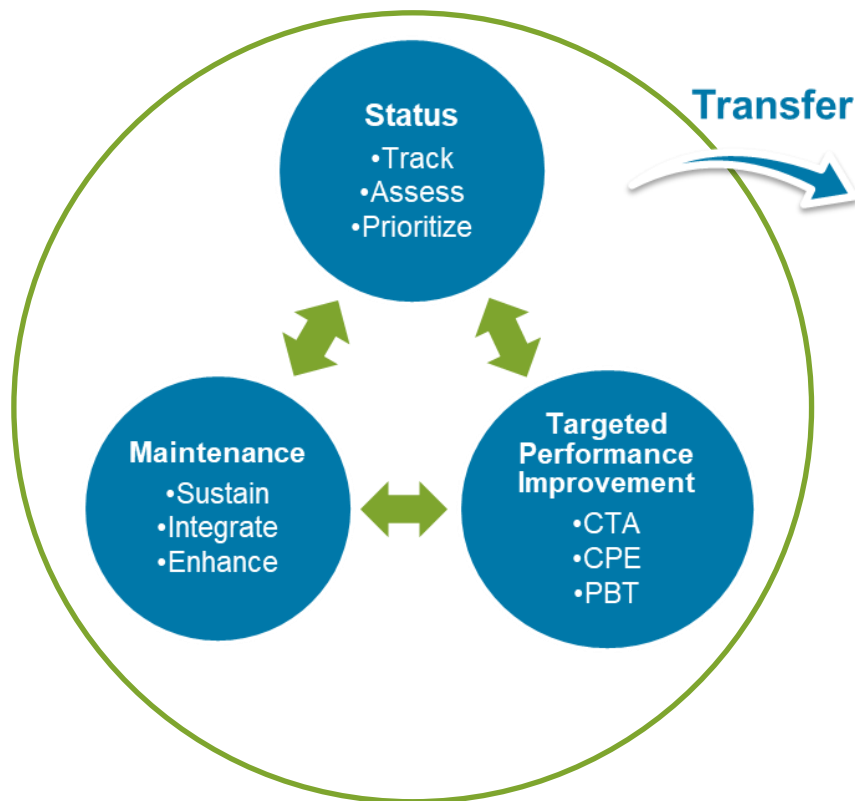
Figure 6: Composite Correction Program Performance Pyramid



The CCP is a two-step approach. The first step, a Comprehensive Performance Evaluation, evaluates and identifies performance limiting factors in the areas of administration, design, maintenance and operations of a wastewater treatment plant. If applicable, in Step 2 (Comprehensive Technical Assistance) a facilitator works with plant operators and managers to address and resolve any factors identified in Step 1. The watershed municipalities of Guelph, Haldimand County and Brantford have applied the CCP approach and have demonstrated its benefits, including improved effluent quality and re-rated capacity.

This approach has proven to be successful but is resource intensive when applied on a plant-by-plant basis. To address this challenge, an area-wide approach (as shown in Figure 7) was adopted based on the successful strategy for optimizing drinking water treatment systems in the US. Major components include Status, Targeted Performance Improvement, and Maintenance. The model utilizes a proactive, continuous improvement approach to improve effluent quality.

Figure 7: Area-Wide Optimization Model



Lake Erie Action Plan

Wastewater treatment plant optimization and area-wide optimization programs are highlighted as actions in the Canada-Ontario Lake Erie Action Plan to reduce phosphorous loadings. (Canada-Ontario Agreement Partners, 2018)

A key activity under the Status Component is plant performance monitoring, used to demonstrate the success of the program, track changes over time and identify plants for further optimization work. Targeted Performance Improvement establishes voluntary performance targets and applies tools for achieving them. This component can include performance-based training, technical assistance, and other activities to develop and transfer skills. The purpose of the Maintenance component is to sustain and grow the program. As part of the maintenance component, a recognition program was developed to encourage participation and to acknowledge plants that:

- Participate in the WWOP,
- Apply CCP concepts,
- Meet all the effluent compliance limits stated in their Environmental Compliance Approval (ECA),

- Adopt and achieve voluntary effluent quality performance targets,
- Participate in enhanced annual reporting (per capita loading, sludge accountability, etc.) and,
- Conduct annual sludge accountability analysis or water balance for lagoon systems.

The recognition awards based on 2025 plant data will be presented in the fall of 2026.

Additionally, the WWOP area-wide model includes a Transfer element to share and encourage other jurisdictions to adopt this approach.

Data Collection Methodology

Voluntary performance reporting across the watershed was initiated through several workshops that were held in 2010 and 2011 that brought wastewater operators, supervisors and managers together from communities within the watershed. These workshops provided information on optimization using the CCP and training on some of the tools used to evaluate WWTP performance. Workshop participants, with the assistance of peer facilitators, were encouraged to carry out the following performance calculations using their own plant data for 2012:

- Annual Average Daily Flow (ADF) as a percentage of Nominal Design Flow (NDF),
- Per capita influent flow,
- Ratio of peak day flow to ADF,
- Per capita TBOD, total suspended solids (TSS), and total Kjeldahl nitrogen (TKN) loading to the plant, and
- The ratios of TSS to TBOD and TKN to TBOD in the raw influent.

Additional workshops were held throughout 2012 to 2025 to review these performance metrics. Participants across the watershed were encouraged to calculate these metrics on an annual basis, report the information back to the GRCA, as well as include them in performance reports to the MECP.

In addition to the metrics listed above, plant staff voluntarily submitted plant performance data including effluent TP and TAN concentrations. An Excel spreadsheet template was provided to plant owners and operators for data submission.

This report summarizes 2025 plant data and compares it to 2012 to 2024 data.

Wastewater Treatment Plant Reporting and Performance

Data Reporting

For 2025, 28 of the 30 WWTPs voluntarily reported data to the GRCA using an Excel spreadsheet template. In presenting summaries of the data in the following sections, the plants are ranked from largest to smallest in terms of flow treated.

Final Effluent Quality

Total Phosphorus (TP)

TP is being targeted for improvement in the WWOP since “a high concentration of phosphorus in most rivers and streams in the Grand River watershed has long been recognized as an issue as it is the primary nutrient that promotes nuisance growth of aquatic plants and algae in the rivers” (GRCA WMP Project Team, 2014). Over the past decade, zones of low oxygen, because of excessive algal growth, have been increasing in Lake Erie causing significant impact on the lake’s environment and Canadian economy (Canada-Ontario Agreement Partners, 2018). In early 2018, the Canada-Ontario Lake Erie Action Plan on achieving phosphorus loading reductions in Lake Erie from Canadian sources was finalized. According to 2003 to 2013 data, “Canadian sources contribute 54 percent of the total phosphorus load to the eastern basin, with the majority of this coming from one tributary - the Grand River” (Canada-Ontario Agreement Partners, 2018). One of the key findings from the first five years of implementing the Lake Erie Action Plan (LEAP) is that sanitary sewage flows and the associated phosphorus loads to wastewater treatment plants are expected to continue increasing as the population grows. Although these sources are currently well managed, maintaining high treatment performance will require ongoing investment, careful operational management, and continued optimization, particularly in high-growth and major urban communities (Canada-Ontario Lake Erie Action Plan, 2024)

Total Ammonia Nitrogen (TAN)

Nitrate and ammonia can have direct toxic effects on aquatic life at high concentrations and TAN acts as an oxygen scavenger that reduces the dissolved oxygen (DO) concentration in water. TAN is being targeted under the WWOP since “high levels of un-ionized ammonia occur in the Grand River watershed in reaches downstream of wastewater treatment plants” (GRCA WMP Project Team, 2014). Un-ionized ammonia is the toxic component of total ammonia nitrogen. As the pH and temperature increase, the amount of un-ionized ammonia increases as well.

Voluntary Effluent Quality Performance Targets

The Grand River Water Management Plan recommends that “watershed municipalities who own WWTPs adopt voluntary effluent quality performance targets that go beyond the compliance objectives as stated in ECAs” to achieve the goal of improved water quality in the watershed (GRCA WMP Project Team, 2014). The proposed voluntary effluent targets are set out in Table 3. The TP targets were established based on demonstrated performance across the province and within the watershed for various levels of treatment (e.g., separate targets were established for secondary and tertiary treatment). Since nitrification is less effective in colder temperatures, there are different targets for TAN in “summer” (May to October) and “winter” (November to April) periods.

Table 3: Voluntary Effluent Quality Performance Targets for TP and TAN

Treatment Type	TP Target (monthly average mg/L)	Summer¹ TAN Target (monthly average mg-N/L)	Winter¹ TAN Target (monthly average mg-N/L)
Lagoon	0.30	Meet ECA objectives, if any	Meet ECA objectives, if any
Tertiary Lagoon	0.15	Meet ECA objectives, if any	Meet ECA objectives, if any
Secondary	0.30	1.0	2.0
Tertiary	0.15	1.0	2.0

Notes: ¹“summer” is May to October, “winter” is November to April

Table 4 shows the percentage of months the TP and TAN targets were achieved in 2025 for each plant. The Table 4 cells are colour-coded with, green cells showing that the targets were achieved in more than 90% of the months of discharge, yellow cells showing that the targets were achieved between 50% to 90% of the months of discharge and the red cells showing that the targets were met in less than 50% of the months of discharge. Blank cells are plants with no TAN target. While several wastewater treatment plants consistently achieved the voluntary TP and TAN targets over multiple years, others experienced year-to-year variability in performance.

Table 4: Percentage of Months Plants Met TP and TAN Targets in 2025

WWTP	TP	TAN
Kitchener	83%	100%
Brantford	100%	100%
Guelph	100%	100%
Waterloo	67%	100%
Galt	0%	75%
Preston	75%	100%
Hespeler	33%	67%
Fergus	25%	42%
Elmira	92%	100%
Paris	58%	100%
Caledonia	100%	100%
Dunnville	100%	100%
New Hamburg	75%	100%
Elora	25%	83%
Ayr	83%	92%
Arthur	57%	100%
Dundalk	75%	No target
Grand Valley	100%	100%
St. George	42%	92%
St. Jacobs	75%	92%
Cayuga	100%	92%
Wellesley	8%	100%
Mapleton	80%	60%
Plattsville	100%	67%
Drumbo	67%	100%
Cainsville	100%	No target
Conestogo	83%	83%
Heidelberg	67%	100%

Voluntary Targets

A study modelling future river water quality conditions suggests that water quality will incrementally improve with the adoption of effluent quality performance targets achieved through enhanced process control techniques as set out in the CCP.” (Project Team, 2014)

Figure 8 shows the proportion of months that all plants combined met the TP and TAN targets from 2012 to 2025. A percentage is used because some plants do not discharge year-round. Additionally, there are two plants that do not have a target for TAN. As presented in Figure 8, the TP targets were achieved 62% in 2012 and 70% in 2025 respectively. The previous year, values were 75% for TP. The achievement of TAN targets has improved 13% since the start of the program from 75% in 2012 to 85% in 2025. In 2024, the value was 87%. The ultimate program goal is to meet the voluntary targets 100% of the time.

Figure 8: Percentage of months meeting the voluntary targets for all plants combined from 2012 to 2025

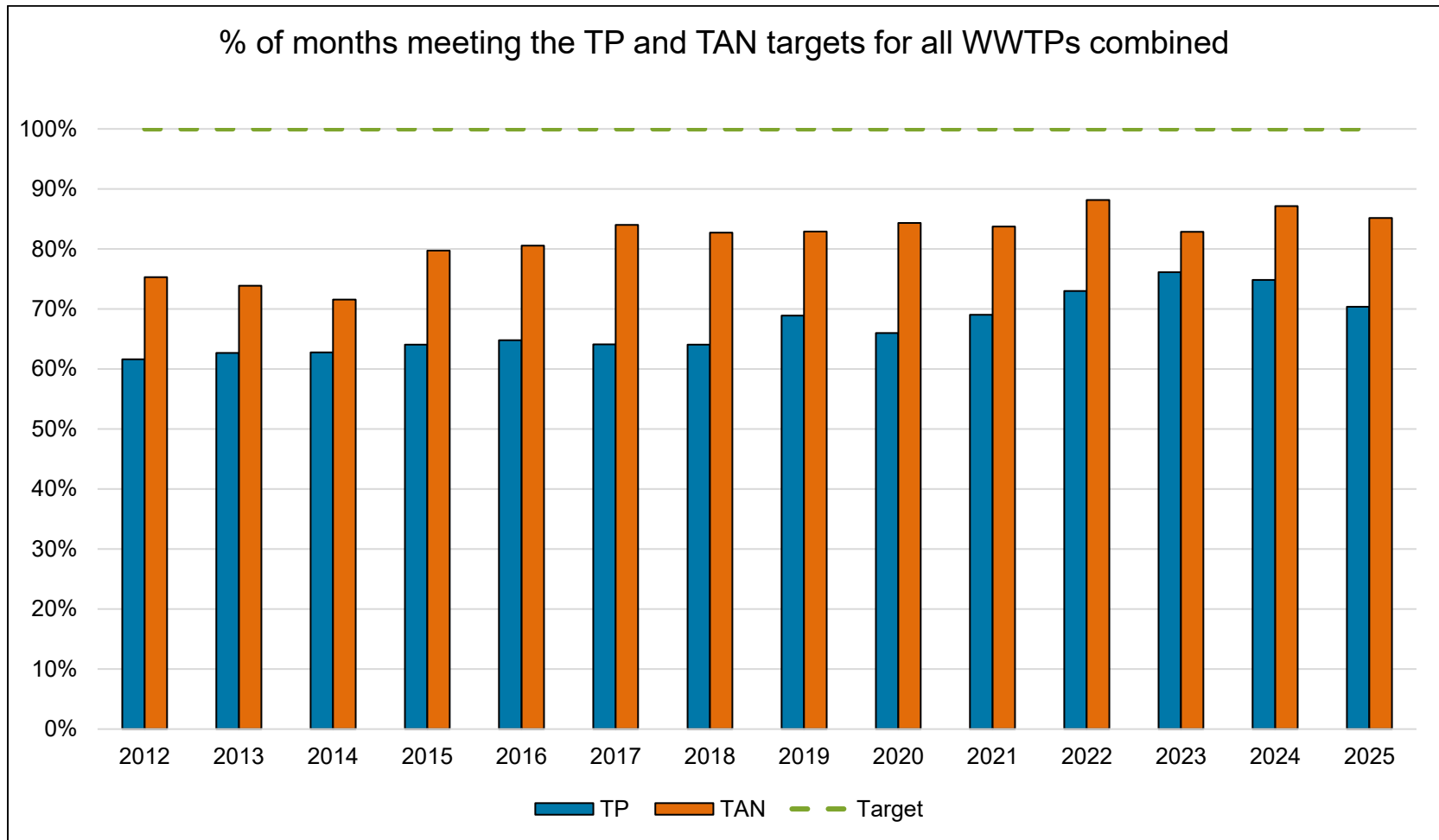


Table 5 shows the annual average effluent TP loadings from all WWTPs combined for the years 2012 to 2025, as well as flow-weighted TP concentrations and targets. The TP loading was calculated based on the product of each plant's monthly average flow and its corresponding monthly average effluent TP concentration. The flow-weighted concentrations were calculated by dividing the total combined loading by the total average flow. The watershed-wide flow-weighted concentration target for TP is calculated by multiplying each plant's average daily flow (ADF) by its corresponding TP concentration target, summing these values, and dividing by the total ADF. This target may vary from year to year as annual ADF changes.

Table 5: Wastewater Effluent TP Loading and Flow-Weighted Concentration

Year	TP Loading (tonne)	TP Flow-Weighted Concentration (mg/L)	TP Flow-Weighted Target (mg/L)
2012	36.0	0.37	0.24
2013	37.7	0.35	0.24
2014	36.8	0.33	0.24
2015	36.5	0.37	0.24
2016	33.8	0.33	0.24
2017	32.5	0.30	0.24
2018	29.8	0.29	0.24
2019	26.5	0.26	0.24
2020	21.4	0.22	0.20
2021	22.2	0.22	0.21
2022	21.1	0.21	0.21
2023	23.3	0.22	0.21
2024	22.4	0.20	0.21
2025	21.9	0.20	0.21

In 2025, total phosphorus (TP) loading decreased by 2% compared to 2024. As shown in Table 5, 2024 marked the first time since the program began summarizing data in 2012 that the flow-weighted concentration fell below the target, and this performance was maintained in 2025. However, significant opportunities for further improvement remain, as several medium and large-sized wastewater treatment plants are still not meeting their individual targets.

The total annual loading of wastewater effluent TAN discharged to surface water and corresponding flow-weighted concentrations are documented in Table 6, which shows the TAN loadings separated into summer and winter periods.

From 2024 to 2025, summer total ammonia nitrogen (TAN) loadings decreased by 19%, largely due to improved performance at the Galt, Guelph, Hespeler, and Dunnville wastewater treatment plants (WWTPs). Winter TAN loadings also improved, decreasing by 8% in 2025 compared to 2024. Since 2012, annual total TAN loadings have decreased by 94%, while flow-weighted TAN concentrations have also declined by 94%. As shown in Table 6, both the summer and winter flow-weighted concentrations are below the TAN targets of 1 mg/L for summer and 2 mg/L for winter, respectively.

Table 6: Wastewater Effluent TAN Loading and Flow-Weighted Concentrations to the Grand River

Year	TAN summer Loading (tonne)	TAN summer Conc.* (mg/L)	TAN summer Target Conc.* (mg/L)	TAN winter Loading (tonne)	TAN winter Conc.* (mg/L)	TAN winter Target Conc.* (mg/L)	TAN Annual Loading (tonne)	TAN Annual Conc.* (mg/L)
2012	417	9.0	1	534	10.6	2	951	9.8
2013	346	6.7	1	426	7.6	2	773	7.2
2014	343	6.2	1	512	9.2	2	855	7.7
2015	206	4.2	1	353	7.0	2	560	5.6
2016	124	2.6	1	223	4.0	2	347	3.3
2017	77	1.5	1	182	3.3	2	259	2.4
2018	49	1.0	1	97	1.7	2	146	1.4
2019	31	0.6	1	118	2.3	2	149	1.5
2020	15	0.3	1	54	1.0	2	70	0.7
2021	24	0.5	1	44	0.9	2	68	0.7
2022	14	0.3	1	44	0.9	2	58	0.6
2023	31	0.6	1	44	0.8	2	75	0.7
2024	16	0.3	1	53	0.9	2	69	0.6
2025	13	0.3	1	49	0.9	2	62	0.6

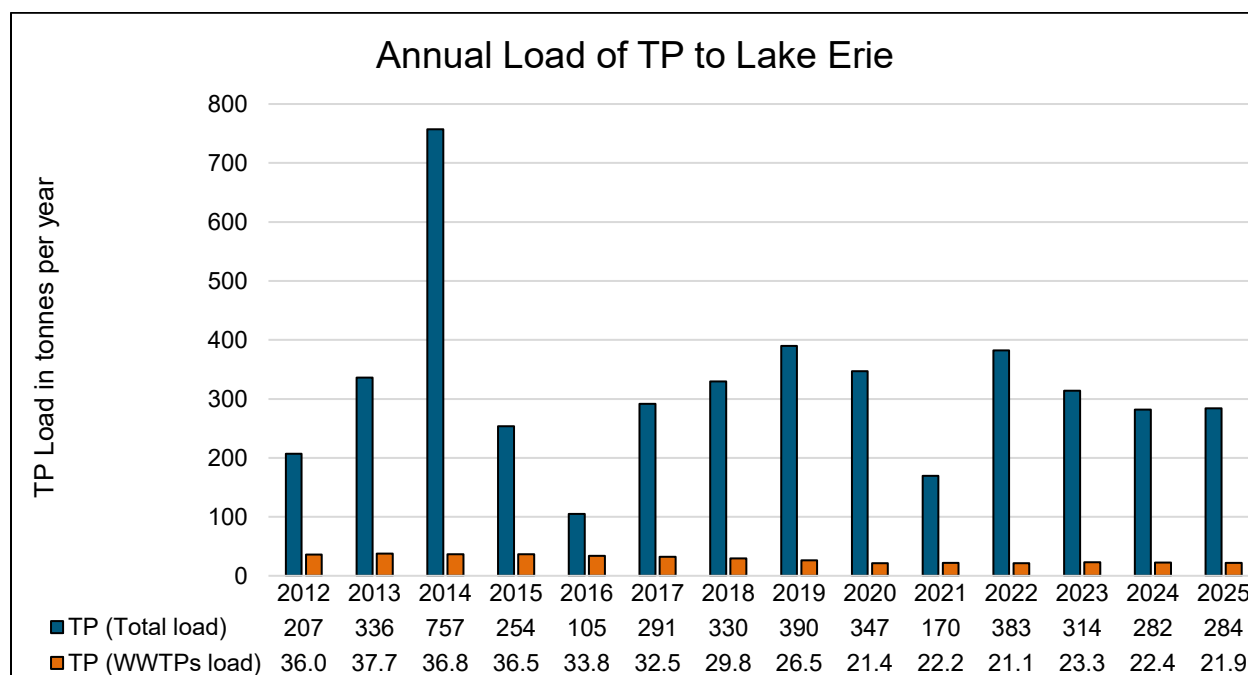
*all concentrations are flow-weighted average concentrations

Influence of WWTPs on the Grand River

TP Loading to Lake Erie from Grand River

Figure 9 shows the estimated TP loading to Lake Erie from the Grand River at York¹ (shown in blue) and the annual TP load from WWTPs (shown in orange) in the Grand River watershed, from 2012 to 2025. The annual load from the Grand River to Lake Erie is highly variable because of high flows and agricultural non-point sources of phosphorus in the spring which are closely linked to climate factors such as precipitation, the timing/volume of snow melt, etc.

Figure 9: Annual TP Load to Lake Erie at York



Over the 13-year period from 2012 to 2025, TP loading from York averaged 318 tonnes per year and ranged between 105 tonnes per year (in 2016) to 757 tonnes per year (in 2014). The TP load from WWTPs in the watershed ranged from 21.1 to 37.7 tonnes per year, averaging 29 tonnes per year, or about 11% of the Grand River's TP load to Lake Erie. In 2025, the total TP load to Lake Erie declined to 284 tonnes, slightly up compared to the previous year, with WWTPs contributing 21.9 tonnes.

Precipitation

Figure 10 shows total precipitation (rainfall and snowfall combined) at selected sites across the watershed. Overall, the Grand River watershed experienced slightly below-normal precipitation in 2025, although precipitation levels in the northern portion of the watershed were near the upper end of the typical range, which is based on the 5th and 95th percentile of historical observations over the past 50 years. Monthly precipitation was near normal in January and

¹ York, in Haldimand County, is the location of GRCA's southern-most flow monitoring station on the Grand River. Annual loadings from the Grand River to Lake Erie are calculated by Environment and Climate Change Canada and made available on-line through the [Environment Canada Data Catalogue](#)

above normal from February through May, as well as in December. However, precipitation was generally below normal from June through November across much of the watershed. This prolonged period of below-normal rainfall contributed to low-water conditions throughout the Grand River watershed during the latter half of the year. Although above-normal precipitation in December helped improve conditions, the year as a whole remained slightly drier than normal. Precipitation during January and February occurred primarily as snowfall, while precipitation from March through May was predominantly rainfall. Combined with snowmelt, these spring rainfall events generated elevated flows throughout the watershed, resulting in increased influent volumes at wastewater treatment plants. The associated peak flow conditions contributed to the majority of bypasses and overflows events reported in 2025. Over the preceding 6, 12, and 18-month periods, cumulative precipitation across the monitoring stations averaged 78%, 98%, and 92% of normal, respectively, indicating that 2025 conditions were drier than average despite near-normal precipitation over the longer 12-month period (Anderson, Fisher, & Taleban, 2025).

Figure 10: Total annual precipitation (in mm) at selected locations across the watershed.



Table 7 shows the relative influence of wastewater effluent on the Grand River by comparing the total volume of treated effluent in each of the years from 2012 to 2025 to the annual average river flow at York for the same years. In addition, Table 7 also contains a statement characterizing the precipitation in each year with respect to the long-term average precipitation in the watershed.

Table 7: WWTP Effluent Flow as a Percentage of Grand River Total Flow Over 2012 to 2025 Period

Year	Precipitation Characterization*	% Annual Average Flow	% August Average Flow
2012	Low end of typical	6.8%	13.9%
2013	Higher than typical in some areas	3.1%	5.4%
2014	Long-term average	2.6%	9.5%
2015	Low end of typical	5.0%	11.5%
2016	Long-term average	4.7%	9.0%
2017	Higher than typical	3.5%	7.3%
2018	Long-term average	3.6%	8.7%
2019	Higher than typical	3.6%	10.3%
2020	Long-term average	4.7%	11.7%
2021	Long-term average	5.1%	12.6%
2022	Low end of typical	5.5%	14.5%
2023	High end of typical	5.0%	7.1%
2024	Long-term average	5.3%	8.5%
2025	Low end of typical	5.0%	12.7%
Overall Average		4.5%	10.1%

* (Shifflett, 2012) (Shifflett, 2013) (Shifflett, 2014) (Shifflett, 2016) (Shifflett, 2017) (Shifflett, 2018) (Shifflett, 2019) (Shifflett, 2020) (Shifflett, 2021) (Shifflett, 2022) (Taleban, 2023), (Anderson et al., 2024), (Anderson et al., 2025).

The volume of treated effluent ranges from 2.6% to 6.8% of the total river flow on an annual average basis. By comparison, based on low-flow conditions observed in the month of August, under summer low-flow, the proportion of treated effluent ranges more widely from 5.4% to 14.5% of the river flow. This shows that the influence of WWTP flow on the river varies from year to year depending on precipitation.

Recent Studies

Since 2007, the Region of Waterloo has implemented a comprehensive surface water quality monitoring program upstream and downstream of its WWTPs. The program is designed to assess whether effluent discharges are affecting the Grand River and its tributaries, and to track

how those impacts may change over time. Monitoring results have shown that some Regional WWTPs, particularly the larger facilities, can have measurable impacts on water quality, especially during the summer and fall when river flows are typically low. A 2025 surface water chemistry study conducted by LGL Limited, identified elevated concentrations of TP and TAN at stations downstream of the three major WWTPs in the Region: Waterloo, Galt, and Hespeler (LGL Limited, 2026). Seasonal comparisons of upstream and downstream TP and TAN concentrations for these facilities are presented in Table 8. Key findings from 2025 include:

- Winter: Elevated TP and TAN concentrations were observed downstream of the Waterloo, Galt, and Hespeler WWTPs.
- Spring (high flows): No significant differences in TP or TAN concentrations were observed between upstream and downstream locations.
- Summer (low flows): Elevated TP concentrations were observed downstream of the Waterloo, Galt, and Hespeler WWTPs, while elevated TAN concentrations were noted downstream of Hespeler WWTP.
- Fall: TP concentrations were elevated downstream of the Waterloo, Galt, and Hespeler WWTPs, while elevated TAN concentrations were noted downstream of the Waterloo WWTP.
- Notably, monitoring results have shown no statistically significant difference in TP or TAN concentrations between the upstream reference condition and the downstream monitoring stations for the Kitchener WWTP.

Table 8: Summary of 2025 River Water Quality Monitoring Upstream and Downstream of Select WWTPs (adapted from LGL Limited (2026))

WWTP	TP	TAN
Waterloo	Winter: ↑	Winter: ↑
	Spring: ↔	Spring: ↔
	Summer: ↑	Summer: ↔
	Fall: ↑	Fall: ↑
Kitchener	Winter: ↔	Winter: ↔
	Spring: ↔	Spring: ↔
	Summer: ↔	Summer: ↔
	Fall: ↔	Fall: ↔
Galt	Winter: ↑	Winter: ↑
	Spring: ↔	Spring: ↔
	Summer: ↑	Summer: ↓
	Fall: ↑	Fall: ↔
Hespeler	Winter: ↑	Winter: ↑
	Spring: ↔	Spring: ↔
	Summer: ↑	Summer: ↑
	Fall: ↑	Fall: ↓

Note: ↔ indicates there is no statistically significant difference between upstream reference condition and downstream monitoring stations concentration, ↑ indicates significantly higher concentrations identified at monitoring stations downstream compared to upstream reference condition, ↓ indicates significantly lower concentrations found at stations identified compared to the upstream reference condition.

Bypasses and Overflows

Bypasses are a diversion of sewage around one or more treatment processes. The diverted sewage is combined with treated effluent at the point of discharge. Overflows are discharges to the environment from the WWTP at a location other than the effluent discharge point. Bypasses and overflows can be caused by equipment failure, power outage, weather-related events, etc. and can be classified as low, moderate, or high according to the level of risk to downstream users. In the Grand River watershed, one of the most sensitive downstream uses is the use of river water as a source for drinking water. The risk categories were developed based on the professional judgment of the Grand River Municipal Water Managers Working Group (Grand River Municipal Water Managers Working Group, 2009). For example, a bypass that has received secondary treatment and disinfection is considered low risk, whereas a bypass that has received secondary treatment without disinfection is classed as moderate risk. A high-risk bypass or overflow, for example, occurs when raw sewage is discharged to the environment without disinfection. Figure 11 presents the number of low, moderate, and high-risk bypasses from wastewater treatment plants (WWTPs) in the Grand River watershed between 2013 and

2025. Low-risk bypasses increased from 31 events in 2024 to 33 events in 2025. Moderate-risk bypasses also increased, from 5 events in 2024 to 7 events in 2025. High-risk bypasses remained unchanged at 10 events in 2025, consistent with the previous year. Figure 12 illustrates the total volume of bypasses in 2025, most of which were attributed to weather-related events that produced high peak day flows to the WWTPs.

Figure 11: Number of Low, Moderate, and High-Risk Bypasses from 2013 to 2025

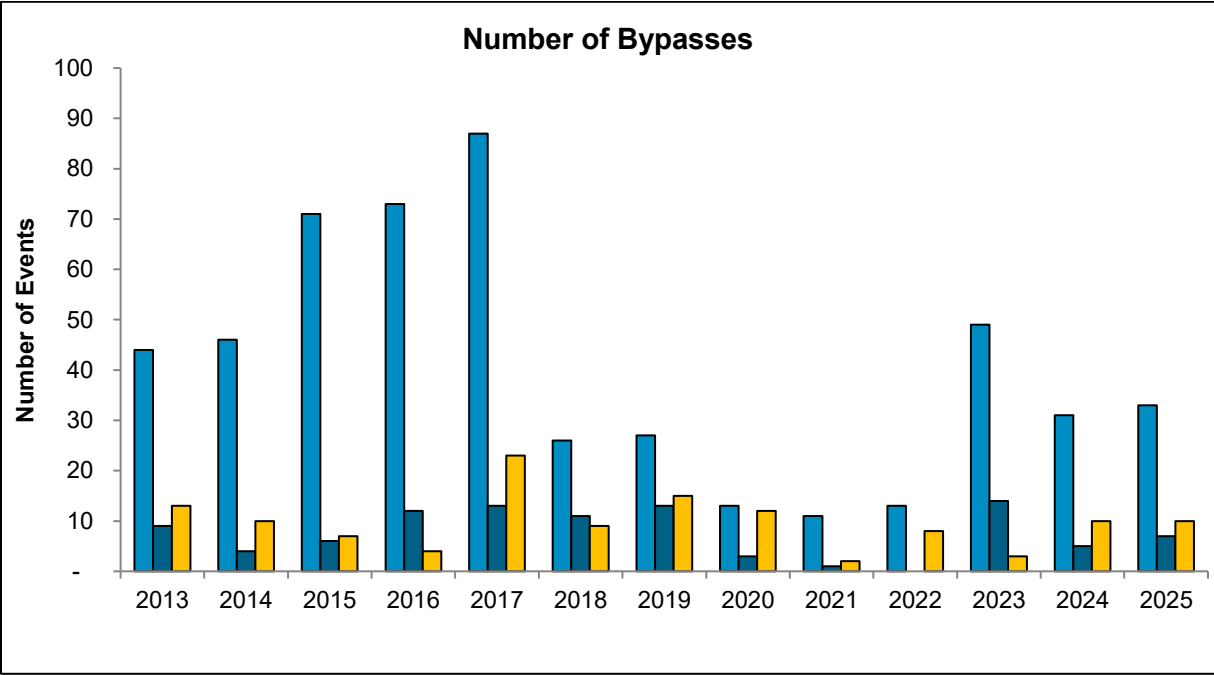
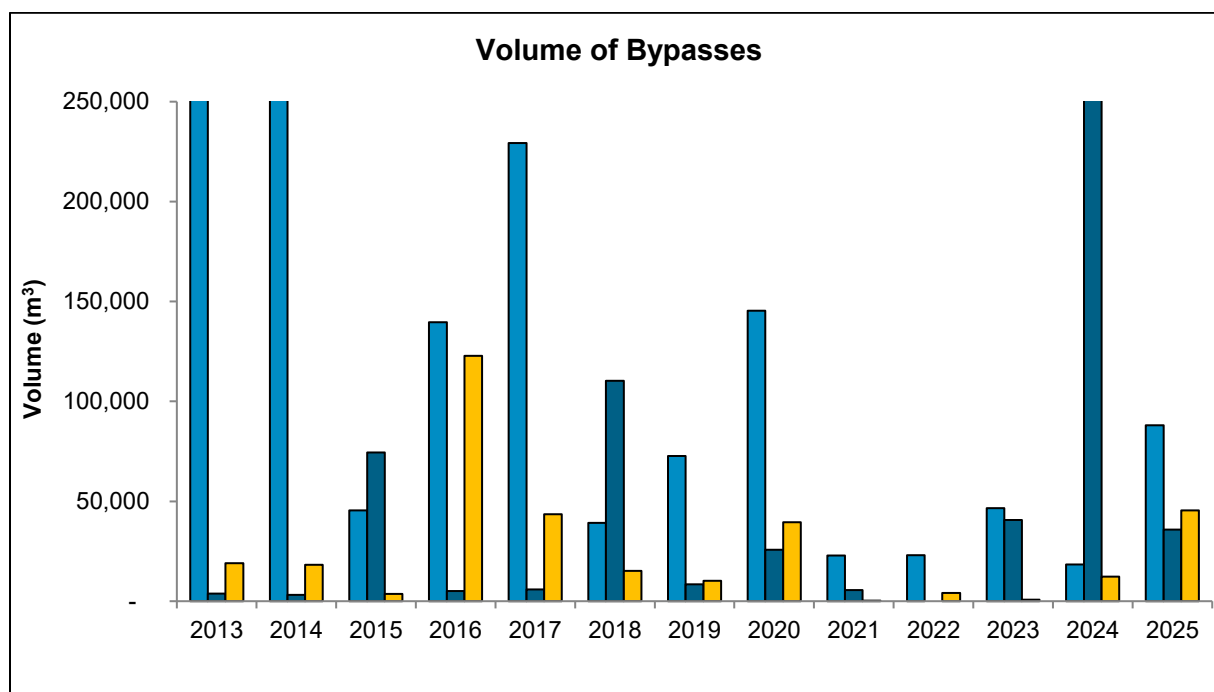


Figure 12: Volume of Low, Moderate, and High-Risk Bypasses from 2013 to 2025



High Flow Preparedness Study

In June 2025, the GRWWOP launched a high-flow inflow and infiltration (I/I) survey to collect information from municipalities on the tools, procedures, and infrastructure used to manage high-flow events. The survey addressed areas such as sampling and testing programs, operational procedures, staffing coverage, funding, and treatment plant capabilities, including side-stream management, step-feed processes, bypass systems, equalization tanks, and disinfection capacity. Responses were received from 12 of the 30 WWTPs discharging effluent to the Grand River or its tributaries, representing a 40% response rate. While the survey provided valuable insight into high-flow preparedness at participating facilities, the relatively low response rate limits the extent to which the results can be considered representative of conditions across the watershed. Based on the survey findings, the following conclusions were drawn:

- Of the facilities that responded, operational procedure review varied from no defined review period to every five to ten years.
- 75% of the facilities have plans to address I/I issues through process optimization, capital expenditure, collection system I/I studies and ongoing implementation of study findings.
- 92% of the respondents indicated adequate funding and staffing to support high flow management.
- Most plants reported achieving the effluent quality requirements during high flow events and 42% of the plants carry out additional sampling and testing during high flows.

- Participants reported a relatively high level of concern regarding high-flow events, rating their concern as 7 out of 10.
- Participants reported a high level of preparedness to manage high-flow events, with a rating of 8 out of 10, indicating that most feel prepared despite their concerns (Tolnai, Irvine, & Matthews, High Flow Preparedness Study, 2025)

Data Integrity Checks

Several data integrity checks were used to determine if the monitoring conducted at a WWTP is truly representative of plant performance. A sludge accountability analysis for mechanical activated sludge plants compares the amount of sludge reported to the amount of sludge projected based on plant loadings and removals, on an annual basis. The reported sludge includes sludge intentionally wasted by the operator to control the biological process and unintentional wasting (i.e., solids lost from the plant in effluent TSS). Projected sludge can include an estimate of primary sludge, biological sludge generated by the conversion of organics to biomass, and chemical sludge (i.e., solids produced as a result of coagulant addition). The formula to calculate sludge accountability is as follows:

$$\frac{\text{projected sludge} - \text{reported sludge}}{\text{projected sludge}} * 100\%$$

If the result is within a range of $\pm 15\%$, the sludge accountability is considered to “close” (US EPA, 1989). If the value is outside of this range, then the monitoring may not be truly representative of plant loading or performance. In the case of sludge accountability that does not close, further investigation is warranted to review sample frequency, sampling techniques, analytical methods, flow measurement accuracy, etc.

Common sources of sludge accountability analysis discrepancy include:

- Non-representative sampling (poor sampling techniques or analytical procedures, inadequate sampling frequency, a sampling location which is not representative, etc.),
- Lack of flow measurement on some process streams or inaccurate flow measurement, and
- Neglecting to consider all inputs and outputs (e.g., no measurements on return streams such as filter backwash or digester decant, etc.).

Table 9 shows the results for 24 plants in the watershed that conducted sludge accountability for 2020 to 2025. For 2025, Kitchener, Brantford, Guelph, Galt, Waterloo, Fergus, Elmira, Dunnville, New Hamburg, Elora, Athur, Grand Valley, Wellesley, Drumbo, and Alt Heidelberg WWTPs have a sludge accountability analysis that closed within $\pm 15\%$. Sludge accountability results for all plants, including reported and projected sludge values can be found in Appendix 1: Sludge Accountability and Water Balance Summary.

Table 9: Summary of 2021 to 2025 Sludge Accountability Analyses

WWTP	2021	2022	2023	2024	2025
Kitchener	8.3%	-3.1%	-1.0%	15.5%	1.7%
Guelph	-6.3%	9.6%	10.0%	-1.5%	9.8%
Waterloo	14.9%	-3.6%	-10.7%	-1.9%	14.0%
Brantford	-3.8%	13.5%	6.8%	13.3%	-10.9%
Galt	25.7%	4.7%	-14.5%	-13.0%	-3.6%
Preston	7.8%	-7.3%	5.8%	20.8%	23.2%
Hespeler	1.7%	9.9%	-2.5%	13.2%	27.9%
Paris	-23.1%	13.5%	-77.5%	-119.2%	-131.8%
Fergus	-21.6%	NA	32.3%	-3.8%	10.3%
Dunnville	0.6%	-32.2%	-36.8%	-3.3%	9.8%
Elmira	-19.1%	-35.3%	4.6%	-2.4%	14.3%
New Hamburg	-47.6%	-17.0%	17.3%	13.1%	-12.0%
Caledonia	21.6%	10.5%	18.5%	27.3%	22.3%
Elora	-43.1%	NA	27.7%	-5.7%	-2.3%
Ayr	-9.9%	19.6%	14.1%	19.9%	-17.7%
Arthur	NA	-27.3%	NA	19.0%	-4.1%
Grand Valley	NA	-4.0%	NA	-4.2%	-8.7%
St. Jacobs	26.3%	12.2%	-20.7%	-41.2%	-18.5%
Wellesley	15.9%	12.2%	8.7%	-5.1%	-8.9%
Cayuga	-32.2%	-42.1%	-9.0%	-16.7%	-21.9%
St. George	-36.0%	-48.3%	-79.4%	-127.1%	-88.7%
Drumbo	-4.3%	11.6%	11.8%	12.9%	-9.0%
Alt Heidelberg	-51.5%	-83.0%	-82.0%	-54.2%	1.6%
Conestogo	11.0%	14.7%	-6.6%	12.7%	20.2%

Under the Grand River WWOP, a water balance analysis was developed for lagoon systems as a performance check since sludge accountability cannot be performed. A water balance analysis compares the difference between the measured net precipitation and the projected net precipitation and is reported as a percentage of influent flow. The measured net precipitation is based on the net precipitation and the lagoon surface area. Projected net precipitation is determined using lagoon level measurements, total influent sewage and effluent volume on an annual basis. The formula for calculating a water balance is as follows:

$$\frac{\text{reported net precipitation} - \text{projected net precipitation}}{\text{influent flow}} * 100\%$$

If the result is within a range of $\pm 15\%$, the water balance is considered to “close”. If the value is outside of this range, then the flow measuring devices or lagoon level measurements may not be accurate. Further investigation is warranted to review all flow measuring devices and confirm their accuracy.

Table 10 shows the results for the lagoons that conducted a water balance analysis for 2021 to 2025. A detailed summary of water balance results is in Appendix 1: Sludge Accountability and Water Balance Summary. Sources of discrepancy in the calculation may include the following: inaccurate flow measurement, inaccurate surface area information, uncertainties in precipitation and/or evaporation data and error in lagoon storage measurements.

Table 10: Summary of 2021 to 2025 Water Balance Analyses of Lagoons

Lagoon	2021	2022	2023	2024	2025
Dundalk	6.4%	15.6%	17.0%	14.4%	4.0%
Drayton	NA	NA	NA	2.6%	-29.5%
Plattsville	13.8%	11.2%	0.0%	6.5%	-11.6%
Cainsville	25.9%	85.2%	83.2%	85.1%	100.8%

Wastewater Treatment Plant Loading Summary

Influent flow

Figure 13 shows a summary of the average daily flow (ADF) to each plant for 2021 to 2025 compared to the Nominal Design Flow (NDF) of the plant as stated in the plant’s ECA (shown in grey). Figure 13 shows three vertical scales since the nominal design of the WWTPs in the watershed vary by orders of magnitude and range from 130 m³/d to 122,745 m³/d. Figure 14 shows the ADF as a percentage of the NDF. In 2025, Wellesley WWTP experienced an ADF that was higher than the NDF. Since 2012 four plants have experienced ADFs higher than their NDF: Arthur (2012 to 2014 and 2017), Drumbo (2013 and 2014), Cainsville (2014 and 2023), and Wellesley (2019, 2024). The NDF for the Arthur plant was re-rated in 2020 from 1,465 to 1,860 m³/d, while the Drumbo plant was re-rated in 2024 from 300 to 450 m³/d.

Figure 13: ADF and Nominal Design Flow of Watershed WWTPs

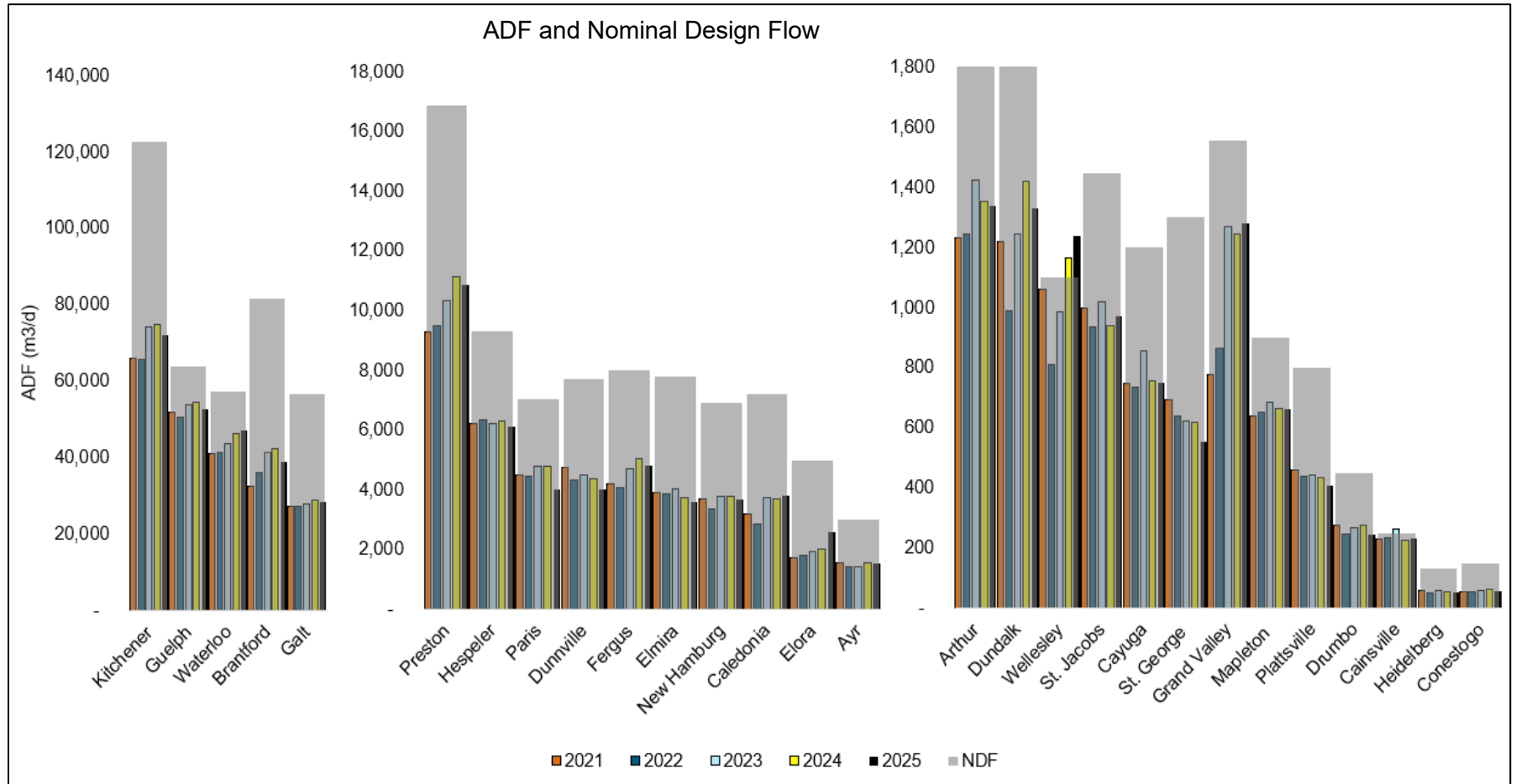
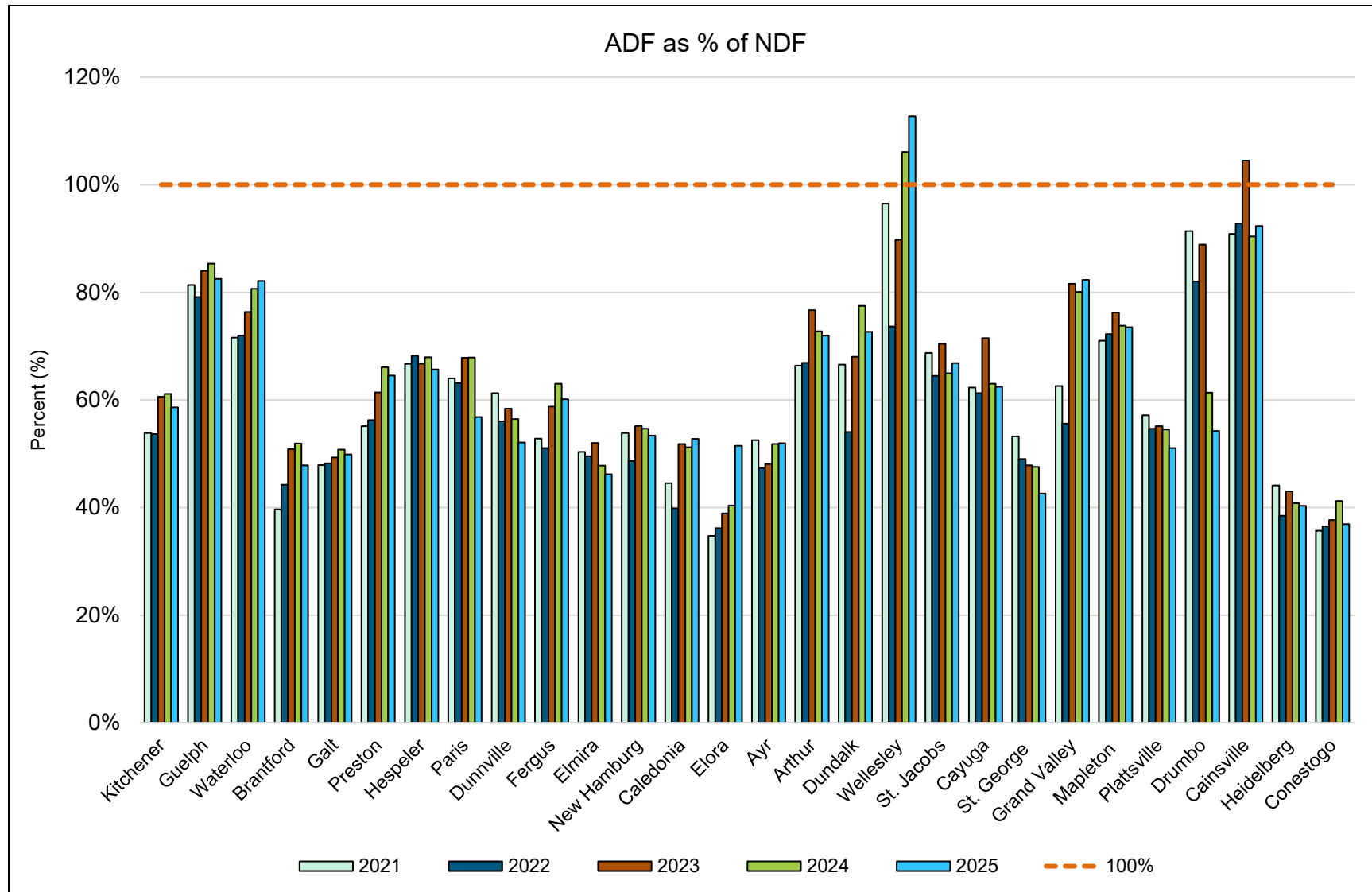


Figure 14: Annual Average Flow as a Percentage of Rated Plant Capacity



Another way to look at influent flow is to normalize it based on the serviced population and express it as per capita flow. Per capita wastewater flows vary from location-to-location, but typical values are from 350 to 500 L/person/d (US EPA, 1989). Figure 15 shows per capita flows for WWTPs in the watershed between 2021 and 2025. From this figure, plants in the Grand River watershed were generally at or below the low end of the typical range. The watershed median in 2025 was 290 L/person/day, below the 2024 median of 295 L/person/day and represents a 6% decrease from the 2012 median of 310 L/person/day.

Some plants experience higher-than-average per capita flows for various reasons. For example, the Cainsville WWTP primarily serves industrial users, resulting in higher per capita flow rates compared to typical domestic systems. As a result, the Cainsville WWTP is excluded from the per capita and ratio figures. Other plants, such as Arthur, Dunnville, St. Jacobs, and Dundalk, may also show elevated flows due to significant inflow and infiltration (I/I).

Figure 16 shows the ratio of peak day flow to ADF, which is another indicator of significant I/I. The ratio of peak day flow to ADF varies from year-to-year depending on climate factors such as heavy rainfall or snowmelt events. The median ratio for plants across the watershed was 3.1 in 2025. Most plants were within the typical range of 2.5-4.0 or less. Several plants are known to experience higher I/I (such as Dundalk, Fergus, Wellesley, Dunnville, or Cayuga WWTP) and this is reflected in Figure 16.

Year-to-year variability in per capita flow is largely due to differences in inflow and infiltration related to precipitation. On a watershed-basis the median per capita flows varied from 351 L/d per person in 2013 (a “wet” year) to a median of 280 L/d per person in 2022.

Figure 15: Per Capita Influent Flow

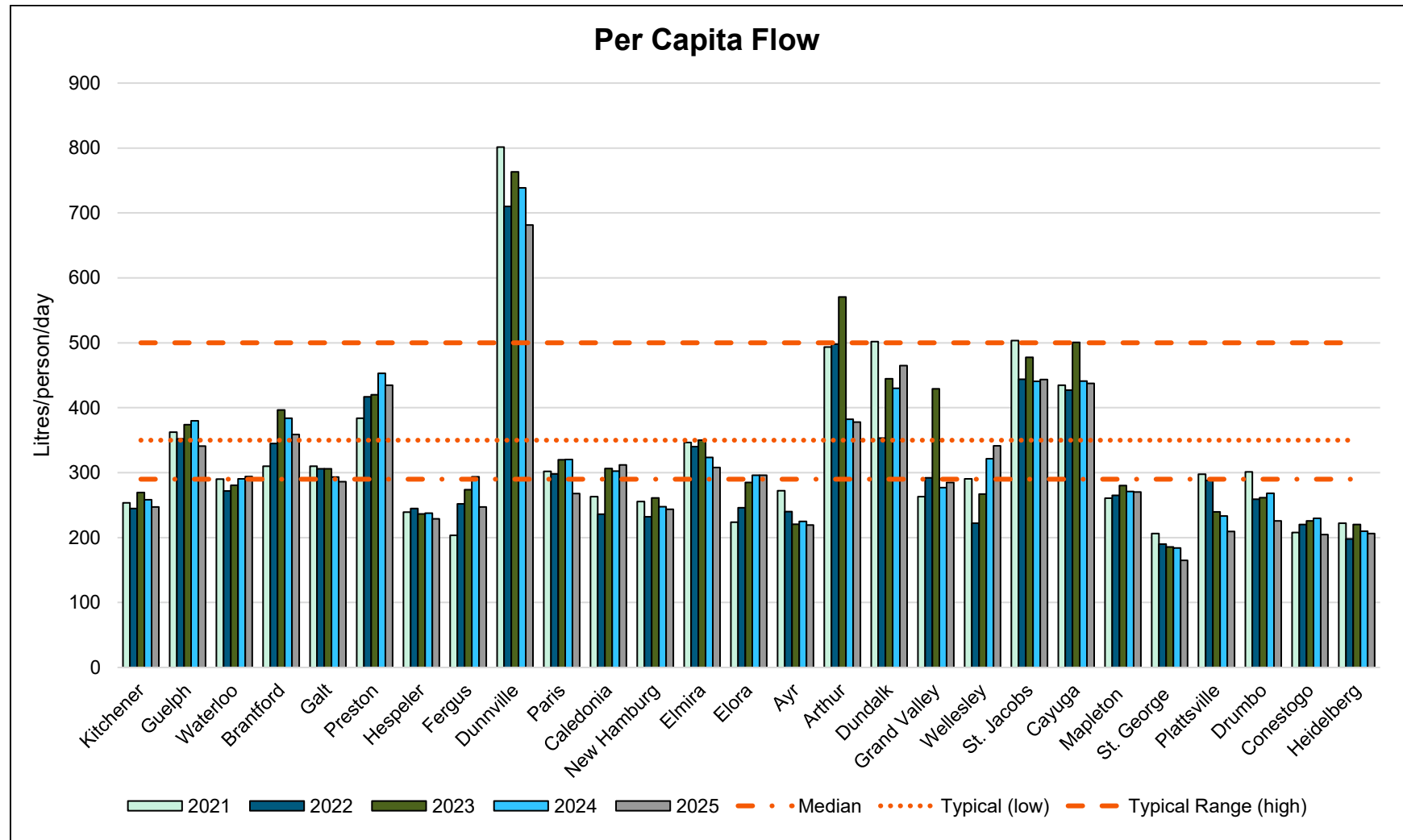
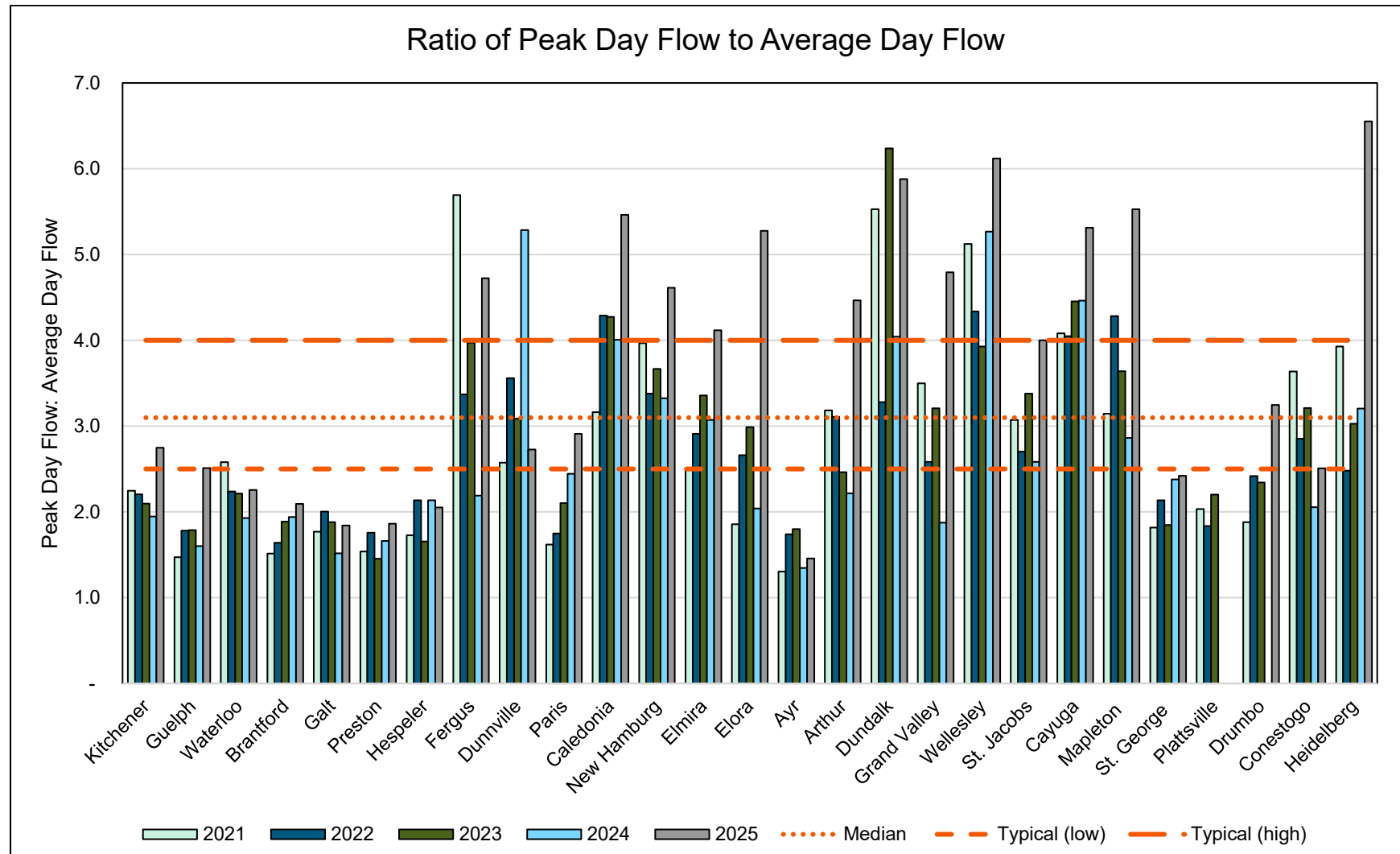


Figure 16: Ratio of Peak Day Flow to Annual Average Flow



Raw Influent Loads

Characterization of raw wastewater is important to ensure effective wastewater treatment, assist with future planning, and identify any issues or changes occurring in the collection system. The loading of raw influent TBOD, TSS and TKN can be calculated by multiplying raw influent concentrations by flow. These loads can be expressed on a per capita basis and compared to values typical of domestic sewage.

TBOD Loading

In 2025, all 28 plants that reported data measured raw influent TBOD. Table 11 summarizes the results of both cBOD and TBOD as reported by plants in the Grand River watershed between 2016 and 2025:

Table 11: Annual Average Raw Influent cBOD and TBOD Concentrations Reported by Grand River Watershed Plants in 2016 to 2025.

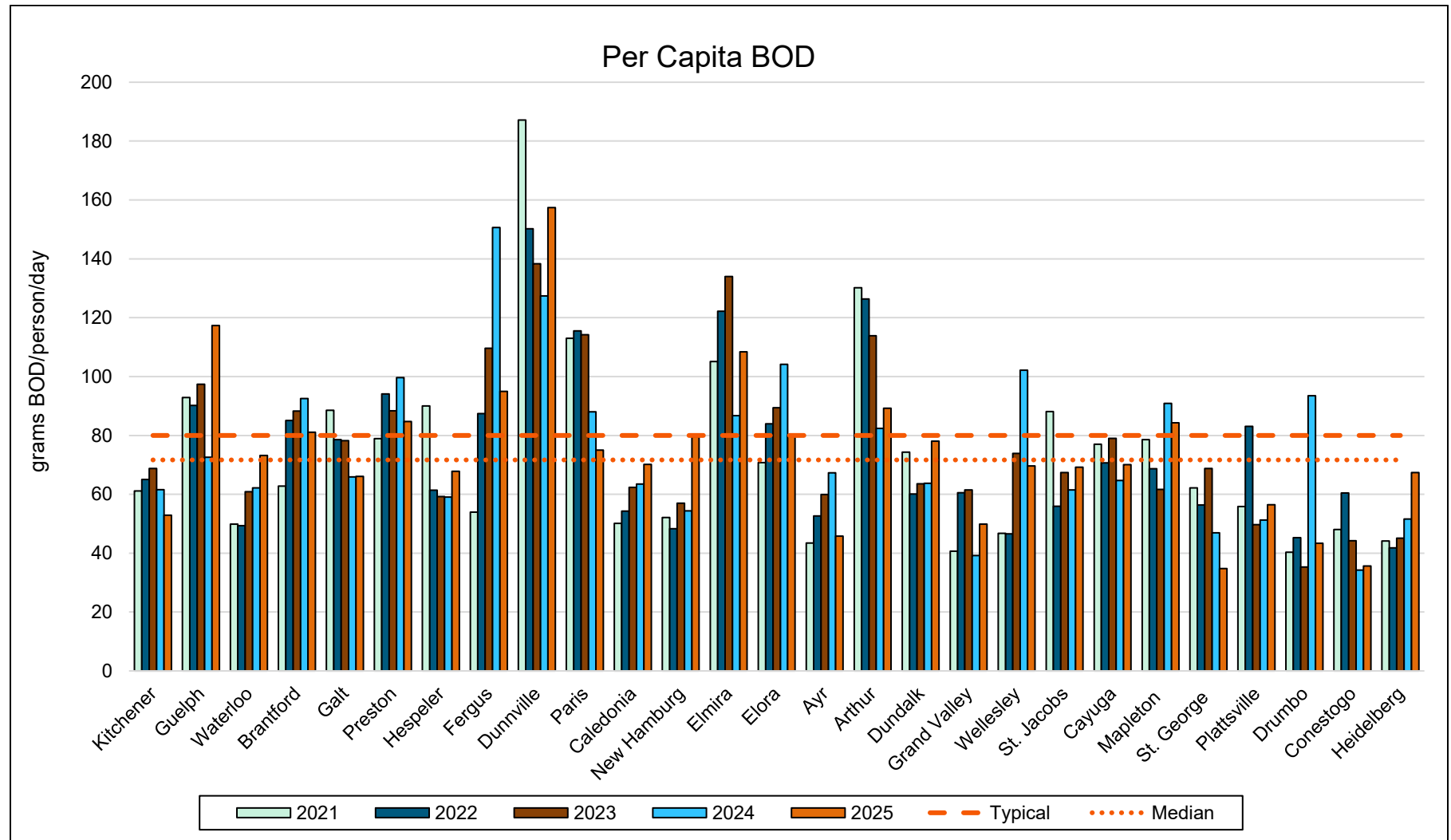
Year	No. of plants reporting cBOD	No. of plants reporting TBOD	No. of plants reporting Both cBOD & TBOD	Median (mg/L) cBOD	Median (mg/L) TBOD	Range (mg/L) cBOD	Range (mg/L) TBOD
2016	18	21	11	195	208	127 to 389	142 to 411
2017	18	26	16	177	194	98 to 411	108 to 421
2018	18	26	16	182	197	94 to 296	112 to 304
2019	18	24	16	177	211	92 to 269	107 to 311
2020	17	23	14	192	203	81 to 322	88 to 396
2021	21	28	18	199	208	89 to 360	134 to 378
2022	19	28	19	214	251	113 to 366	134 to 393
2023	19	28	19	219	221	93 to 364	139 to 417
2024	20	28	19	218	224	129 to 358	143 to 523
2025	20	28	20	210	231	134 to 332	156 to 384

Albertson (1995) has documented that the cBOD test underestimates the strength of raw wastewater by 20 to 40% (Albertson, 1995). In 2025, 20 of 28 reporting plants in the watershed measured both cBOD and TBOD. The average TBOD:cBOD ratio among these plants is 1.13. A factor of 1.2 was used for estimation in previous years.

Figure 17 shows estimated per capita TBOD loads for plants in the Grand River watershed. A typical value for domestic wastewater is 80 g/person/d (US EPA, 1989). The reported median for 2025 is 71.7 g/person/day, which was higher than both the 2024 median of 66.6 g/person/day and the GRCA long-term average of 69.3 g/person/day.

Per capita TBOD loads that are much higher or much lower than the typical value should be further investigated to see if there is a reasonable explanation for the discrepancy. In some cases, industrial contributions may result in elevated per capita TBOD loads. However, atypical TBOD loads may also be related to inadequate sampling frequency, non-representative sampling, errors in flow metering or population estimates, etc.

Figure 17: Per Capita TBOD Load



TSS Loading

TSS loads in raw influent for 2021 to 2025 are summarized in Figure 18. The 2025 watershed median was 81 g/person/d, which is less than the typical value of 90 g/person/d (US EPA, 1989). Where the loads are significantly less than typical, it brings into question the adequacy of raw influent sampling to accurately characterize the influent. Higher than expected loads may be attributed to industrial inputs and/or internal recycle streams.

TKN Loading

Figure 19 shows per capita TKN loads to plants in the watershed. The watershed median was 13.5 g/person/d for 2025 which is slightly higher than the typical value of 13 g/person/d (WEAO, 2010). Several plants (such as Dundalk, Elmira, Galt, Mapleton, and Preston) reported TKN loads that are higher than expected and in most cases the per capita TSS and/or estimated TBOD loads were also high. A small number of plants had TKN, TSS and TBOD loads that were less than typical. Further investigation, such as characterization of raw influent and recycle streams and review of population estimates, may be helpful when per capita loadings are outside the typical range.

TP Loading

Figure 20 shows the TP loads in the raw influent for 2021 to 2025. The watershed median for 2025 was 1.8 g/person/d. This is less than the typical value of 2.1 g/person/d.

Figure 18: Per Capita TSS Load

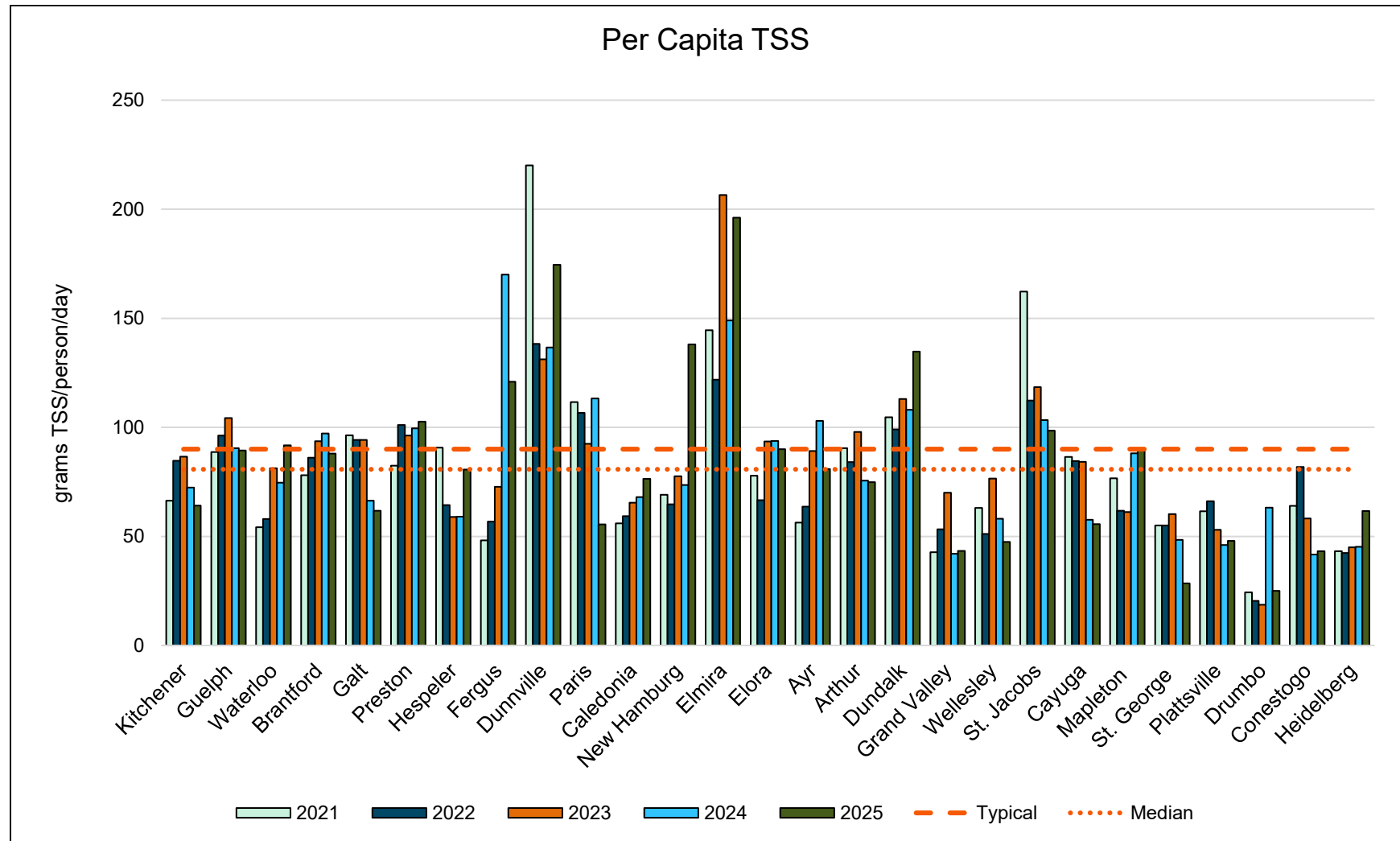


Figure 19: Per Capita TKN Load

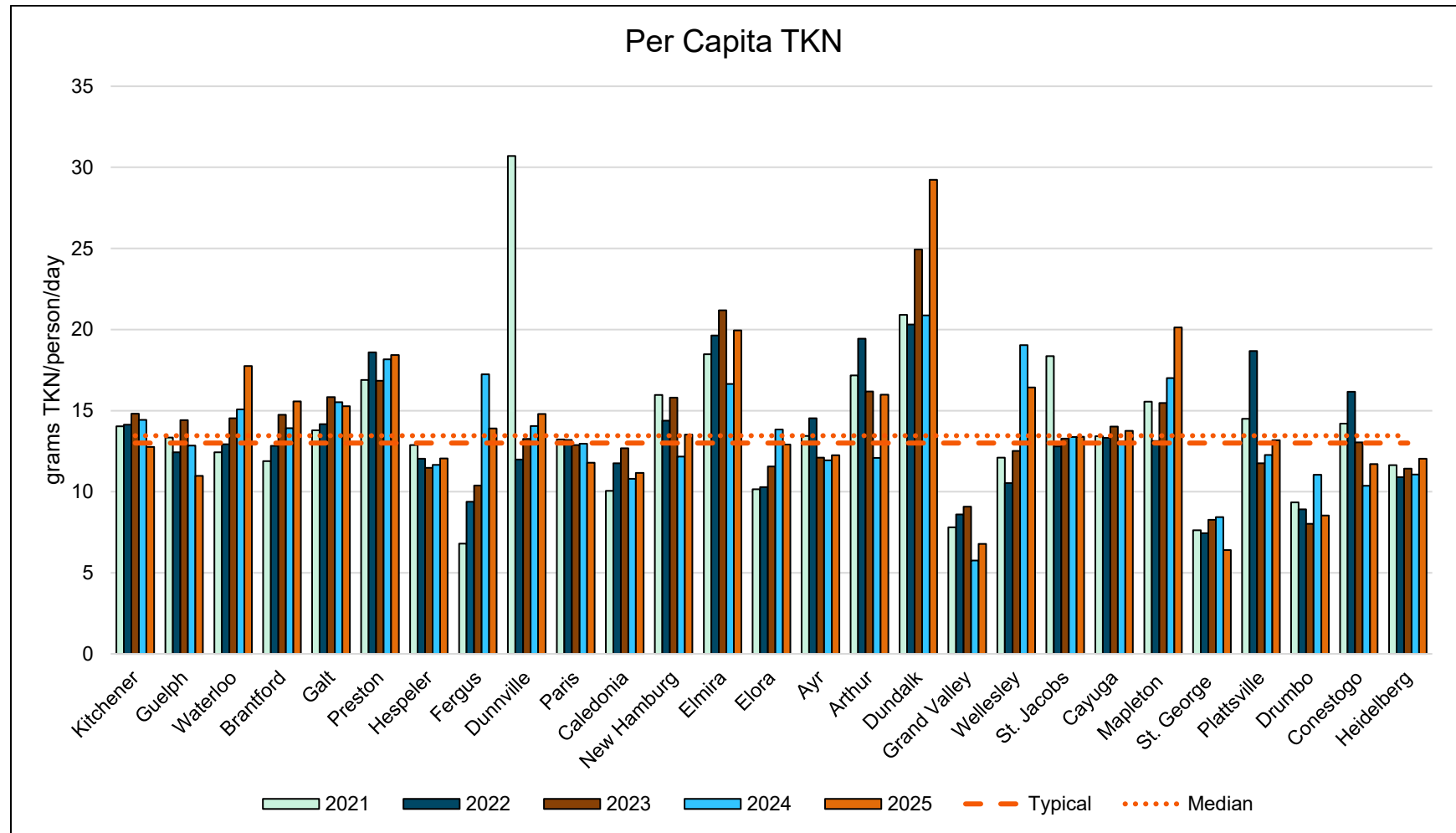
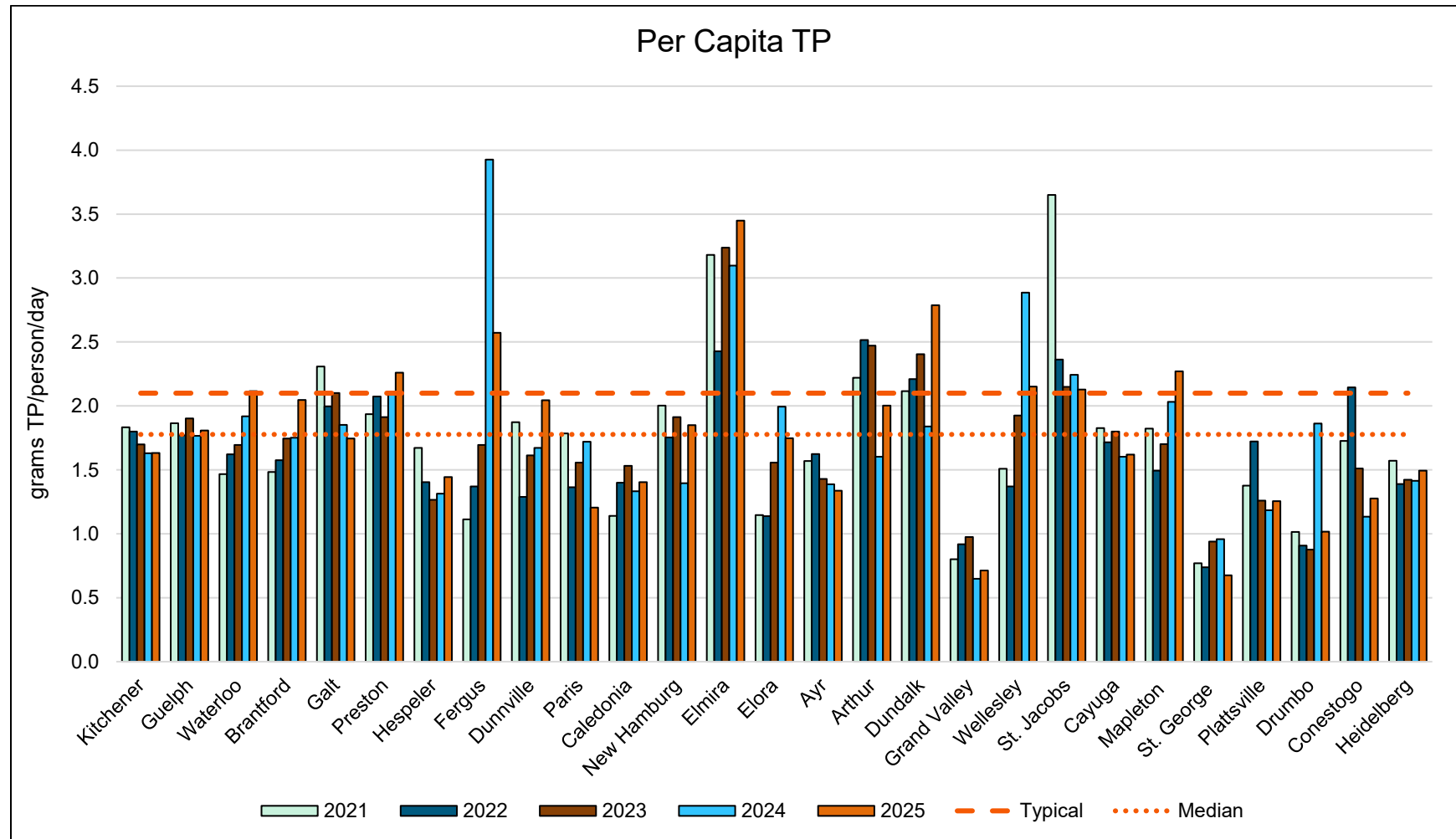


Figure 20: Per Capita TP Load



Ratios

Calculating raw influent ratios for TSS:TBOD and TKN:TBOD can be used to provide insight on what is entering the plant from the collection system as well as any potential sampling problems. Figure 21 shows the ratio of raw influent TSS to TBOD concentrations. For a typical domestic sewage system, this value ranges between 0.8 and 1.2. The median for watershed plants in 2025 was 1.09, similar to 2024. This value fell within the typical range and was slightly lower than in previous years.

Figure 22 shows a graph for the ratio of raw TKN to TBOD, with a range of 0.1 to 0.2 considered typical. The 2025 watershed median was 0.19, which is at the higher end of the typical range but similar to previous years. Higher ratios could be attributed to recycle streams, an industrial influence on the collection system, or the fact that all plants are now reporting TBOD, which may have been overestimated in previous years.

Figure 21: Ratio of Raw TSS to Raw TBOD

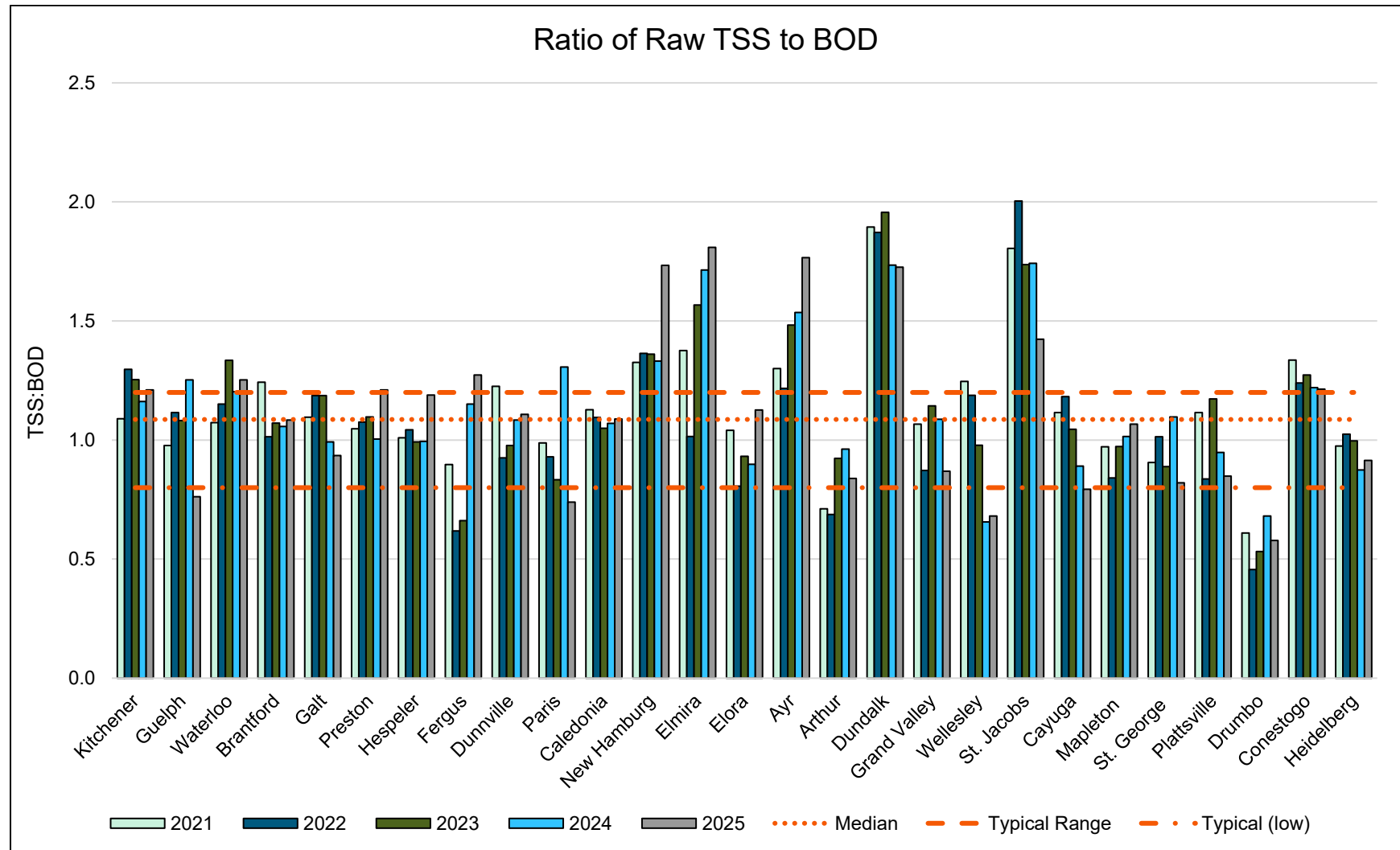
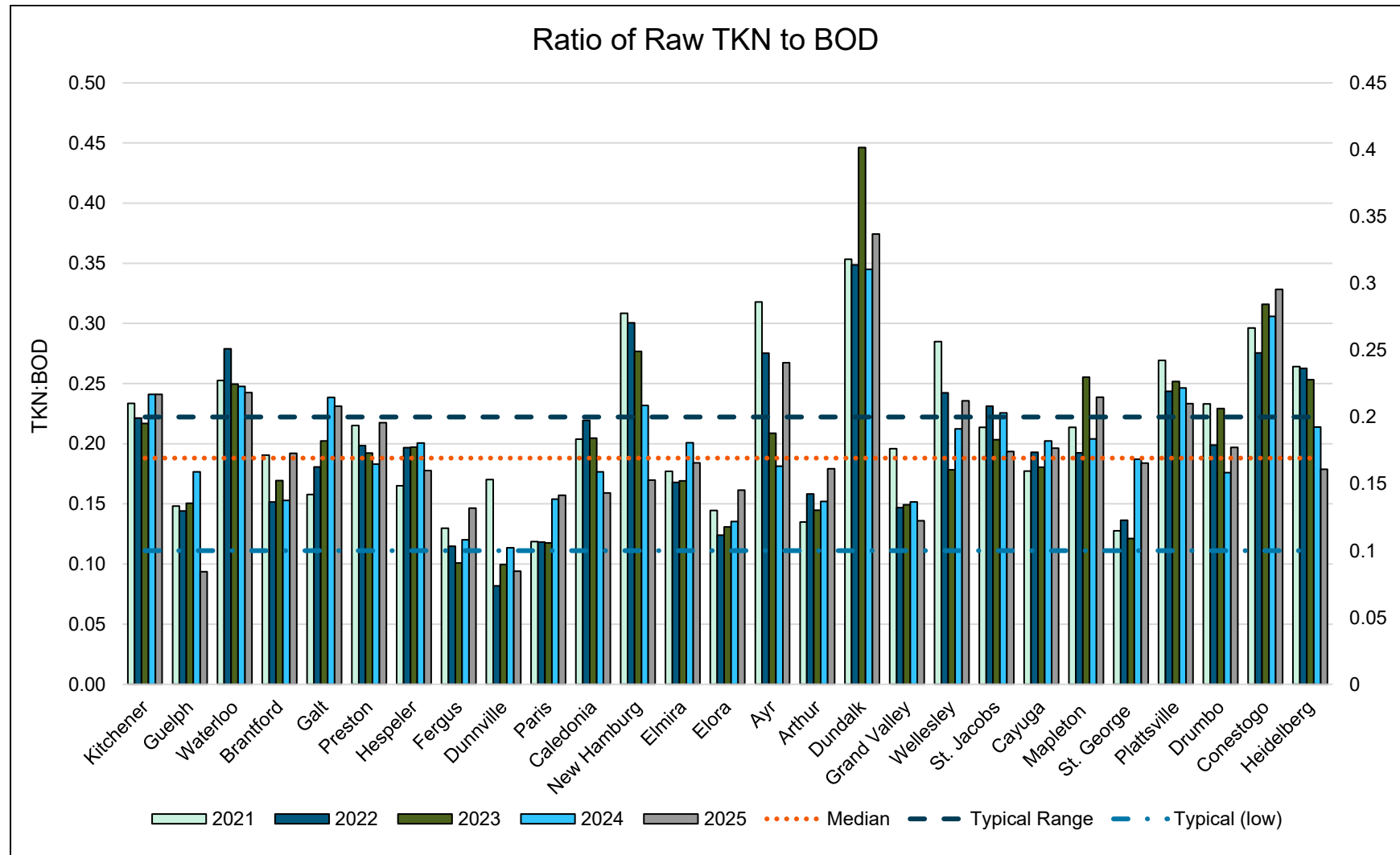


Figure 22: Ratio of Raw TKN to Raw TBOD



Final Comments

The data presented in this report documents significant improvements in effluent quality across the Grand River watershed since 2012, driven by facility upgrades and ongoing optimization efforts. These advancements have led to substantial reductions in TP and TAN discharged to the river.

Notably, 2023 marked the first year in the program's history in which both TP and TAN loadings increased relative to the previous year. However, in 2024, both flow-weighted concentrations and total loadings of TP and TAN declined compared to 2023. This trend continued in 2025, with further decreases in both flow-weighted concentrations and total loadings relative to the previous year.

Despite continued population growth in the watershed, flow-weighted TP concentrations declined from 0.37 mg/L in 2012 to 0.20 mg/L in 2025, while flow-weighted TAN concentrations fell from 9.8 mg/L to 0.6 mg/L over the same period.

Annual reporting has been instrumental in driving progress under the watershed-wide wastewater optimization program. The ongoing success of this evolving program depends on the voluntary participation of wastewater operators and managers.

The WWOP remains committed to fostering this community of practice by providing opportunities for knowledge sharing and collaboration. Through an optimization-based approach, the WWOP contributes to a healthy, sustainable watershed that supports thriving and growing communities into the future.

As part of the ongoing watershed-wide wastewater optimization program, the GRCA will continue to encourage and support municipalities to report on performance and loading metrics on an annual basis. Tracking these metrics over time will document the effectiveness of the program and help to identify candidates that may benefit from further optimization activities.

The authors thank Ministry of Environment, Conservation and Parks (MECP) for financial contribution, and WWOP participants for their efforts at voluntary reporting and encourage them to consider adopting and reporting against the Water Management Plan voluntary effluent quality performance targets for TP and TAN. By embracing an optimization approach to reduce these nutrients in wastewater effluent, municipalities can help to ensure a healthy and sustainable watershed that supports prosperous and growing communities into the future.

Further information on the Grand River Watershed-wide Optimization Program can be obtained from the Grand River wastewater optimization [web page](#), or by contacting [Simion Tolnai](#), the Optimization Extension Specialist at 519-621-2761 extension 2295 or [Cameron Irvine](#) at 519-621-2761 extension 2234.

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Appendix 1: Sludge Accountability and Water Balance Summary

Table 12: Summary of Sludge Accountability Analysis Results

Year	2021			2022			2023			2024			2025		
WWTP	Projected	Reported	Analysis	Projected	Reported	Analysis	Projected	Reported	Analysis	Projected	Reported	Analysis	Projected	Reported	Analysis
Kitchener	15,524	14,234	8.3%	17,057	17,591	-3.1%	23,303	23,527	-1.0%	20,061	16,955	15.5%	16,302	16,017	1.7%
Brantford	8,553	8,877	-3.8%	10,105	8,737	13.5%	9,944	9,266	6.8%	12,382	10,739	13.3%	8,507	9,436	-10.9%
Guelph	12,736	13,534	-6.3%	14,029	12,689	9.6%	14,161	12,744	10.0%	13,859	14,070	-1.5%	15,164	13,684	9.8%
Galt	10,030	7,455	25.7%	7,632	7,274	4.7%	7,935	9,084	-14.5%	6,765	7,642	-13.0%	7,916	8,198	-3.6%
Waterloo	8,630	7,343	14.9%	10,419	10,798	-3.6%	17,107	18,940	-10.7%	12,655	12,896	-1.9%	15,099	12,990	14.0%
Preston	2,363	2,178	7.8%	2,880	3,091	-7.3%	2,977	2,805	5.8%	3,082	2,441	20.8%	3,127	2,403	23.2%
Hespeler	2,239	2,201	1.7%	1,633	1,471	9.9%	1,568	1,608	-2.5%	1,570	1,363	13.2%	1,806	1,302	27.9%
Fergus	1,251	1,521	-21.6%	Not reported			1075	728	32.3%	3,070	3,187	-3.8	1,449	1,300	10.3%
Elmira	1,712	2,039	-19.1%	1600	2164	-35.3%	2320	2214	4.6%	1,686	1,727	-2.4%	2,274	1,948	14.3%
Dunnville	793	788	0.6%	643	851	-32.2%	591	809	-36.8%	665	687	-3.3%	810	730	9.8%
Caledonia	944	740	21.6%	1000	895	10.5%	1,113	907	18.5%	1,184	861	27.3%	1,251	972	22.3%
Paris	1,060	1,305	-23.1%	1142	987	13.5%	1048	1860	-77.5%	842	1,846	-119.2%	795	1,842	-131.8%
New Hamburg	734	1,083	-47.6%	698	816	-17.0%	735	608	17.3%	783	680	13.1%	913	1,022	-12.0%
Elora	566	810	-43.1%	Not reported			536	387	27.7%	942	996	-5.7%	572	585	-2.3%
Ayr	268	294	-9.9%	306	246	19.6%	349	300	14.1%	396	317	19.9%	307	362	-17.7%
Arthur	Not reported			209	266	-27.3%	Not reported			289.7	234.8	19.0%	236	246	-4.1%
St. Jacobs	203	149	26.3%	155	136	12.2%	133	161	-20.7%	121	171	-41.2%	121	144	-18.5%
St. George	190	258	-36.0%	139	206	-48.3%	205	367	-79.4%	165	375	127.1%	141	267	-88.7%
Grand Valley	Not reported			101	105	-4.0%	Not reported			140.6	146.5	-4.2%	125	136	-8.7%
Wellesley	139	117	15.9%	166	146	12.2%	238	217	8.7%	300	316	-5.1%	208	227	-8.9%
Cayuga	95	126	-32.2%	102	145	-42.1%	119	130	-9.0%	101	118	-16.7%	108	131	-21.9%
Drumbo	91	95	-4.3%	98	87	11.6%	83	73	11.8%	110	96	12.9%	84	91	-9.0%
Conestogo	16	14	11.0%	18	15	14.7%	15	16	-6.6%	14	12	12.7%	14	11	20.2%
Heidelberg	10	15	-51.5%	9	17	-83.0%	10	18	-82.0%	11	17	-54.2%	13	13	1.6%

Table 13: Summary of Water Balance Results from Plants that Report On It

Year	Plant	Dundalk	Mapleton	Plattsville	Cainsville
2016	Reported	28,101	48,910		
	Projected	-17,969	-9,672	Not	Not Reported
	Influent Flow	380,883	215158	Reported	
	Water Balance (%)	-12.1%	-27.2%		
2017	Reported	60,260		17,107	
	Projected	7,475	Not	27,493	Not Reported
	Influent Flow	404,642	Reported	196,483	
	Water Balance (%)	-13.0%		5%	
2018	Reported	38,875	47,700	8,237.24	
	Projected	-16,532	9,835	15,497	Not Reported
	Influent Flow	380,477	233,250	172,542	
	Water Balance (%)	14.6%	16.2%	-4.2%	
2019	Reported	23,292		20,381	1,968.2
	Projected	-33,731	Not	15,522	-62,908
	Influent Flow	413,461	Reported	187,078	84,205
	Water Balance (%)	13.8%		2.6%	77%
2020	Reported	31,952		19,995	-6,547
	Projected	-8,490	Not	31,550	-62,908
	Influent Flow	388,091	Reported	176,723	84,205
	Water Balance (%)	10.4%		-6.5%	67%
2021	Reported	34,984		7,102	1,725.7
	Projected	7,451	Not	-19,290	-19,290
	Influent Flow	431,240	Reported	81,139.6	81,139.6
	Water Balance (%)	6.4%		26%	26%
2022	Reported	3,772		-15,208	-4,343
	Projected	-52,415	Not	-32,987	-76,494
	Influent Flow	360,770	Reported	159,301	84,642
	Water Balance (%)	15.6%		11.2%	85.2%
2023	Reported	22,240		13,386	3,948
	Projected	-50,974	Not	13,327	-75,325
	Influent Flow	431,398	Reported	160,848	95,278
	Water Balance (%)	17.0%		0.0%	83.2%
2024	Reported	40,754	50,032.0	14,529	2,315
	Projected	-32,381	43,672.0	4,198	-67,726
	Influent Flow	509,365	242,240.0	159,762	82,343

Year	Plant	Dundalk	Mapleton	Plattsville	Cainsville
	Water Balance (%)	14.4%	2.6%	6.5%	85.1%
2025	Reported	25,449	-85	3,598	1,122
	Projected	6,175	71,196	20,876	-80,689
	Influent Flow	486,821	241,776	149,045	81,178
	Water Balance (%)	4.0%	-29.5%	-11.6%	100.8%