2024 ANNUAL EVALUATION REPORT ASSESSING THE EFFECTIVENESS OF THE CORROSION CONTROL MEASURES

Corrosion Control Program
Woodward Avenue Drinking Water Subsystem

March 2025

Hamilton

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1 SUMMARY

This annual evaluation report is provided as per Section 9.2 of Schedule C of the City of Hamilton's (the City's) Municipal Drinking Water Licence (MDWL) Number: 005-101 Issue 11, dated May 24, 2024; as per Part V of the Safe Drinking Water Act, 2002 (SDWA). This report assesses the effectiveness of the Corrosion Control Program within the City's Woodward Avenue Drinking Water Subsystem (Woodward Distribution System). It outlines the activities undertaken by the City and covers the 2024 calendar year.

This report covers the following:

- Lead results and a summary of any key corrosion control parameters
- A technical evaluation of the effectiveness of corrosion control measures
- A summary of lead levels and other metals monitored since implementation of corrosion control and comparison to pre-implementation levels
- An evaluation of secondary impacts resulting from corrosion control implementation
- Summary of results of all other aspects of the City's lead mitigation strategy

The City began the addition of phosphoric acid on November 8, 2018, with 2024 being the sixth year of program operation. Throughout 2024, operating conditions were stable at the Woodward Avenue Water Treatment Plant with orthophosphate inhibitor concentrations steadily observed at the ends of the Woodward Distribution System.

The Schedule 15.1 Community Lead Sampling Program was reinstated in 2018 for the Woodward Distribution System under a reduced sampling schedule to monitor the effectiveness of corrosion control measures put in place. Two sampling rounds: Round 33 (Winter) and Round 34 (Summer), were completed in 2024 for a total of 12 rounds completed since Corrosion Control Program implementation. Result summaries are included in this report which show a significantly lower level of lead in comparison to levels measured prior to the Corrosion Control Program implementation.

2 INTRODUCTION

At the November 25, 2015, City of Hamilton Council Meeting, Public Works Report 15-015, the Corrosion Control Program for the Woodward Distribution System was approved. The primary recommendation of the report was to implement corrosion control within the Woodward Distribution System using a phosphate-based treatment approach, with orthophosphate as the method for corrosion control and phosphoric acid as the treatment additive. On November 8, 2018, the City began adding phosphoric acid completing the pre-implementation requirements and moving into post-implementation and ongoing activities. This 2024 evaluation report summarizes the post-implementation sampling and monitoring activities of the year and illustrates the observed effectiveness of the program.

3 TECHNICAL EVALUATION OF THE EFFECTIVENESS OF CORROSION CONTROL MEASURES

3.1 KEY MILESTONES OF POST IMPLEMENTATION SAMPLING AND MONITORING

Post-implementation sampling and monitoring continues to be the main way of evaluating the program's goal of reducing lead concentrations observed at the tap (premise). Post-implementation sampling, as per Schedule C of the Municipal Drinking Water Licence (MDWL), was performed including two rounds of the legislated Community Lead Sampling Program.

Ongoing proactive and reactive flushing of the Woodward Distribution System took place throughout 2024. This ensured the movement of orthophosphate throughout the system, minimizing secondary impacts and reducing water age.

The Plant Optimization Study commenced in 2019 to examine the Woodward Avenue Water Treatment Plant's dosing system for orthophosphate and ammonia. The goal of the study is to ensure the chemicals are delivered effectively and do not create adverse conditions in the Woodward Distribution System. The study, previously on-hold due to the COVID-19 Pandemic, resumed in 2023. Recommendations to begin the first phase of orthophosphate concentration reduction towards a maintenance dosage began and were implemented in October 2024. The target orthophosphate concentration, at the point of entry into the Woodward Distribution System, was reduced from 2.10 mg/L to 1.90 mg/L. The study will continue in 2025 and provide additional recommendations as the City moves towards a maintenance dose.

System-wide sampling continued in 2024 and provided additional monitoring data for the entire Woodward Distribution System. This branch of the monitoring program allows for surveillance of orthophosphate levels and potential secondary impacts. In the event of an elevated orthophosphate, colour, or turbidity result, further sampling occurs to determine the cause of any anomaly and to ensure appropriate action is taken.

The key post-implementation activities are summarized in Table 1.

TABLE 1: 2024 CORROSION CONTROL PROGRAM POST-IMPLEMENTATION MONITORING PLAN

Task	Status
Distribution System Flushing	On-going • 2,953 hydrants flushed in 2024 • Proactive flushing continues in 2025
Post-Implementation Monitoring	On-going • Sampling as per Schedule C of the MDWL completed in 2024 • Additional System-wide monitoring program and lead pipe loop monitoring • 984 samples collected in 2024 • Sampling continues in 2025
Plant Optimization Study	On-going • Study to optimize the Water Treatment Plant's dosing system for orthophosphate and ammonia • Target orthophosphate concentration reduced from 2.10 mg/L to 1.90 mg/L • Study continues in 2025

3.2 EQUIPMENT MALFUNCTION OR UPSET CONDITIONS

No equipment malfunctions or upset conditions occurred in 2024.

A summary of the continuously monitored parameters at the Point of Entry, where values are recorded every 15 minutes, is included in Table 2. The Municipal Drinking Water Licence (MDWL) also requires additional parameters to be measured at the Point of Entry annually, quarterly and monthly. The results from these grab samples are summarized in Table 3. Pre- and post-implementation comparison of these parameters illustrate a minimal change in water quality.

TABLE 2: SUMMARY OF CONTINUOUSLY MONITORED PARAMETERS AT THE POINT OF ENTRY

Dates	Point of Entry Continuous Monitoring, Result Value Range			
	pH	Temperature Raw Water (^{0}C)	Orthophosphate (mg/L)	Turbidity (NTU)
08-Nov-2018 to 31-Dec-2018	7.58 - 8.17	1.50 - 6.66	0.02 - 3.39	0.03 - 0.54
01-Jan-2019 to 31-Dec-2019	6.67 - 7.64	-1.03 - 20.47	0.20 - 7.81	0.02 - 0.33
01-Jan-2020 to 31-Dec-2020	6.66 - 7.64	0.63 - 23.35	0.84 - 3.46	0.02 - 0.27
01-Jan-2021 to 31-Dec-2021	6.74 - 7.60	-0.53 - 23.29	0.96 - 5.33	0.02 - 0.86
01-Jan-2022 to 31-Dec-2022	6.22 - 7.71	-0.48 - 22.50	0.68 - 6.38	0.009 - 0.282
01-Jan-2023 to 31-Dec-2023	7.06 - 7.56	0.45 - 20.89	0.74 - 2.86	0.03 - 0.71
01-Jan-2024 to 31-Dec-2024	6.95 - 7.47	0.29 - 22.74	1.34 - 2.76	0.03 - 7.75

TABLE 3: SUMMARY OF CORROSION CONTROL RELATED PARAMETERS AT THE POINT OF ENTRY

Dates	Point of Entry Result Value Range								
	Lead (mg/L)	Iron (mg/L)	Copper (mg/L)	Alkalinity (mg/L)	TDS (mg/L)	Colour (apparent) (CU)	Chloride (mg/L)	Sulphate (mg/L)	Ortho-phosphate (mg/L)
Pre-Implementation									
04-Feb-2008 to 22-May-2018	<0.001	<0.01 - 0.059	0.00039 - <0.002	82 - 99	156 - 252	<2 - 4	30.0 - 31.5	24.2 - 28.2	<0.15
Post-Implementation									
01-Oct-2018 to 31-Dec-2018	<0.0001	<0.003	0.0002	85	178	<2	30.0 - 31.5	23.7 - 24.7	<0.15 - 3.80
01-Jan-2019 to 31-Dec-2019	<0.0001	<0.003 - 0.004	0.0003 - 0.0006	83 - 88	160 - 232	<2	29.1 - 42.6	22.9 - 27.0	<0.15 - 2.69
01-Jan-2020 to 31-Dec-2020	<0.0001	<0.003	0.0002 - 0.0004	86 - 88	166 - 228	<2 - 2	29.2 - 40.3	23.3 - 26.1	1.60 - 2.48

Dates	Point of Entry Result Value Range								
	Lead (mg/L)	Iron (mg/L)	Copper (mg/L)	Alkalinity (mg/L)	TDS (mg/L)	Colour (apparent) (CU)	Chloride (mg/L)	Sulphate (mg/L)	Ortho-phosphate (mg/L)
01-Jan-2021 to 31-Dec-2021	<0.0001	<0.003	0.0002 - 0.0008	86	170 - 248	<2 - 2	29.1 - 43.4	22.6 - 25.7	1.20 - 2.89
01-Jan-2022 to 31-Dec-2022	<0.0001	<0.003	0.0003 - 0.0004	80 - 91	162 - 202	<2 - 2	28.4 - 44.0	22.5 - 25.1	1.48 - 2.85
01-Jan-2023 to 31-Dec-2023	<0.0001	<0.003	0.0002 - 0.0003	87 - 91	150 - 228	<2 - 2	28.4 - 39.1	22.1 - 25.8	1.34 - 2.58
01-Jan-2024 to 31-Dec-2024	<0.0001	<0.003	0.0003 - 0.0004	86 - 89	182 - 226	<2	28.9 - 38.3	22.1 - 23.8	1.00 - 2.85

3.3 ABILITY TO MAINTAIN OPERATING CONDITIONS AND INHIBITOR CONCENTRATIONS, IN THE DISTRIBUTION SYSTEM AND PREMISE PLUMBING (RESIDENTIAL & NON-RESIDENTIAL)

The ability to maintain operating conditions and inhibitor concentrations within the Woodward Distribution System was monitored as required by the Municipal Drinking Water Licence (MDWL). The regulated sampling program continued in 2024 with orthophosphate concentrations and other related parameters measured at the ends of the Woodward Distribution System. In addition, these parameters were measured throughout the Woodward Distribution System through the system-wide corrosion control sampling program that continued in 2024. This branch of the program provides monitoring data beyond the regulatory requirements for the entire Woodward Distribution System. It allows for a system-wide surveillance of orthophosphate levels and potential secondary impacts. In the event of an observed anomaly, flushing and enhanced sampling is initiated to determine the cause and to ensure appropriate action is taken.

As illustrated in Table 4, orthophosphate residuals at the ends of the distribution system demonstrate consistent delivery of orthophosphate throughout the system. There was one instance where the orthophosphate residual measured in the distribution system exceeded the desired range of 1.8 mg/L to 3.0 mg/L. Flushing was performed at the location and subsequent sampling showed a return to normalized concentrations of orthophosphate.

Pre- and post-implementation turbidity values are summarized in Table 4. The addition of the inhibitor has not been shown to negatively impact the aesthetic appearance of the water in the Woodward Distribution System.

Although operating conditions and inhibitor concentrations are not measured in premise plumbing, Section 4 discusses the levels of lead and other metals as seen in premise plumbing because of orthophosphate use.

TABLE 4: COMPARISON OF PRE- AND POST-IMPLEMENTATION ORTHOPHOSPHATE RESIDUALS, FIELD TURBIDITY, FIELD TEMPERATURE AND IRON IN THE DISTRIBUTION SYSTEM

Dates	Distribution Result Value Range			
	Orthophosphate (mg/L)	Field Turbidity (NTU)	Field Temperature (^{0}C)	Iron (mg/L)
Pre-Implementation				
01-Jul-2016 to 30-Sept-2016	<0.15	0.05 - 3.49	n/a	n/a
01-Nov-2016 to 30-Jan-2017	<0.15	0.09 - 3.10	n/a	n/a
01-Mar-2017 to 30-Jun-2017	<0.15	0.07 - 0.71	n/a	n/a
Post-Implementation				
05-Nov-2018 to 27-Dec-2018	<0.15 - 2.55	0.06 - 1.10	7.1 - 17.3	<0.003 - 0.056
01-Jan-2019 to 31-Dec-2019	0.22 - 2.42	0.05 - 1.16	3.1 - 22.0	<0.003 - 0.102
01-Jan-2020 to 31-Dec-2020	1.72 - 3.53	<0.05 - 1.67	4.8 - 22.3	<0.003 - 0.093
01-Jan-2021 to 31-Dec-2021	1.43 - 6.54	<0.05 - 5.04	<0.1 - 25.0	<0.003 - 0.079
01-Jan-2022 to 31-Dec-2022	1.76 - 10.0	0.05 - 9.87	4.0 - 24.3	<0.003 - 0.062
01-Jan-2023 to 31-Dec-2023	1.48 - 7.80	0.05 - 4.2	4.8 - 23.0	<0.003 - 0.167
01-Jan-2024 to 31-Dec-2024	1.41 - 4.81	0.06 - 2.44	4.3 - 23.7	<0.003 - 0.485

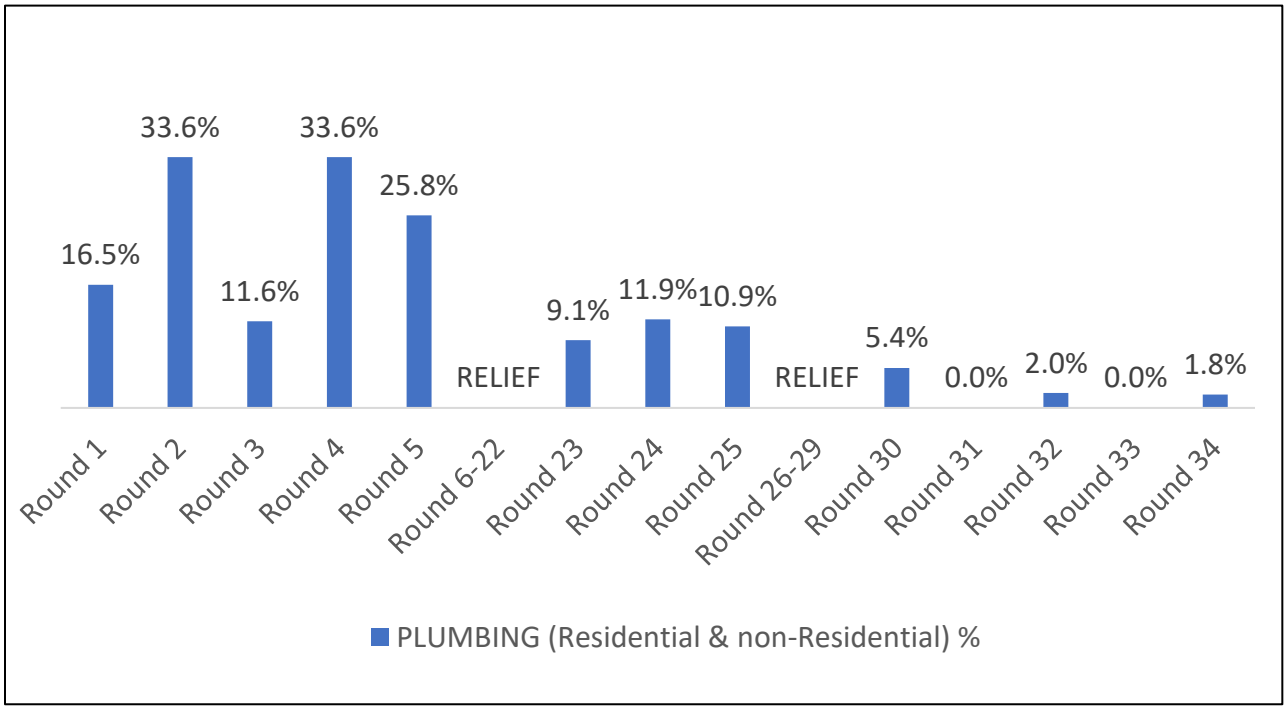
3.4 ABILITY TO ACHIEVE REDUCTION IN LEAD LEVELS AND OTHER CORROSION RELATED PARAMETERS IN THE DISTRIBUTION SYSTEM AND PREMISE PLUMBING (RESIDENTIAL & NON-RESIDENTIAL)

Lead levels and other corrosion control related parameters are monitored primarily through the Schedule 15.1 Community Lead Sampling Program, under O. Reg. 170/03 of the Safe Drinking Water Act. Prior to the inhibitor addition in the Woodward Distribution System, the Municipal Drinking Water Licence (MDWL) contained a Condition of Lead Regulatory Relief - Schedule D.

Upon addition of the inhibitor, the Schedule 15.1 sampling program was resumed under a reduced sampling plan as specified in the Woodward Distribution System MDWL. Round 32 (Winter) and Round 33 (Summer) took place in 2024 with a summary of the results found in Section 4 of this report.

As summarized in Chart 1, an overall decline in lead levels at the tap and the percentage of samples with results above the Maximum Acceptable Concentration (MAC) for lead (0.01 mg/L) has been observed.

CHART 1: PERCENT (%) OF PREMISE SAMPLES WITH LEAD ABOVE THE MAC (0.01 MG/L)



4 SUMMARY OF LEAD LEVELS AND OTHER METALS

4.1 SCHEDULE 15.1 COMMUNITY LEAD SAMPLING UNDER ONTARIO REGULATION 170/03

Tables 5, 6 and 7 illustrate the pre- and post-implementation results from the Schedule 15.1 sampling rounds for the Woodward Distribution System as seen at premise plumbing (residential and non-residential) and in the distribution system.

TABLE 5: PRE- AND POST-IMPLEMENTATION RESULTS FROM THE SCHEDULE 15.1 SAMPLING FOR THE WOODWARD DISTRIBUTION SYSTEM – PREMISE (RESIDENTIAL)

Round	Dates	Number of Samples		Results Value Range		Percent (%) of Samples with Lead >0.01 mg/L
		Total	Lead >0.01 mg/L	Lead (mg/L)	Field pH	
1	20-Feb-2008 to 2-Apr-2008	105	18	<0.001 - 0.056	6.17 - 7.80	17%
2	2-Sep-2008 to 9-Oct-2008	106	36	<0.001 - 0.239	7.12 - 7.92	34%
3	26-Feb-2009 to 21-Mar-2009	100	10	<0.001 - 0.0118	6.94 - 7.41	10%
4	26-Sept-2009 to 15-Oct-2009	103	35	<0.001 - 0.0339	6.97 - 8.01	35%
5	15-Dec-2009 to 15-Apr-2010	110	28	<0.0005 - 0.0353	7.25 - 8.00	26%
6-22	Regulatory Relief					

Round	Dates	Number of Samples		Results Value Range		Percent (%) of Samples with Lead >0.01 mg/L
		Total	Lead >0.01 mg/L	Lead (mg/L)	Field pH	
23	15-Dec-2018 to 15-Apr-2019	50	5	<0.0001 -0.0226	7.34 - 7.65	10%
24	15-June-2019 to 15-Oct-2019	53	5	<0.0001 - 0.0331	6.77 - 7.81	9%
25	15-Dec-2019 to 15-Apr-2020	50	4	<0.0001 - 0.0189	7.25 - 7.89	8%
26-29	COVID Regulatory Relief for lead sampling (premise)					
30	15-Jun-2022 to 15-Oct-2022	51	2	<0.0001 - 0.0152	7.38 - 7.64	4%
31	15-Dec-2022 to 15-Apr-2023	50	0	<0.0001 - 0.0070	7.22 - 7.73	0%
32	15-Jun-2023 To 15-Oct-2023	50	1	<0.0001 - 0.0152	7.14 - 7.63	2%
33	15-Dec-2023 to 15-Apr-2024	51	0	<0.0001 -0.0063	7.34 - 7.87	0%
34	15-Jun-2024 to 15-Oct-2024	50	1	<0.0001 - 0.0118	7.08 - 7.56	2%

TABLE 6: PRE- AND POST-IMPLEMENTATION RESULTS FROM THE SCHEDULE 15.1 SAMPLING FOR THE WOODWARD DISTRIBUTION SYSTEM – PREMISE (NON-RESIDENTIAL)

Round	Dates	Number of Samples		Results Value Range		Percent (%) of Samples with Lead >0.01mg/L
		Total	Lead >0.01 mg/L	Lead (mg/L)	Field pH	
1	20-Feb-2008 to 2-Apr-2008	10	1	<0.001 - 0.0270	6.94 - 7.30	10%
2	2-Sep-2008 to 9-Oct-2008	10	3	<0.001 - 0.0250	7.39 - 7.58	33%
3	26-Feb-2009 to 21-Mar-2009	12	3	<0.001 - 0.0502	6.82 - 7.72	25%
4	26-Sept-2009 to 15-Oct-2009	10	3	<0.001 - 0.0489	7.46 - 7.65	33%
5	15-Dec-2009 to 15-Apr-2010	10	3	<0.0005 - 0.0407	7.35 - 7.76	33%
6-22	Regulatory Relief					
23	15-Dec-2018 to 15-Apr-2019	5	0	0.0004 - 0.0092	7.41 - 7.72	0%
24	15-June-2019 to 15-Oct-2019	6	2	0.0006 - 0.0020	7.48 - 7.65	33%

Round	Dates	Number of Samples		Results Value Range		Percent (%) of Samples with Lead >0.01mg/L
		Total	Lead >0.01 mg/L	Lead (mg/L)	Field pH	
25	15-Dec-2019 to 15-Apr-2020	5	2	0.0004 - 0.0029	7.48 - 7.89	40%
26-29	COVID Regulatory Relief for lead sampling (premise)					
30	15-Jun-2022 to 15-Oct-2022	5	1	<0.0001 - 0.0330	7.40 - 7.63	20%
31	15-Dec-2022 to 15-Apr-2023	5	0	<0.0001 - 0.0012	7.37 - 7.45	0%
32	15-Jun-2023 to 15-Oct-2023	5	0	<0.0001 - 0.0025	7.24 - 7.44	0%
33	15-Dec-2023 to 15-Apr-2024	5	0	<0.0001 - 0.0005	7.38 - 7.50	0%
34	15-Jun-2024 to 15-Oct-2024	5	0	<0.0001 - 0.0040	7.34 - 7.67	0%

TABLE 7: PRE- AND POST-IMPLEMENTATION RESULTS FROM THE SCHEDULE 15.1 SAMPLING FOR THE WOODWARD DISTRIBUTION SYSTEM – DISTRIBUTION SYSTEM

Round	Dates	Number of Samples		Results Value Range			Percent (%) of Samples with Lead >0.01mg/L
		Total	Lead >0.01 mg/L	Lead (mg/L)	Field pH	Alkalinity (mg/L)	
1	20-Feb-2008 to 2-Apr-2008	20	0	<0.001 - 0.001	6.10 - 8.00	82 - 87	0%
2	2-Sep-2008 to 9-Oct-2008	21	0	<0.001 - 0.002	7.20 - 7.60	80 - 85	0%
3	26-Feb-2009 to 21-Mar-2009	20	0	<0.001 - 0.004	6.10 - 7.60	84 - 88	0%
4	26-Sept-2009 to 15-Oct-2009	20	0	<0.001 - 0.002	7.20 - 7.70	77 - 90	0%
5	15-Dec-2009 to 15-Apr-2010	23	0	<0.0005 - 0.0027	7.57 - 8.03	83 - 88	0%
6-22	Regulatory Relief						
23	15-Dec-2018 to 15-Apr-2019	10	0	0.0001 - 0.0025	7.36 - 7.66	82 - 89	0%
24	15-June-2019 to 15-Oct-2019	11	1*	<0.0001 - 0.0444	7.35 - 7.87	82 - 90	9%
25	15-Dec-2019 to 15-Apr-2020	10	0	<0.0001 - 0.0012	7.40 - 8.01	84 - 87	0%

Round	Dates	Number of Samples		Results Value Range			Percent (%) of Samples with Lead >0.01mg/L
		Total	Lead >0.01 mg/L	Lead (mg/L)	Field pH	Alkalinity (mg/L)	
26	15-June-2020 to 15-Oct-2020	10	0	<0.0001 - 0.0003	7.42 - 7.65	85 - 88	0%
27	15-Dec-2020 to 15-Apr-2021	10	0	<0.0001 - 0.0018	7.39 - 7.60	86 - 88	0%
28	15-June-2021 to 15-Oct-2021	10	0	<0.0001 - 0.0003	7.23 - 7.45	83 - 86	0%
29	15-Dec-2021 to 15-Apr-2022	10	0	<0.0001 - 0.0006	7.47 - 7.87	87 - 90	0%
30	15-Jun-2022 to 15-Oct-2022	10	0	<0.0001 - 0.0003	7.47 - 7.59	86 - 93	0%
31	15-Dec-2022 to 15-Apr-2023	10	0	<0.0001 - 0.0002	7.21 - 7.59	89 - 90	0%
32	15-Jun-2023 to 15-Oct-2023	10	0	<0.0001 - 0.0005	7.24 - 7.53	85 - 88	0%
33	15-Dec-2023 to 15-Apr-2024	10	0	<0.0001 - 0.0003	7.36 - 7.59	84 - 88	0%
34	15-Jun-2024 to 15-Oct-2024	10	0	<0.0001 - 0.0004	7.27 - 7.46	88 - 91	0%

*Hydrant was found to contain a lead port. Resampling and analysis at the same hydrant had a lead result of <0.01 mg/L.

As required by the Municipal Drinking Water Licence, copper is monitored at residential and non-residential premise plumbing through the Schedule 15.1 Community Lead Sampling Program. Copper was not measured prior to the implementation of the Corrosion Control Program; however, it was measured throughout the Woodward Distribution System over three sampling periods as part of the City's Corrosion Control baseline study.

The Ontario Drinking Water Standards, Objectives and Guidelines have an Aesthetic Objective guideline of 1.0 mg/L for copper. Pre- and post-implementation sampling results are illustrated in Table 8 and show copper results remaining well below the Aesthetic Objective guideline.

TABLE 8: PRE- AND POST-IMPLEMENTATION RESULTS OF COPPER IN THE SYSTEM

Dates	Number of Samples	Copper Results (Range) (mg/L)
Pre-Implementation		
01-Jul-2016 to 30-Sept-2016	98	<0.002 - 0.0062
01-Nov-2016 to 30-Jan-2017	79	<0.002 - 0.0900
01-Mar-2017 to 30-Jun-2017	82	<0.002 - 0.0042
Post-Implementation		
01-Jan-2019 to 31-Dec-2019	114	0.0020 - 0.0931
01-Jan-2020 to 31-Dec-2020	55	0.0017 - 0.0633
01-Jan-2021 to 31-Dec-2021	COVID Regulatory Relief for sampling	
01-Jan-2022 to 31-Dec-2022	56	0.0012 - 0.0906
01-Jan-2023 to 31-Dec-2023	110	0.0014 - 0.2390
01-Jan-2024 to 31-Dec-2024	110	0.1400 - 0.2390

5 EVALUATION OF SECONDARY IMPACTS

5.1 CUSTOMER FEEDBACK OR WATER QUALITY COMPLAINTS, SINCE IMPLEMENTATION OF CORROSION CONTROL, WITH ANALYSIS OF REASONS

The City collects and reviews customer feedback and water quality complaints to ensure customer safety and satisfaction. In 2024, no water quality complaints related to the Corrosion Control Program were received. There were six inquires on lead in drinking water and the Corrosion Control Program. In all six cases, the information requested was promptly provided through the Customer Service and Community Outreach team and included information of the City's Corrosion Control Program.

Section 6b summarizes the outreach and education performed by the City in relation to the Corrosion Control Program and lead awareness.

5.2 IMPACTS ON SECONDARY DISINFECTION, INCLUDING BIOFILM FORMATION

The City monitors secondary disinfection through measuring chlorine residuals throughout the Woodward Distribution System. Biofilm formation is monitored through the Heterotrophic Plate Count (HPC) test. Table 9 summarizes both chlorine residuals and HPC as seen before and after orthophosphate addition.

In 2019 and 2021, an increase in the HPC was observed at specific locations. The City investigated locations with elevated HPC as part of their due diligence HPC resampling program. It was discovered that internal building plumbing was the cause of the increase, as these locations had very little or no water use. By increasing water use at these locations, the HPC count returned to baseline levels. Due diligence HPC resampling continued in 2024 as a proactive means of acting on water quality indicators.

There were no significant changes observed with the chlorine residuals within the Woodward Distribution System.

TABLE 9: SUMMARY OF CHLORINE RESIDUALS AND HPC VALUES PRE- AND POST-IMPLEMENTATION

Dates	Distribution Results Range	
	Combined Chlorine (mg/L)	HPC (CFU/1mL)
PRE-IMPLEMENTATION		
01-Jan-2018 to 07-Nov-2018	0.64 - 2.80	0 - 98
POST-IMPLEMENTATION		
08-Nov-2018 to 31-Dec-2018	0.93 - 2.80	0 - 64
01-Jan-2019 to 31-Dec-2019	0.51 - 3.06	0 - 1010
01-Jan-2020 to 31-Dec-2020	0.11 - 2.81	0 - 2200
01-Jan-2021 to 31-Dec-2021	0.19 - 2.85	0 - 1720
01-Jan-2022 to 31-Dec-2022	0.51 - 2.95	0 - 810
01-Jan-2023 to 31-Dec-2023	0.04 - 2.90	0 - 1700
01-Jan-2024 to 31-Dec-2024	0.08 - 3.05	0 - 188

5.3 IMPACTS ON WASTEWATER TREATMENT PLANTS RECEIVING TREATED WATER FROM THE OWNER, INCLUDING ESTIMATES OF INCREASES IN PHOSPHOROUS LOADINGS TO THE RECEIVER, AND COMPARISON TO EFFLUENT LIMITS

The City operates both the Woodward Avenue and Dundas Wastewater Treatment Plants (WWTPs). Since program implementation in 2018, the addition of orthophosphate has had minimal effects on the wastewater treatment process. This has been shown in the final effluent concentrations summaries illustrated in Tables 10 and 11. The values remain below the effluent limits set by the Environmental Compliance Approvals (ECA)/Certificate of Approval; Woodward Avenue WWTP ECA Number 9410-B65QRT, dated May 14, 2019, and Dundas WWTP Certificate of Approval Number 3101-89PNRC, dated October 6, 2010.

TABLE 10: SUMMARY OF RAW INFLUENT CONCENTRATIONS AND LOADINGS PRE- AND POST-IMPLEMENTATION

Dates	Annual Average Results					
	Woodward Avenue WWTP			Dundas WWTP		
	TP (mg/L)	Lab pH	TP Daily Loadings (Kg/day)	TP (mg/L)	Lab pH	TP Daily Loadings (Kg/day)
Pre-Implementation						
Jan-Oct 2018	4.83	7.74	1,484	3.24	7.66	40
Post-Implementation						
Nov-Dec 2018	5.55	7.72	1,897	3.29	7.71	44
Jan-Dec 2019	4.25	7.69	1,560	3.22	7.67	42
Jan-Dec 2020	5.49	7.61**	1,611	3.39	7.65	40
Jan-Dec 2021	4.87	7.59	1,344	3.41	7.62	37
Jan-Dec 2022	5.23	7.58	1,332	3.76	7.61	38
Jan-Dec 2023	8.21	7.57	2,664	4.36	7.56	52
Jan-Dec 2024	7.39	7.60	2,246	3.78	7.52	46

NOTE: TP - Total Phosphorus as P

**For samples collected from May 29, 2021, to December 31, 2021, use lab pH results with caution as an electrode malfunction may have impacted the results.

TABLE 11: SUMMARY OF FINAL EFFLUENT CONCENTRATIONS AND LOADINGS PRE- AND POST-IMPLEMENTATION

Dates	Annual Average Results					
	Woodward Avenue WWTP			Dundas WWTP		
	TP (mg/L)	Lab pH	TP Daily Loadings (Kg/day)	TP (mg/L)	Lab pH	TP Daily Loadings (Kg/day)
Pre-Implementation						
Jan-Oct 2018	0.443	7.85	138	0.052	7.70	0.65
Nov-Dec 2018	0.341	7.77	116	0.054	7.75	0.72
Post-Implementation						
Jan-Dec 2019	0.504	7.76	194	0.083	7.76	1.07
Jan-Dec 2020	0.572	7.62**	171	0.108	7.45**	1.27
Jan-Dec 2021	0.573	7.54	162	0.131	7.52	1.45
Jan-Dec 2022	0.437	7.54	116	0.129	7.51	1.25
Jan-Dec 2023	0.200	7.06	63	0.089	7.59	1.05
Jan-Dec 2024	0.210	7.05	63	0.093	7.23	1.12

NOTE: TP - Total Phosphorus as P
Woodward Avenue ECA Limits for TP = 0.80mg/L; TP Loadings = 327Kg/day; pH = 6.0 to 9.5 inclusive.

Dundas ECA Limits for TP = 0.50mg/L; TP Loadings = 9.1Kg/day; pH = 6.0 to 9.5 inclusive.

*Woodward Avenue WWTP Data is an average of Final Effluent North and South. Beginning October 2022, the data is an average of Final Effluent 1 and 2, where the final treatment process moved from secondary to tertiary (third) level treatment as a result of the Woodward Wastewater Treatment Plant Upgrades. Tertiary treatment includes additional phosphorus removal.

**For samples collected from May 29, 2021, to December 31, 2021, use lab pH results with caution as an electrode malfunction may have impacted the results.

6 OWNER LED MITIGATION STRATEGIES

6.1 LEAD SERVICE LINE REPLACEMENT ON PUBLIC AND PRIVATE PROPERTY

The City has estimated that there was a total of 18,770 sub-standard/lead water service lines (LWSLs) remaining within the Woodward Distribution System at the end of 2024. This number is an approximation due to various uncertainties and variables that make it difficult to track.

The City's Sub-Standard Water Service Line Replacement Program has been in place for over 30 years to address customer requests related to pressure or other concerns (such as undersized services or leaks). Over the last 10 to 15 years, as the public has been made more aware of the risk associated with lead, the focus of the program has shifted from poor pressure to sub-standard/LWSL replacements.

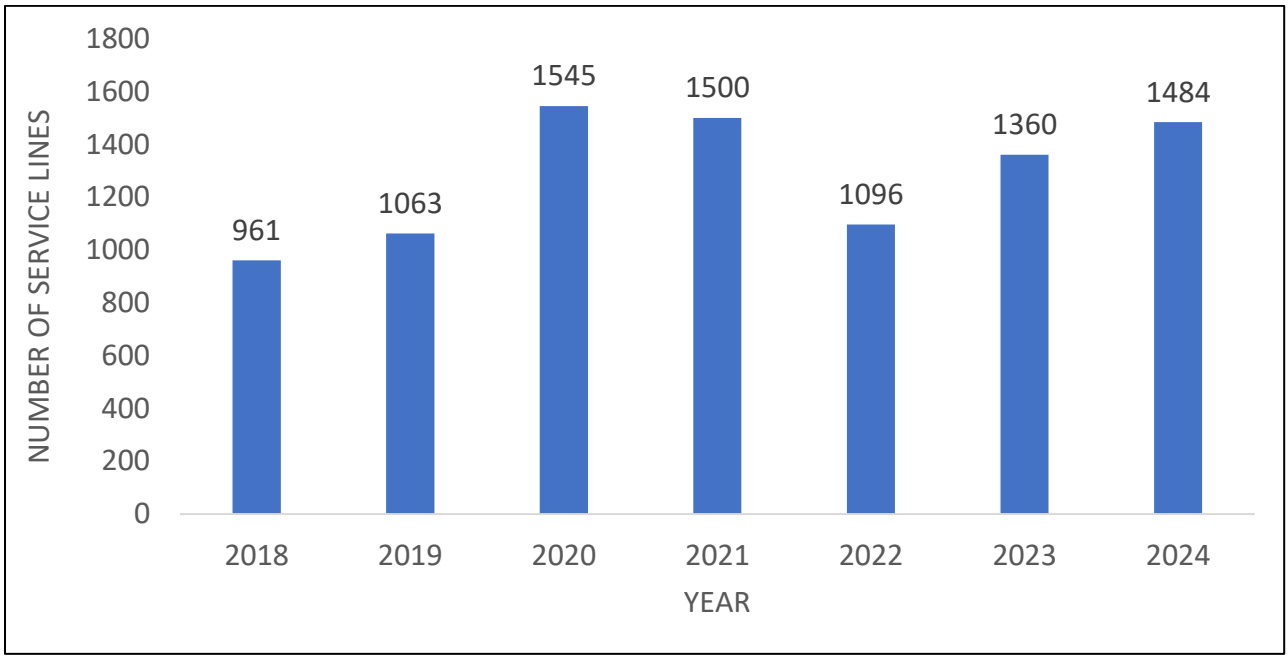
In this program, the City replaces the sub-standard material up to the property line (public portion) when the homeowner replaces the privately-owned portion. In addition, the City has a loan program available to assist homeowners with the replacement of their privately-owned portion.

Under this program in 2024, 428 sub-standard/LWSLs replacements were completed by the City on the public portion, with 826 replacements performed on the private portion, and 230 replacements completed as part of routine watermain maintenance/rehabilitation work. It is important to note that only the public portion is replaced as part of routine watermain work as performed by capital construction. This summary is illustrated in Table 12. A summary of the number of sub-standard service line replacement over the last 5 years is illustrated in Chart 2.

TABLE 12: SUMMARY OF SUB-STANDARD SERVICE LINE REPLACEMENTS PERFORMED IN 2024

Year	Public	Private	Watermain Maintenance/Rehabilitation Work (Public)
2024	428	826	230

CHART 2: NUMBER OF SUB-STANDARD SERVICE LINE REPLACEMENTS, 2018-2024



6.2 OUTREACH AND EDUCATION, ESPECIALLY TO POPULATIONS VULNERABLE TO LEAD IN DRINKING WATER

In 2024, the following outreach/education on lead awareness and the Corrosion Control Program was completed:

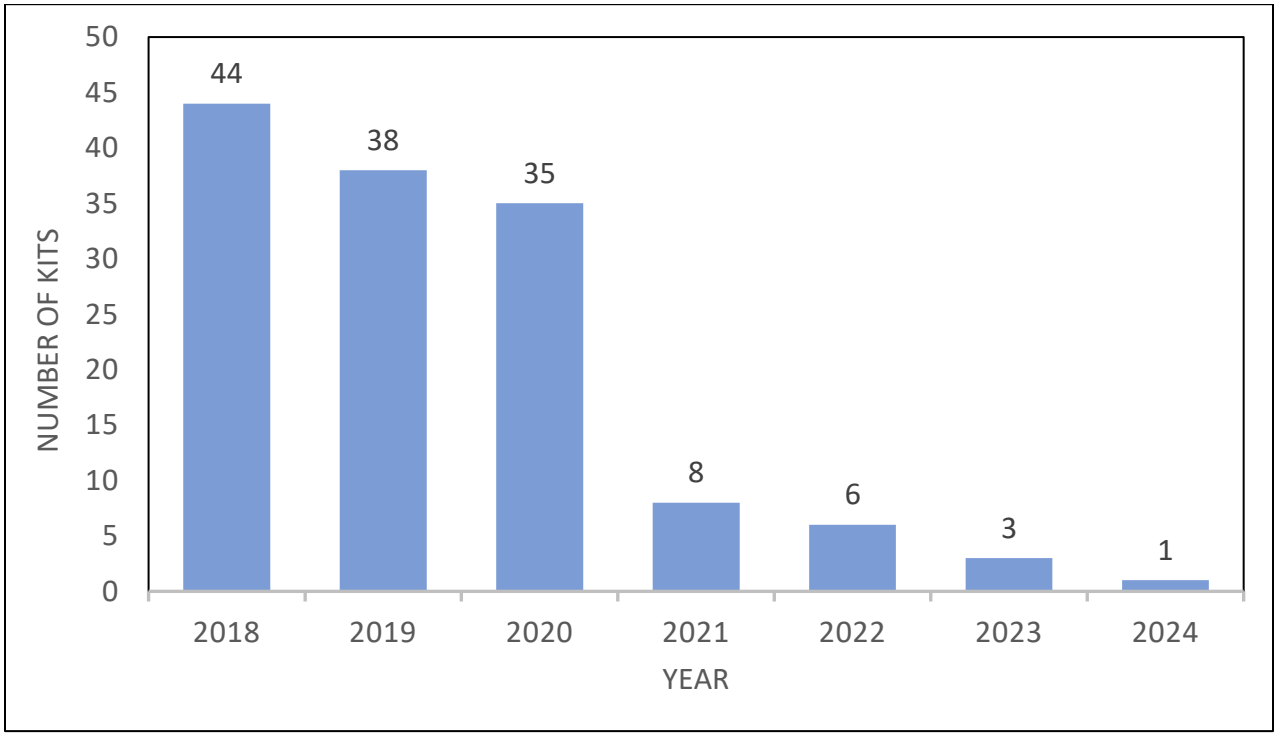
- The City maintained the following websites:
    - Lead in your Drinking Water (www.hamilton.ca/home-neighbourhood/house-home/home-water-services/lead-your-drinking-water)
    - Lead Water Service Replacement (www.hamilton.ca/LeadPipes)
    - Corrosion Control (www.hamilton.ca/CorrosionControl)
- Lead Awareness Advertising: (September 1 - 30, 2024):
    - Digital: The Weather Network and the Hamilton Spectator (target wards 1, 3 and 4)
    - Social media: Meta (target wards 1, 3 and 4)
    - Print: The Hamilton Spectator

- 25,321 properties were mailed lead awareness packages. These were sent to properties with known lead service lines, as well as to homes built before 1955 where the service type is unknown.
- 784 Coordinated Roads information packages were mailed out including Public Health Lead inserts and the Lead Pipe Replacement Program details to property owners that were going to be affected by road cuts at their properties due to work such as watermain replacement or road resurfacing.
- 145,000 properties within the Woodward Distribution System received the 2024 Water & Wastewater/Stormwater Rates Newsletter in January and a Hamilton Water Program Newsletter in the Fall via the Alectra Bill Insert. This insert included Lead Pipe Awareness messaging including the Lead Water Service Replacement Loan Program. Alectra Utilities is an electricity utility and distributor that invoices water, wastewater and stormwater charges on behalf of the City.

6.3 FILTER KIT PROGRAM

The City provides filter kits certified by the National Sanitation Foundation (NSF/ANSI-53). The kit consists of a Brita jug and 3 filters. They are provided to homeowners when requested or to contractors when a permit to replace a lead water service line is obtained. In 2024, 1 lead filter kit was provided to a resident by the City. Data from the last 7 years shows a decline in the number of kits provided by the City (Chart 3). The cause of the decline remains unclear, however the City continues to maintain this program.

CHART 3: NUMBER OF LEAD FILTER KITS HANDED OUT BY THE CITY OF HAMILTON, 2018-2024



6.4 INVOLVEMENT OF PUBLIC HEALTH AUTHORITIES

Public Health Services (PHS) has worked in conjunction with Hamilton Water from the development of the Corrosion Control Program to the implementation of activities related to the program. Public Health Services educates the public on the risks associated with lead exposure by maintaining a link on their website of the various sources of lead in the environment, the health risks, and how the public can take steps to protect themselves from lead exposure.

Public Health Services was also involved in all Adverse Water Quality Incidents (AWQIs) that were initiated in 2024. Semi-annual liaison meetings between Public Health Services and Hamilton Water continued in 2024 keeping both units informed on related activities. These semi-annual meetings and the involvement of Public Health Services during Adverse Water Quality Incidents continues in 2025.

7 CONCLUSION

The City began the addition of phosphoric acid in the Woodward Distribution System on November 8, 2018, and in conformance with the requirements of Schedule C of the Municipal Drinking Water Licence, continues to sample and monitor to evaluate the effectiveness of the program for lead control.

The post-implementation sampling and monitoring plan shows the orthophosphate inhibitor is working as expected with minimal secondary effects observed. The Schedule 15.1 Community Lead Sampling results demonstrate a reduction in lead concentrations and a decreasing trend in the percentage of samples above the Maximum Acceptable Concentration (MAC) of 0.01 mg/L set by Ontario Regulation 169/03.

Sampling and monitoring, including the Schedule 15.1 Community Lead Sampling Program will continue in 2025.