



**Caledonia and Cayuga Distribution System
2018 Annual Water Quality Report**

January 1, 2018 – December 31, 2018

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Quality Management System Policy

The purpose of The Corporation of Haldimand County's Quality Management System policies are to:

- Ensure that our drinking water systems comply with all current legislation and regulatory requirements for the safe supply of drinking water;
- Ensure financial support is provided to maintain infrastructure integrity to allow safe and consistent delivery of drinking water to our water customers;
- Commit to review and update our Operational Plans as regulated by the Drinking Water Quality Management Standard in order to continually improve our Quality Management System and to communicate the results with our water customers.



Haldimand County Quality Management System Summary

Haldimand County's Quality Management System (QMS) is legislated under the Drinking Water Quality Management Standard (DWQMS) through the Safe Drinking Water Act. To maintain operating authority accreditation, Drinking Water Works Permits and Municipal Drinking Water Licenses for the County's waterworks systems, the Ministry of the Environment, Conservation and Parks (MECP) mandate tasks that must be completed annually. These activities include:

- Conducting an internal audit of the Quality Management System.
- Conducting a Management Review meeting.
- Participating in an external audit conducted by a third party Accreditation Body
- Updating the Quality Management System Operational Plan.
- Updating Council of the status of the County's Quality Management System.

The QMS Operational Plan was reviewed in 2018 including an update to the drinking water system's risk assessment. A review will be completed in 2019, with a focus on continual improvement and an update to staff roles and responsibilities directly impacting the drinking water system.

Haldimand County conducted internal audits with staff from Operations, Compliance and Management. An audit report was generated that identified minor non-conformances and opportunities for improvement. Staff have corrected the non-conformances and have been diligent in implementing all opportunities for improvement.

Haldimand County must receive accreditation annually to operate the water distribution systems. Through a qualified third party auditor, the County must demonstrate that its QMS meets the requirements of the DWQMS. SAI Global conducted an external audit on December 19 and 20, 2018. The County has reviewed the audit report, addressed the non-conformances and will be implementing the opportunities for improvement.

Staff are required to conduct an annual Management Review meeting to evaluate the effectiveness of the QMS. Deficiencies and opportunities for improvement are identified and action items are developed to ensure follow-up. The County held their management review meeting on November 1, 2018.

All requirements were achieved in 2018 and SAI Global have recommended that Haldimand County is issued continued accreditation to operate the drinking water systems in 2019.

Caledonia and Cayuga Distribution System



Caledonia and Cayuga Distribution System Overview

Chloraminated water is received from the City of Hamilton's Woodward Water Treatment Plant at the Caledonia Reservoir. Sodium hypochlorite is added to the water to achieve breakpoint chlorination and create a free chlorine residual that meets regulatory requirements. The chlorinated water is sent through transmission main to the Caledonia Distribution System. A standpipe provides secondary water storage and maintains water pressure within the distribution system.

Potable water is also sent via transmission main to Cayuga. At the Cayuga Reservoir, sodium hypochlorite can be added to increase the disinfectant residual. The chlorinated water is then pumped to the Cayuga distribution system. A standpipe provides secondary storage and maintains water pressure within the distribution system.

The distribution system infrastructure services approximately 9,674 people (2016 Census).

Haldimand County operates and maintains all aspects of the drinking water system, including reservoirs, hydrants, valves, sample stations and watermains.

Expenditure Information

Haldimand County staff are diligent in prioritizing projects on an annual basis to eliminate unnecessary expenditure. Using the best available information at the time of this report, key expenditures occurring in the Caledonia and Cayuga Distribution System are identified in Table 1. All drinking water expenditure information is not included in this report.

Table 1: Caledonia and Cayuga Distribution System 2018 Expenditures

Caledonia and Cayuga Distribution System:	
Leak Detection Program (Caledonia and Cayuga)	
Cayuga Reservoir Generator Rehabilitation	
Cayuga Reservoir Inlet Flow Meter Replacement	
Instrumentation Calibrations/Verification	
SCADA Upgrades	
Caledonia Standpipe Inspection and Repair	
Caledonia Reservoir Pump Replacement	
Caledonia Inlet Chlorine Injection Refurbishments	
Total Cost	\$91,896

Multi-Barrier Approach

Through the Walkerton Inquiry, Justice O'Connor recommended that drinking water is best protected by taking an approach that uses multiple barriers to prevent contamination from affecting our drinking water. The multi-barrier approach addresses potential threats by ensuring barriers are in place to either eliminate or minimize their impact. This holistic approach recognizes that each barrier may not be able to completely remove a contaminant, but by working together the barriers provide a high-level of protection. Typical barriers include:

Source Protection

- **Source Protection Plans**
- **Treatment**
 - **Treatment and Disinfection Goals**
- **Distribution System**
 - **Residual Maintenance**
- **Monitoring**
 - **Sampling Programs**
- **Emergency Preparedness**
 - **Emergency Plans**



Haldimand County has adopted the multi-barrier approach in ensuring safe, reliable drinking water. *Figure 1* shows how administration, design, maintenance, and operation work together to establish and maintain multi-barrier protection (US EPA, 1998).

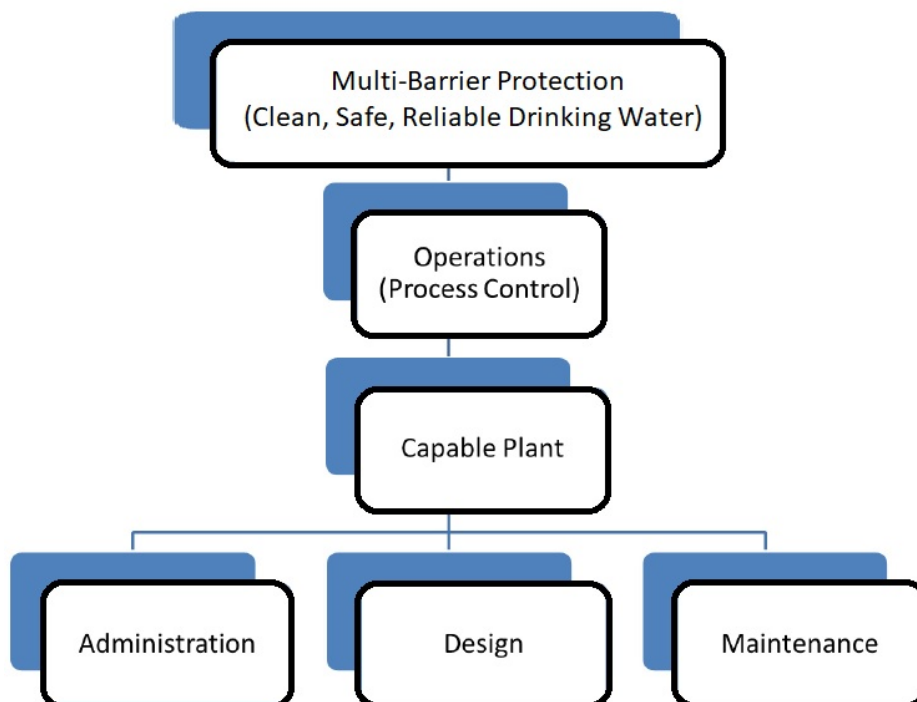


Figure 1: Responsibilities for Clean, Safe and Reliable Drinking Water

A description of the responsibilities in each area is summarized as follows:

- **Administration:** The administrators or managers of a water treatment system are responsible for providing the resources (budget and staff) and policies (hours of staffing, reporting requirements, training and certification requirements, etc.). Funding may also need to be justified and obtained if the design of a system is inadequate or major upgrades are required. Managers establish and maintain emergency response plans and communication procedures to ensure prompt response to unsafe drinking water.
- **Design:** The designer's responsibility is to provide the physical infrastructure (pipes, valves, tanks, meters, etc.) capable of reliably producing and distributing the quality and quantity of water required. The design must provide adequate flexibility and controllability to enable the operator to make appropriate adjustments.
- **Maintenance:** The system must be maintained in good working order with the key equipment functional at all times. Should a key piece of equipment break down then it should be repaired in a timely manner.
- **Operations:** Once a capable system is in place, then it is the operator's responsibility to deliver safe drinking water through monitoring, testing and process control (for example by changing the setting on the dosing pumps). Operators are also responsible for maintaining records (log books, data forms, etc.), which aid in troubleshooting and design of upgrades. A further, and commonly unrecognized responsibility of the operator is to communicate the needs of the facility to administrators for possible action.

WATER SAMPLING

To comply with drinking water legislation, drinking water systems are required to monitor their water quality. Haldimand County has committed to providing safe, reliable drinking water and is diligent in ensuring that sampling and monitoring programs effectively characterize water quality. All samples are taken by certified operators and tests performed by accredited, licensed laboratories.

Microbiological Sampling

Microbial quality is one of the primary indicators for the safety of a drinking water supply. Of all contaminants in drinking water, human and/or animal feces present the greatest danger to public health. Pathogenic or disease causing micro-organisms (including certain protozoa, bacteria or viruses) may be found in untreated water supplies. Bacteriological monitoring or testing is a way to detect and control pathogenic bacteria in treated drinking water supplies. Heterotrophic Plate Count (HPC) and background bacteria samples are monitored to identify potential changes in water quality and are not used as an indicator of adverse human health effects. Table 2 provides a summary of microbiological sampling completed in the Caledonia and Cayuga Distribution System during 2017.

Table 2: 2018 Caledonia and Cayuga Distribution System Microbiological Sampling

	Number of Samples	Range of E.coli Results (cfu/100ml)	Range of Total Coliform Results (cfu/100ml)	Number of HPC Samples	Range of HPC Results (cfu/ml)	Number of Background Samples	Range of Background Results (cfu/ml)
Caledonia Distribution	208	0	0	52	0 – 280	208	0 – >200
Cayuga Distribution	156	0	0	52	0	156	0 – 90

*Note: At a minimum, 25% of all drinking water samples must be analyzed for HPC.

Operational Sampling

Operational sampling and monitoring is important in maintaining the integrity of each barrier in the multi-barrier approach. Schedule 7 and 8 of Ontario Regulation 170/03 specify requirements for operational checks that municipalities must follow. Table 3 provides a summary of operational samples taken for the drinking water system. Regulatory requirements were achieved for all samples taken. Although not included in this report, Caledonia and Cayuga Reservoirs have continuous monitoring chlorine residual analyzers, which monitor all water pumped to the distribution systems.

Table 3: 2018 Caledonia and Cayuga Distribution System Operational Sampling

	Number of Grab Samples	Range of Results	Regulatory Requirement	Minimum Recommended Target
Free Chlorine Caledonia	365	0.39 – 1.72 mg/L	≥ 0.05 mg/L	≥ 0.20 mg/L
Free Chlorine Cayuga	312	0.30 – 1.33 mg/L	≥ 0.05 mg/L	≥ 0.20 mg/L

As result of public inquiries, a quarterly treated water hardness sampling program was initiated in 2018.

The term hardness was originally applied to waters that were hard to wash in, referring to the soap wasting properties of hard water. Hardness prevents soap from lathering by causing the development of an insoluble curdy precipitate in the water; hardness typically causes the buildup of hardness scale (such as seen in cooking pans). Dissolved calcium and magnesium salts are primarily responsible for most scaling in pipes and water heaters and can cause numerous problems in laundry, kitchen, and bath. Hardness is usually expressed in grains per gallon (or ppm) as calcium carbonate equivalent.

The degree of hardness standard as established by the American Society of Agricultural Engineers (S-339) and the Water Quality Association (WQA) is shown in the following table:

Table 4: Standard Degree of Hardness

Degree of Hardness	Grains per Gallon (gpg)	Ppm (mg/L)
Soft	< 1.0	< 17.0
Slightly Hard	1.0 – 3.5	17 - 60
Moderately Hard	3.5 – 7.0	60 - 120
Hard	7.0 – 10.5	120 - 180
Very Hard	> 10.5	> 180

The sample results in Table 5 indicate that the average values for Caledonia and Cayuga are moderately hard to hard water as taken from the Degree of Hardness Table above. The September 18th sample for Caledonia was unusually high at 304 mg/L and may not accurately show the water hardness during that period.

Table 5: 2018 Caledonia and Cayuga Distribution System Hardness Sampling

Parameter	Sample Date	Caledonia	Cayuga
Total Hardness (mg/L as CaCO ₃)	March 1, 2018	136	128
	June 19, 2018	120	121
	September 18, 2018	304	132
	November 6, 2018	118	126
2018 Average >		170	127

Lead Sampling

The community lead testing program is a requirement of O.Reg. 170/03 under the Safe Drinking Water Act, 2002. Haldimand County is exempt from sampling private residences due to having less than 10% of plumbing sample locations exceed the standard for two consecutive periods of reduced sampling. Annual pH and alkalinity samples are taken, as well as distribution system lead samples, every three years. There are no regulatory limits for alkalinity and pH, however Haldimand County sample results are within the operational guidelines provided by the MECP. A summary of 2018 sampling has been provided in Table 6.

Table 6: 2018 Caledonia and Cayuga Distribution System Lead Sampling

	Sample Type	Number of Samples	Range of Results	Number of Exceedances
Caledonia	Plumbing - Lead	N/A	N/A	N/A
	Distribution - Lead	4	0.01 – 0.16	0
	Distribution - Alkalinity	4	87 – 90 mg/L	N/A
	Distribution - pH	4	7.56 – 7.74	N/A
Cayuga	Plumbing - Lead	N/A	N/A	N/A
	Distribution - Lead	4	0.01 – 0.87	0
	Distribution - Alkalinity	4	88 – 90 mg/L	N/A
	Distribution - pH	4	7.43 – 7.81	N/A

Organic Sampling

To protect drinking water from pathogens, a disinfectant (usually chlorine) is added to the drinking water. Disinfectants can react with naturally-occurring materials in the water to form disinfection byproducts, which may pose health risks.



A challenge for water systems is balancing pathogen control and disinfection byproduct formation. It is important to provide protection from pathogens while minimizing health risks from disinfection byproducts. More information on each byproduct is summarized in Table 7.

Haldimand County sample for haloacetic acids (HAA) and trihalomethanes (THM) in the distribution system where there is an elevated potential for the formation of these byproducts.

Table 7: Disinfection Byproduct Information

Disinfection Byproduct	How it is formed?	Health Effects
Trihalomethanes	Trihalomethanes occur when naturally-occurring organic and inorganic materials in the water react with the disinfectants, chlorine and chloramine.	Some people who drink water containing total trihalomethanes in excess of the MCL over many years could experience liver, kidney, or central nervous system problems and increased risk of cancer.
Haloacetic Acids	Haloacetic acids occur when naturally-occurring organic and inorganic materials in the water react with the disinfectants, chlorine and chloramine.	Some people who drink water containing haloacetic acids in excess of the MCL over many years may have an increased risk of getting cancer.

Regulatory reporting is based on a running annual average of quarterly sample results. The calculated THM and HAA averages were below the maximum allowable concentrations (MAC) permitted by the MECP. Table 8 provides a summary of 2018 organic sample results.

Table 8: 2018 Caledonia and Cayuga Distribution System DBP Sampling

Parameter	Sample Date	Sample Results (ug/L)	Annual Average (ug/L)	Regulatory MAC (ug/L)	Exceedance
Haloacetic Acids Caledonia Distribution	February 13, 2018	20.5	17.3	80	No
	May 8, 2018	16.0			
	August 7, 2018	17.5			
	November 5, 2018	15.1			
Haloacetic Acids Cayuga Distribution	February 13, 2018	18.0	19.8	80	No
	May 8, 2018	16.5			
	August 7, 2018	27			
	November 5, 2018	17.5			
Trihalomethanes Caledonia Distribution	February 13, 2018	28	38.3	100	No
	May 8, 2018	35			
	August 7, 2018	58			
	November 5, 2018	32			
Trihalomethanes Cayuga Distribution	February 13, 2018	26	44.5	100	No
	May 8, 2018	34			
	August 7, 2018	74			
	November 5, 2018	44			

WATER USE

Raw Water

Haldimand County does not have a Permit to Take Water for the Caledonia and Cayuga Distribution System. All water supplied to the Caledonia and Cayuga Distribution System originates from Lake Ontario and is treated by the City of Hamilton at their Woodward Water Treatment Plant.

Potable Water

As required by Schedule 22 of Ontario Regulation 170/03, Table 9, Table 10, *Figure 1* and *Figure 2* are intended to provide a summary of potable water supplied to the Caledonia and Cayuga Distribution System in 2018.

Table 9: 2018 Caledonia Reservoir Monthly Potable Water Flow Data

System	Month	Monthly Total m ³	Daily Average m ³	Maximum Daily m ³
Caledonia Reservoir	January	92,144	2,972	3,659
	February	80,015	2,858	3,261
	March	88,300	2,848	3,288
	April	86,414	2,880	3,494
	May	108,559	3,502	4,765
	June	112,018	3,734	4,575
	July	119,945	3,869	4,734
	August	108,717	3,507	4,170
	September	101,506	3,384	4,115
	October	94,181	3,038	3,522
	November	89,318	2,977	3,440
	December	96,890	3,125	4,135

The Caledonia Reservoir flows include all water pumped to York and Cayuga. *Figure 2* compares the monthly flows over the last five years at the Caledonia Reservoir. When comparing the average monthly flows for 2017 and 2018, there was a 5.3% increase in potable water pumped by the Caledonia Reservoir in 2018.

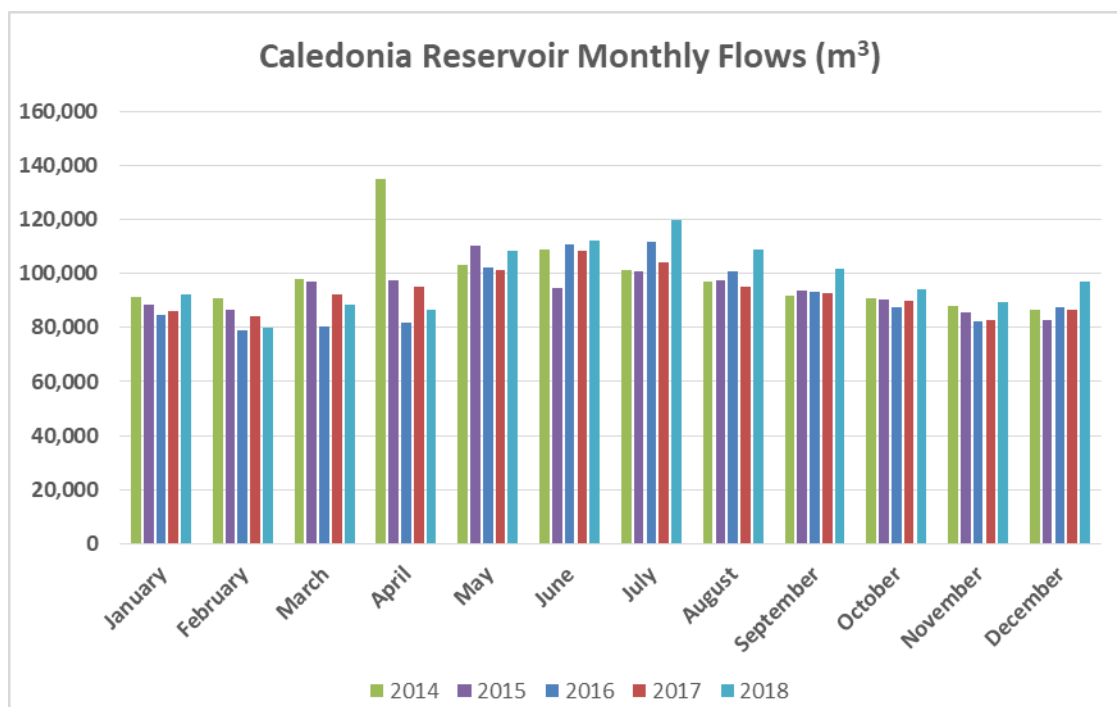


Figure 2: Caledonia Reservoir Five Year Monthly Flow Comparison

Table 10: 2018 Cayuga Reservoir Monthly Water Quantities and Flow Rates

System	Month	Monthly Total m ³	Daily Average m ³ /d	Maximum Daily Flow m ³ /d
Cayuga Reservoir	January	16,275	525	643
	February	14,714	526	722
	March	16,221	523	671
	April	15,223	507	666
	May	20,753	669	891
	June	18,625	621	882
	July	17,703	571	823
	August	16,735	540	672
	September	17,602	587	793
	October	18,492	597	851
	November	16,767	559	638
	December	17,990	580	864

Figure 3 compares the monthly flows over the last five years at the Cayuga Reservoir. When comparing the average monthly flows for 2017 and 2018, there was a 9.7% increase in potable water pumped by the Cayuga Reservoir in 2018.

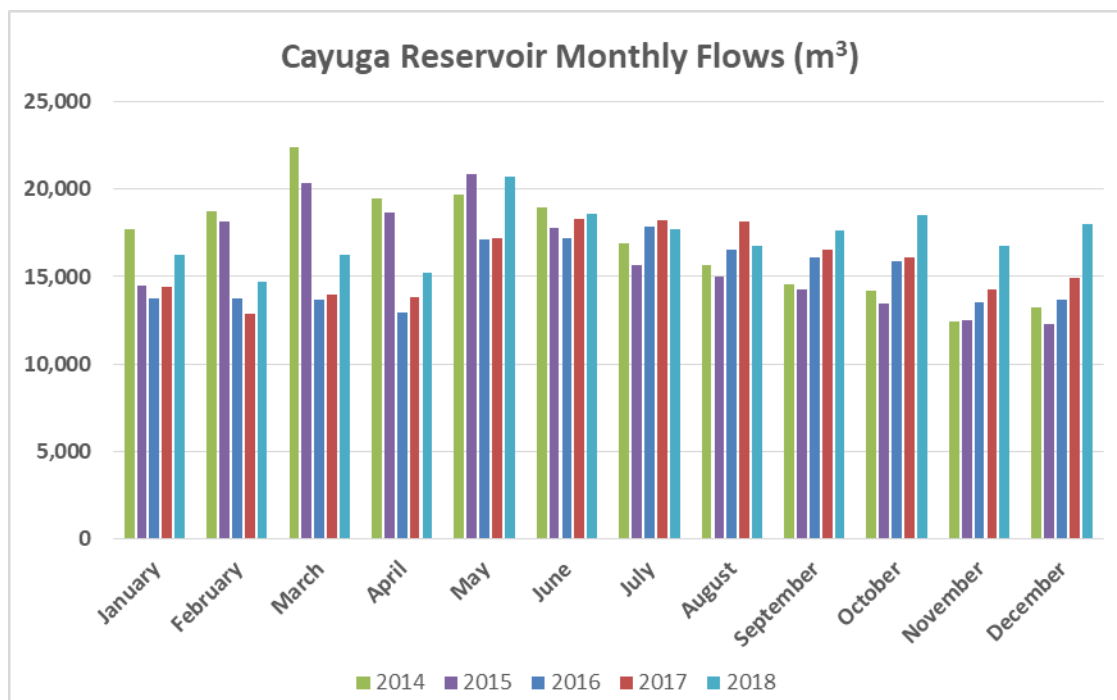


Figure 3: Cayuga Reservoir Five Year Monthly Flow Comparison

Each facility is assigned a rated capacity in their Engineer’s Report. When the maximum daily flow for 2018 and the rated capacity are compared, the Caledonia and Cayuga Reservoirs are operating at approximately 40% of design capacity, however this calculation does not take into account any operational and infrastructure limitations.

Table 11: Summary Comparison of Rated Capacities and 2017 Maximum Flows

System and Municipal Drinking Water License	Rated Capacity	Maximum Daily Flow (m³ / day)	Percentage of Capacity
Caledonia 066-103	13,000 m ³ /day	4,765	36.7%
Cayuga 066-103	2,333 m ³ /day	891	38.2%

To ensure the water treatment facility is capable of meeting current and projected demands, Haldimand County staff annually review plant capability and performance and update development allocation accordingly.

REGULATORY COMPLIANCE

Adverse Water Quality Incidents

Regulatory compliance includes reporting any adverse water quality incidents to the Ministry of Health (MOH) and the MECP. In all instances, corrective action is initiated to resolve the issue. In 2018, there were no adverse events in the Caledonia and Cayuga Distribution System.

Annual Drinking Water Inspection

The MECP annually confirms compliance with drinking water legislation by conducting inspections on municipal drinking water systems. All aspects of the drinking water system are reviewed, including treatment equipment, disinfection, training records, and operational data required under the Safe Drinking Water Act, Ontario Regulations 170/03, 169/03 and 128/04. These inspections provide Haldimand County an opportunity to review best management practices and work towards continually improving the operation and management of the drinking water systems. Any issues of regulatory non-compliance are identified and corrective actions issued.

The Caledonia and Cayuga Distribution System inspection occurred on October 17, 2018. Below is a summary of the key inspection findings:

Caledonia and Cayuga Distribution System – Waterworks # 260004566

There were no instances of non-compliance during the inspection period and the County received a 100% inspection rating from the MECP.

During each inspection, the Ministry may provide recommendations and best practices specific to each drinking water system. It is recommended that owner's and operators develop an awareness of the identified items and consider measures to address them.

The following items were identified during the drinking water inspection:

1. The owner indicated during the physical inspection that internal checks are not conducted on the Hach Pocket Colorimeters using secondary standards.

Recommendation: It is recommended that the owner conducts internal calibration checks on the Hach Pocket Colorimeters every three months using secondary standards. This is recommended from Hach's document ID: TE6258.

County Follow-Up: The County has purchased the required standards and will be conducting and documenting quarterly calibration checks on all colorimeters used in the distribution system.

2. During the inspection period, there were a number of category 1 watermain breaks through out the Caledonia-Cayuga Distribution System. On three occasions during the category watermain break repairs the Watermain Disinfection Procedure was not followed by either not flushing or collecting a chlorine residual following completion of the repair.

Recommendation: It is recommended that the owner revises internal standard operating procedure(s) and work orders to ensure the Watermain Disinfection Procedure is fully followed during category 1 watermain breaks. It is also recommended the owner notifies all operators of changes made to the standard operation procedure and work orders.

County Follow-Up: The County conducted a review of applicable standard operating procedures and determined that the documents did not require any revisions. Procedures were reviewed with operational staff to promote an understanding of the MECP's Watermain Disinfection Procedure. County water main break reports were revised to ensure that all water main breaks were flushed and chlorine residuals are taken.

3. The Haloacetic acid samples were collected from the furthest and approximately the middle of the distribution system at non-residential sample stations in the town of Caledonia and in the town of Cayuga.

Recommendation: It is recommended that the next Haloacetic acid sample is collected at the sample stations closest to the re-chlorination facilities. This sample should be collected when the facility is injecting sodium hypochlorite. All Haloacetic acid sample results should be reviewed when further developing your monitoring program to ensure samples collected from elevated levels of Haloacetic acids in the distribution system.

County Follow-Up: The County has reviewed available water sample sites and will take samples from locations close to the chlorine boosting stations in all County drinking water systems. Once data has been obtained and reviewed, sample locations will be assessed to determine a location that is likely to have an elevated potential for haloacetic acid formation and the County's sampling and monitoring program will be updated accordingly.

Haldimand County continues to work closely with regulatory bodies to ensure a continued supply of safe, reliable drinking water to its users. All recommendations have been addressed and communicated to the MECP.

REPORT AVAILABILITY

This report can be viewed online at:

<https://www.haldimandcounty.ca/drinking-water/>

Reports can also be obtained upon request at any Haldimand County Satellite Office:



Cayuga Administration Building
45 Munsee Street North
PO Box 400
Cayuga, ON N0A 1E0

Phone: 905-318-5932

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