



Attachment 'A'

The Ontario Ministry of the Environment, Conservation and Parks
Inspection Report
January 09, 2019



Ministry of the Environment, Conservation and Parks

MARKHAM DISTRIBUTION SYSTEM

Inspection Report

Site Number:	220004162
Inspection Number:	1-I6J6L
Date of Inspection:	Jan 09, 2019
Inspected By:	Francisco Baldizon



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OWNER INFORMATION:

Company Name: MARKHAM, THE CORPORATION OF THE CITY OF
Street Number: 101 **Unit Identifier:**
Street Name: TOWN CENTRE Blvd N
City: MARKHAM
Province: ON **Postal Code:** L3R 9W3

CONTACT INFORMATION

Type: Main Contact **Name:** Helena Frantzke
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Title: Compliance Coordinator

Type: Contact **Name:** Peter Solymos
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Title: Supervisor

Type: Main Contact **Name:** Mario Puopolo
Phone: (905) 477-7000 **Fax:** (905) 475-4732
Email: mpuopolo@markham.ca
Title: Compliance Coordinator

INSPECTION DETAILS:

Site Name: MARKHAM DISTRIBUTION SYSTEM
Site Address: 101 TOWN CENTRE BLVD N MARKHAM L3R 9W3
County/District: Markham
MECP District/Area Office: York-Durham District
Health Unit: YORK REGION HEALTH SERVICES DEPARTMENT
Conservation Authority:
MNR Office:
Category: Large Municipal Residential
Site Number: 220004162
Inspection Type: Announced
Inspection Number: 1-I6J6L
Date of Inspection: Jan 09, 2019
Date of Previous Inspection: Dec 14, 2017

COMPONENTS DESCRIPTION

Site (Name): MOE DWS Mapping
Type: DWS Mapping Point **Sub Type:**

Site (Name): Markham Operation Office

Type: Other

Sub Type: Other

Comments:

The Markham Distribution System is owned and operated by the City of Markham, and receives treated water from the City of Toronto and the Region of Peel. The trunk transmission lines, pumping stations, and water storage facilities located within the City of Markham are owned and operated by the Region of York. The Region of York measures and monitors the distribution water flows and volumes directed to the City of Markham through the use of nineteen (19) flow meters located along the Richmond Hill, Vaughan, Stouffville, Toronto and Markham boundaries.

The Markham Distribution System provides potable water to approximately 350,000 residents of Markham and consists of approximately 1,070 km of watermains, 8,620 hydrants, 10,910 valves, and 82,277 service connections.

INSPECTION SUMMARY:

Introduction

- The primary focus of this inspection is to confirm compliance with Ministry of the Environment, Conservation and Parks (MECP) legislation as well as evaluating conformance with ministry drinking water policies and guidelines during the inspection period.

This drinking water system is subject to the legislative requirements of the Safe Drinking Water Act, 2002 (SDWA) and regulations made therein, including Ontario Regulation 170/03, "Drinking Water Systems" (O. Reg. 170/03). This inspection has been conducted pursuant to Section 81 of the SDWA.

This report is based on an inspection of a "stand alone connected distribution system". This type of system receives treated water from a separately owned "donor" system. This report contains the elements required to assess key compliance and conformance issues associated with a "receiver" system. This report does not contain items associated with the inspection of the donor system, such as source waters, intakes/wells and treatment facilities.

This report is based on a "focused" inspection of the system. Although the inspection involved fewer activities than those normally undertaken in a detailed inspection, it contained critical elements required to assess key compliance issues. This system was chosen for a focused inspection because the system's performance met the ministry's criteria, most importantly that there were no deficiencies as identified in O. Reg. 172/03 over the past 3 years. The undertaking of a focused inspection at this drinking water system does not ensure that a similar type of inspection will be conducted at any point in the future.

This inspection report does not suggest that all applicable legislation and regulations were evaluated. It remains the responsibility of the owner to ensure compliance with all applicable legislative and regulatory requirements.

On January 09, 2019, Water Inspectors, Francisco Baldizon and Dee Cox conducted an announced inspection of the Markham Distribution System.

Documents pertaining to the system were reviewed both onsite and offsite. Information and assistance with the inspection were provided by the City of Markham staff.

The inspection review period is from December 01, 2017 through to December 15, 2018.

The Markham Distribution System operates under Municipal Drinking Water License (MDWL) # 021-101, Issue # 7 and Drinking Water Works Permit (DWWP) # 021-201, Issue # 3.

Treatment Processes

- The owner had ensured that all equipment was installed in accordance with Schedule A and Schedule C of the Drinking Water Works Permit.
- The owner/operating authority was in compliance with the requirement to prepare Form 1 documents as required by their Drinking Water Works Permit during the inspection period.
Six (6) Forms 1 were required for the Drinking Water System during the review period. The information provided was reviewed and was in compliance with Schedule B Condition 3.0 of the DWWP.
- The owner/operating authority was in compliance with the requirement to prepare Form 2 documents as

Treatment Processes

required by their Drinking Water Works Permit during the inspection period.

One (1) Form 2 was required for the System during the review period. The information provided was reviewed and was in compliance with Schedule B, Condition 4.0 of the DWWP.

Treatment Process Monitoring

- The secondary disinfectant residual was measured as required for the distribution system.

The system collects at least seven samples per week in different locations to meet the requirements prescribed in Schedule 7-2 of O. Reg. 170/03. Total and free chlorine residuals are collected using handheld colorimeters during dead end hydrant flushing and during microbiological sampling. In addition to grab samples two continuous on-line analyzers collect chlorine residuals every 2.5 minutes to meet the requirements for on-line continuous monitoring prescribed in Schedule 6-5 of O. Reg. 170/03.

- Operators were examining continuous monitoring test results and they were examining the results within 72 hours of the test.
- All continuous monitoring equipment utilized for sampling and testing required by O. Reg. 170/03, or Municipal Drinking Water Licence or Drinking Water Works Permit or order, were equipped with alarms or shut-off mechanisms that satisfy the standards described in Schedule 6.

Information provided by City of Markham staff and confirmed in the "Continuous Chlorine Analyzer – Monitoring" section of the DWS' Operations Manual acknowledge that when there is a continuous chlorine analyzer failure, at any of the analyzers, an alarm will be sent to the ORO to their cell phone. A failure of the chlorine analyzer may be due to loss in communication (equipment malfunction, power outage, and no flow sensors), low sample flow, or a combined chlorine residual reading of equal or less than 0.40 mg/L; equal or greater than 2.10 mg/L; equal or less than 0.25 mg/L or equal or greater than 3.00 mg/L.

- Continuous monitoring equipment that was being utilized to fulfill O. Reg. 170/03 requirements was performing tests for the parameters with at least the minimum frequency specified in the Table in Schedule 6 of O. Reg. 170/03 and recording data with the prescribed format.
Online chlorine analyzers are required to record total and free chlorine residual values at least every hour (60 minutes) with a minimum alarm standard of 0.25 mg/L. The two chlorine online analyzers currently operating at the DWS record values every 2.5 minutes with minimum alarms standards set at equal or less than 0.40 mg/L.
- All continuous analysers were calibrated, maintained, and operated, in accordance with the manufacturer's instructions or the regulation.

Distribution System

- Existing parts of the distribution system that are taken out of service for inspection, repair or other activities that may lead to contamination, and all new parts of the distribution system that come in contact with drinking water, were disinfected in accordance with Schedule B, Condition 2.3 of the Drinking Water Works Permit, or an equivalent procedure (i.e. the Watermain Disinfection Procedure).

Operations Manuals

- The operations and maintenance manuals contained plans, drawings and process descriptions sufficient for the safe and efficient operation of the system.

Up to date drawings and maps are available digitally with hard copies maintained at the City of Markham's operations centre.

Operations Manuals

- The operations and maintenance manuals met the requirements of the Drinking Water Works Permit and Municipal Drinking Water Licence issued under Part V of the SDWA.

The Operations Manual was reviewed and it meets the requirements prescribed in Condition 16.0 of the Municipal Drinking Water License.

Logbooks

- Logbooks were properly maintained and contained the required information.

Log books were reviewed at the time of the inspection and they were in compliance with the requirements for records-keeping prescribed in Section 27 of O. Reg. 128/04. The use of liquid paper was identified in some entries; this issue is addressed in the Summary of Recommendations and Best Practices Issues section of this report.

- Records or other record keeping mechanisms confirmed that operational testing not performed by continuous monitoring equipment was being done by a certified operator, water quality analyst, or person who suffices the requirements of O. Reg. 170/03 7-5.

Information identified in the log books confirmed that only certified operators are conducting operational checks in the system. Operator's licences were reviewed on Site and verified at the Ontario Water and Wastewater Certification Office (OWWCO) website.

Security

- The owner had provided security measures to protect components of the drinking water system.

The majority of the DWS components are unexposed. Sample stations are locked and equipment for repairs is stored securely at the City of Markham's Public Works Yard within a fenced area equipped with an alarm system after hours to prevent access to unauthorized persons.

Certification and Training

- The overall responsible operator had been designated for each subsystem.
- Operators in charge had been designated for all subsystems which comprised the drinking-water system.

Water Quality Monitoring

- All microbiological water quality monitoring requirements for distribution samples were being met.

According to O. Reg. 170/03, the System is required to collect one hundred and thirty five (135) microbiological samples every month with at least one sample collected each week. All samples are to be analyzed for Escherichia coli and total coliforms, and 25% of the samples required must also be tested for heterotrophic plate count (HPC). Sampling records reviewed as part of this inspection confirmed that these requirements were achieved during the inspection review period.

- All haloacetic acid water quality monitoring requirements prescribed by legislation are being conducted within the required frequency and at the required location.

Haloacetic acids (HAA) monitoring is conducted at least once every calendar quarter from a point in the drinking water system that is likely to have an elevated potential for the formation of HAAs, as required by section 13-6.1 of Schedule 13 of O. Reg. 170/03.

Please refer to the Haloacetic Acids (HAAs) Sampling Concerns Letter submitted by the Ministry to Municipal

Water Quality Monitoring

Drinking Water Systems in May 9, 2018 and attached to this report in Appendix C for further reference regarding sampling locations and procedures.

- **All trihalomethane water quality monitoring requirements prescribed by legislation were conducted within the required frequency and at the required location.**
THM samples are being collected every quarter of a calendar year in the extremities of the system as required in O. Reg. 170/03.

- **All water quality monitoring requirements imposed by the Municipal Drinking Water Licence and Drinking Water Works Permit were being met.**

The Drinking Water System was granted regulatory relief for lead sampling under MDWL # 021-101, Section 1, Schedule D. In exchange of regulatory requirements under Schedule 15.1 of O. Reg. 171/03, the owner is required to collect and test for lead at ten (10) sampling points in the distribution system. This was in effect for the December 15, 2017 to April 15, 2018 and June 15, 2018 to October 15, 2018 sampling periods. Data was review during the inspection period and confirmed that the DWS complied with these requirements.

- **Records confirmed that chlorine residual tests were being conducted at the same time and at the same location that microbiological samples were obtained.**

Chains of custody of the microbiological sampling were reviewed as part of the inspection and it was confirmed that chlorine residuals were taken each time that bacteriological samples were collected.

Water Quality Assessment

- **Records did not show that all water sample results taken during the inspection review period did not exceed the values of tables 1, 2 and 3 of the Ontario Drinking Water Quality Standards (O.Reg. 169/03).**

Three (3) exceedances to Schedule 1 of O. Reg. 169/03 were identified during the current review period: Total Coliforms Present on June 27, 2017; July 17, 2018 and July 24, 2018 (3 sampling stations).

Reporting & Corrective Actions

- **Corrective actions (as per Schedule 17) had been taken to address adverse conditions, including any other steps that were directed by the Medical Officer of Health.**

Resamples for the adverse results were collected resulting in compliance with the standard. No further actions were required by the local Health Unit for those incidents.

- **All required notifications of adverse water quality incidents were not immediately provided as per O. Reg. 170/03 16-6.**

On December 11, 2018 a category 2 water main break occurred in a section of the DWS. The Operator attending the site did not report the incident to their Supervisor immediately and as a result the Spills Action Centre (SAC) and the Health Unit (HU) were not notified. On December 13, 2018 after reviewing documents and log books the Supervisor identified that the incident was classified as a category 2 - Observation Watermain Break. The Water Quality Coordinator immediately contacted the Area Inspector. The Area Inspector advised them to contact SAC and the HU and submit part 2A immediately.

Corrective actions were followed and the watermain was repaired the same day: December 11, 2018; however immediate verbal notification and written notice within 24 hours were not provided to the Spills Action Centre or the Health Unit as is required in Schedule 16-6 of O. Reg. 170/03.

- **Where required continuous monitoring equipment used for the monitoring of chlorine residual and/or**

Reporting & Corrective Actions

turbidity triggered an alarm or an automatic shut-off, a qualified person responded in a timely manner and took appropriate actions.

- All changes to the system registration information were provided within ten (10) days of the change.

Other Inspection Findings

- The following issues were also noted during the inspection:

During the physical inspection several entries in the water main break forms were corrected using liquid paper. In addition to this on May 16, 2018 one entry was identified to be corrected with liquid paper on the Supervisor's Standby Journal.

NON-COMPLIANCE WITH REGULATORY REQUIREMENTS AND ACTIONS REQUIRED

This section provides a summary of all non-compliance with regulatory requirements identified during the inspection period, as well as actions required to address these issues. Further details pertaining to these items can be found in the body of the inspection report.

1. All required notifications of adverse water quality incidents were not immediately provided as per O. Reg. 170/03 16-6.

Verbal notification not provided within 24 hours after an Adverse Water Quality Incident occurred

Action(s) Required:

Ensure that verbal notifications of Adverse Water Quality Incidents are provided in timely fashion and to the authorities required in Schedule 16 of O. Reg. 170/03.

SUMMARY OF RECOMMENDATIONS AND BEST PRACTICE ISSUES

This section provides a summary of all recommendations and best practice issues identified during the inspection period. Details pertaining to these items can be found in the body of the inspection report. In the interest of continuous improvement in the interim, it is recommended that owners and operators develop an awareness of the following issues and consider measures to address them.

1. The following issues were also noted during the inspection:

Entries in log books corrected using liquid paper.

Recommendation:

COMPLIANCE DATES: FEBRUARY 15 & MARCH 15, 2019.

BY NO LATER THAN FEBRUARY 1, 2019.

The City of Markham shall develop/revise their "Logbook/Record Keeping "Standard Operating Procedure" (SOP). The SOP shall include a provision prohibiting the use of liquid paper and state the correct form to include corrections in every entry. The City of Markham shall submit a copy of the SOP to the undersigned Provincial Officer.

BY NO LATER THAN MARCH 15, 2019.

The operators of the City of Markham shall be trained on the "Logbook/Record Keeping" SOP including the requirements for record-keeping prescribed in Section 27 of O. Reg. 128/04. The City shall submit a copy of the training record, including operator's signatures, to the undersigned Provincial Officer to confirm that all operators have been trained.

Francisco Baldizon
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YDTHP District Office, Central Region
Ministry of the Environment Conservation and Parks
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(p) 905-427-5613
(e) Francisco.Baldizon@ontario.ca

SIGNATURES

Inspected By:

Francisco Baldizon


Signature: (Provincial Officer)

Reviewed & Approved By:

Tessa Villeneuve

Signature: (Supervisor)



Review & Approval Date:

Jan. 16 2019

Note: This inspection does not in any way suggest that there is or has been compliance with applicable legislation and regulations as they apply or may apply to this facility. It is, and remains, the responsibility of the owner and/or operating authority to ensure compliance with all applicable legislative and regulatory requirements.

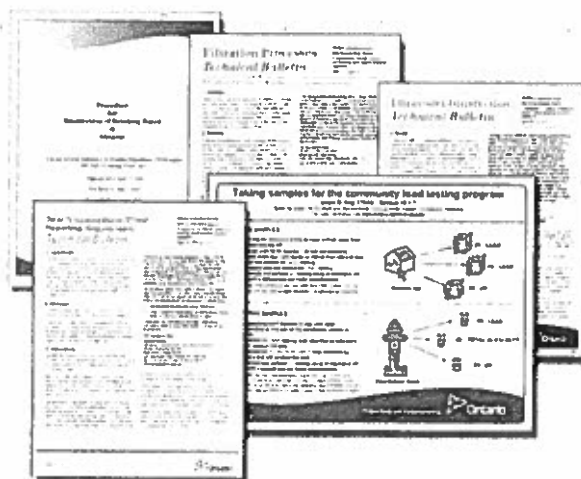


APPENDIX A STAKEHOLDER APPENDIX

Many useful materials are available to help you operate your drinking water system. Below is a list of key materials owners and operators of municipal residential drinking water systems frequently use.

To access these materials online click on their titles in the table below or use your web browser to search for their titles. Contact the Public Information Centre if you need assistance or have questions at 1-800-565-4923/416-325-4000 or picemail.moe@ontario.ca.

For more information on Ontario's drinking water visit www.ontario.ca/drinkingwater and email drinking.water@ontario.ca to subscribe to drinking water news.

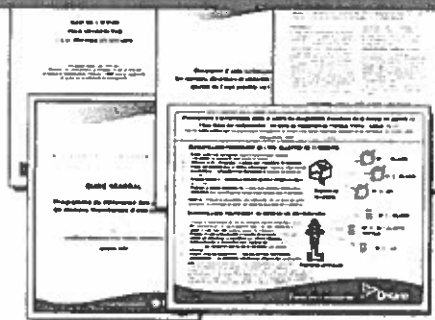


PUBLICATION TITLE	PUBLICATION NUMBER
Taking Care of Your Drinking Water: A Guide for Members of Municipal Councils	7889e01
FORMS: Drinking Water System Profile Information, Laboratory Services Notification, Adverse Test Result Notification Form	7419e, 5387e, 4444e
Procedure for Disinfection of Drinking Water in Ontario	4448e01
Strategies for Minimizing the Disinfection Products Trihalomethanes and Haloacetic Acids	7152e
Total Trihalomethane (TTHM) Reporting Requirements Technical Bulletin (February 2011)	8215e
Filtration Processes Technical Bulletin	7467
Ultraviolet Disinfection Technical Bulletin	7685
Guide for Applying for Drinking Water Works Permit Amendments, Licence Amendments, Licence Renewals and New System Applications	7014e01
Certification Guide for Operators and Water Quality Analysts	
Guide to Drinking Water Operator Training Requirements	9802e
Taking Samples for the Community Lead Testing Program	6560e01
Community Sampling and Testing for Lead: Standard and Reduced Sampling and Eligibility for Exemption	7423e
Guide: Requesting Regulatory Relief from Lead Sampling Requirements	6610
Drinking Water System Contact List	7128e
Technical Support Document for Ontario Drinking Water Quality Standards	4449e01

ontario.ca/drinkingwater

De nombreux documents utiles peuvent vous aider à exploiter votre réseau d'eau potable. Vous trouverez ci-après une liste de documents que les propriétaires et exploitants de réseaux résidentiels municipaux d'eau potable utilisent fréquemment.

Pour accéder à ces documents en ligne, cliquez sur leur titre dans le tableau ci-dessous ou faites une recherche à l'aide de votre navigateur Web. Communiquez avec le Centre d'information au public au 1 800 565-4923 ou au 416 325-4000, ou encore à picemail.moe@ontario.ca si vous avez des questions ou besoin d'aide.



Pour plus de renseignements sur l'eau potable en Ontario, consultez le site www.ontario.ca/eaupotable ou envoyez un courriel à drinking.water@ontario.ca pour suivre l'information sur l'eau potable.

TITRE DE LA PUBLICATION	NUMÉRO DE PUBLICATION
Prendre soin de votre eau potable – Un guide destiné aux membres des conseils municipaux	7889f01
Renseignements sur le profil du réseau d'eau potable, Avis de demande de services de laboratoire, Formulaire de communication de résultats d'analyse insatisfaisants et du règlement des problèmes	7419f, 5387f, 4444f
Marche à suivre pour désinfecter l'eau potable en Ontario	4448f01
Strategies for Minimizing the Disinfection Products Trihalomethanes and Haloacetic Acids (en anglais seulement)	7152e
Total Trihalomethane (TTHM) Reporting Requirements: Technical Bulletin (février 2011) (en anglais seulement)	8215e
Filtration Processes Technical Bulletin (en anglais seulement)	7467
Ultraviolet Disinfection Technical Bulletin (en anglais seulement)	7685
Guide de présentation d'une demande de modification du permis d'aménagement de station de production d'eau potable, de modification du permis de réseau municipal d'eau potable, de renouvellement du permis de réseau municipal d'eau potable et de permis pour un nouveau réseau	7014f01
Guide sur l'accréditation des exploitants de réseaux d'eau potable et des analystes de la qualité de l'eau de réseaux d'eau potable	
Guide sur les exigences relatives à la formation des exploitants de réseaux d'eau potable	9802f
Prélèvement d'échantillons dans le cadre du programme d'analyse de la teneur en plomb de l'eau dans les collectivités	6560f01
Échantillonnage et analyse du plomb dans les collectivités : échantillonnage normalisé ou réduit et admissibilité à l'exemption	7423f
Guide: Requesting Regulatory Relief from Lead Sampling Requirements (en anglais seulement)	6610
Liste des personnes-ressources du réseau d'eau potable	7128f
Document d'aide technique pour les normes, directives et objectifs associés à la qualité de l'eau potable en Ontario	4449f01

ontario.ca/eaupotable



APPENDIX B INSPECTION RATING RECORD

Ministry of the Environment - Inspection Summary Rating Record (Reporting Year - 2018-2019)

DWS Name: MARKHAM DISTRIBUTION SYSTEM
DWS Number: 220004162
DWS Owner: Markham, The Corporation Of The City Of
Municipal Location: Markham

Regulation: O.REG 170/03
Category: Large Municipal Residential System
Type Of Inspection: Adhoc
Inspection Date: January 9, 2019
Ministry Office: York-Durham District

Maximum Question Rating: 327

Inspection Module	Non-Compliance Rating
Treatment Processes	0 / 22
Distribution System	0 / 21
Operations Manuals	0 / 28
Logbooks	0 / 18
Certification and Training	0 / 14
Water Quality Monitoring	0 / 63
Reporting & Corrective Actions	21 / 70
Treatment Process Monitoring	0 / 91
TOTAL	21 / 327

Inspection Risk Rating 6.42%

FINAL INSPECTION RATING: 93.58%

Ministry of the Environment - Detailed Inspection Rating Record (Reporting Year - 2018-2019)

DWS Name: MARKHAM DISTRIBUTION SYSTEM
DWS Number: 220004162
DWS Owner: Markham, The Corporation Of The City Of
Municipal Location: Markham

Regulation: O.REG 170/03
Category: Large Municipal Residential System
Type Of Inspection: Adhoc
Inspection Date: January 9, 2019
Ministry Office: York-Durham District

Non-compliant Question(s)	Question Rating
Reporting & Corrective Actions	
Were all required verbal notifications of adverse water quality incidents immediately provided as per O. Reg. 170/03 16-6?	21
TOTAL QUESTION RATING	21

Maximum Question Rating: 327

Inspection Risk Rating 6.42%

FINAL INSPECTION RATING: 93.58%



APPENDIX C

HALOACETIC ACIDS (HAAs)

Ministry of the Environment,
Conservation and Parks

Compliance, Promotion
and Support Branch

2nd floor
40 St. Clair Ave West
Toronto ON M4V 1M2

ministère de l'Environnement, de
la Protection de la nature et des
Parcs

Direction de la promotion de la
conformité
et du soutien

2^{ème} étage
40, avenue St. Clair Ouest
Toronto (Ontario) M4V 1M2



August 1st, 2018

RE: Haloacetic Acids (HAAs) Sampling Concerns

Non-Municipal Year Round Residential Drinking Water System Owners/Operators,

The purpose of this document is to clarify ministry guidance for HAAs sampling. HAAs are disinfection by-products (DBPs) that are formed when dissolved organic matter reacts with chlorine which is added for the purpose of disinfection. Detailed information on HAAs can be found in "Health Canada (2008) Guidelines for Canadian Drinking Water Quality: Guideline Technical Document — Haloacetic Acids".

HAAs are a collection of several different compounds. The haloacetic acids most commonly found in drinking water are monochloroacetic acid (MCA), dichloroacetic acid (DCA), trichloroacetic acid (TCA), monobromoacetic acid (MBA) and dibromoacetic acid (DBA). Total HAAs is the sum of these five haloacetic acids. The HAAs most commonly found in the distribution system of drinking water systems are TCA and DCA. However the presence of bromide ions can result in the formation of MBA and DBA.

Sampling Points for HAAs

The ministry has recognized that more than one sampling location may be needed to characterize the HAAs levels throughout a distribution system. HAA concentrations can vary within and between distribution systems and so monitoring samples should be taken at points in the "middle" of the distribution system (i.e. an average water age, post re-chlorination). In light of the recently introduced HAAs standard of 80 µg/L, which will come in to force on January 1, 2020, the following guidance should be used in developing your monitoring program:

1. As a general rule, all samples described below should be obtained from a sampling point where the free (combined) chlorine residual concentration is maintained over 0.2 mg/L (1.0 mg/L) respectively.
2. First year of sampling: A system's established THM sampling point may be appropriate provided the chlorine concentrations are as described in item 1. If the residual is below the concentrations listed, use a nearby sampling point that meets the recommended residual.
3. Second year of sampling: obtain the sample from another point in the distribution system.
4. Third year of sampling:
 - a. If neither of the running annual averages for HAAs calculated (after year one and two) were higher than one-half of the standard (40 µg/L), the sampling point used in the first year of sampling can be used for compliance in future years.
 - b. If one of the running annual averages is over 40 µg/L, a third sampling point should be chosen using the same criteria as the second year. Subsequent sampling should be conducted from the point which had the highest individual sample result.

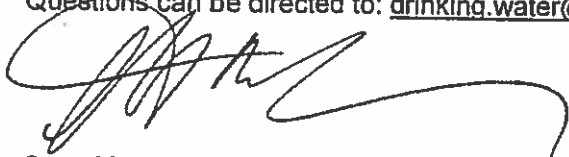
The outlined sampling plan is intended to be flexible and recognizes that sampling for HAAs has been required since 2017. The purpose of this plan is for an operator to understand their distribution system. It will also determine if there is an issue so any steps necessary can be taken to resolve the issue prior to the standard for HAAs coming into effect to avoid adverse water quality incidents for your system.

Factors influencing the creation of HAAs

The levels of DBPs formed depend on many water quality parameters and operating conditions. In the case of HAAs, higher precursor concentrations (synthetic and natural organic matter, bromide ion) in the raw water, chlorine dose, chlorination pH, water temperature and the residence time will influence the type (THMs, HAAs, etc.) and the levels of DBPs formed. Studies found that surface water sources are more likely to produce higher HAAs than ground water sources.

HAAs concentrations are found to be higher in the distribution system, usually just after the chlorination process. Health Canada studies performed in 2002 and 2003 indicated that concentration of HAAs peaked in the distribution system closer to the chlorine addition point and decreased in the extremities of the system. Furthermore, the location of peak HAA values in a distribution system tends to change throughout the year, it is likely to be closer to the chlorine addition point in the summer and fall and further away from the point in the winter and spring. Precipitation and runoff events can also affect DBPs.

Questions can be directed to: drinking.water@ontario.ca.



Scott McCharles on behalf of Cammy Mack
Director, Compliance, Promotion and Support Branch
Ministry of the Environment, Conservation and Parks