Township of Hamilton

QMS 01 Operational Plan

For the:

Camborne Drinking Water System
(OP #139-403)

Creighton Heights Drinking Water System
(OP #139-402)

Contents

Element
Element 1.0 Introduction 3
Element 2.0 Quality Management System (QMS) Policy 4
Element 3.0 Commitment and Endorsement 4
3.1 Refer to QMS 03 Commitment and Endorsement 4
Element 4.0 QMS Representative 4
Element 5.0 Document and Records Control 4
Element 6.0 Drinking Water Systems 5
6.1 Camborne Drinking Water System 5
6.2 Creighton Heights Drinking Water System 6
Element 7.0 Risk Assessment 8
Element 8.0 Risk Assessment Outcomes 9
8.1 Critical control points and critical control limits 9
Element 9.0 Organizational Roles, Responsibilities, and Authorities 11
Element 10.0 Competencies 12
Element 11.0 Personnel Coverage 13
Element 12.0 Communications 14
Element 13.0 Essential Supplies and Services 15
Element 14.0 Review and Provision of Infrastructure 15
Element 15.0 Infrastructure Maintenance, Rehabilitation and Renewal 15
Element 16.0 Sampling, Testing and Monitoring 16
Element 17.0 Measurement and Recording Equipment Calibration and Maintenance 16
Element 18.0 Emergency Management 17
Element 19.0 Internal Audits 18
Element 20.0 Management Review 18
Element 21.0 Continual Improvement 19
Appendix “A” QMS Calendar 20
Appendix “B” Documents and Records Listing, Internal and External Documents 21
C.1 Camborne Drinking Water System 24
Appendix “D” Risk Assessment Outcomes 27
D.1 Camborne Drinking Water System (refer to Scoring chart on Page 10) 27
D.2 Creighton Heights Drinking Water System (refer to Scoring chart on Page 10) 30
Appendix “E” Essential Supplies and Services 34
Appendix “F” Sample and Testing Program 36

5

Element 1.0 Introduction

This Operational Plan satisfies one of the requirements of the Ministry of the Environment, Conservation and Parks' ("the Ministry's") Municipal Drinking Water Licensing program for municipal drinking water systems in Ontario.

The Operational Plan describes the Township of Hamilton's Quality Management System (***QMS***) that:

1. ***meets the requirements*** of the Drinking Water Quality Management Standard (***DWQMS***), and
2. helps ensure we ***consistently achieve the intended outcomes*** of our drinking water systems' processes and programs.

The Corporation of the Township of Hamilton is the ***owner*** and the Township's Water Operations department is the ***operating authority*** for the Camborne Drinking Water System and Creighton Heights Drinking Water System.

Our Operational Plan, other QMS information (e.g. standard operating procedures, work instructions, forms) and training programs - all support achieving our ***QMS Policy commitments to:***

- *provide **safe drinking water** to consumers,*
- ***comply** with legislation and regulations, and*
- *maintain and **continually improve** our QMS.*

Organization and People Elements of this Plan describe:

- the ***commitments*** we've made (Elements 2 and 3)
- the ***people*** we have and their ***roles, responsibilities and authorities*** (Element 9)
- how we ensure staff ***competencies*** and ***coverage*** (Elements 10 and 11)
- the ways in which we ***communicate internally*** (among staff and to the owner) and ***externally*** (to essential suppliers and to the public) (Element 12)

System Operations and Maintenance Elements describe:

- the processes and programs we have in our ***drinking water system*** (Element 6)
- ***risks*** associated with our drinking water system (Elements 7 and 8)
- ***supplies and services essential*** to our operations and maintenance (Element 13)
- ways in which we annually ***review the adequacy of our infrastructure*** (Element 14)
- what infrastructure ***maintenance, rehabilitation and renewal programs*** we have (Element 15)
- how we maintain a ***state of emergency preparedness*** (Element 18)

Support and Performance Evaluation Elements describe:

- the ways in which we manage and ***control documents and records*** (Element 5)
- how we ***sample, test, and monitor*** for process control and finished water quality, with what ***calibrated equipment*** and how we ***share results*** (Elements 16 and 17)
- how we ***conduct internal audits*** to verify we achieved everything we should (Element 19)
- the content of our ***QMS reports to top management*** and to the ***Owner*** (Element 20)

The Continual Improvement Element describes:

- how we ***track and measure continual improvement*** (Element 21)

This operational plan is available for viewing by the public at the Township of Hamilton office, located at 8285 Majestic Hills Drive, Cobourg, Ontario and on our website under the heading Resident Services, Water Services.

A QMS calendar for QMS updates is included in ***Appendix "A"***.

Element 2.0 Quality Management System (QMS) Policy

2.1 Refer to QMS 02 Quality Management System Policy

Element 3.0 Commitment and Endorsement

3.1 Refer to QMS 03 Commitment and Endorsement

Element 4.0 QMS Representative

The ***Manager of Water Operations*** is appointed as the Quality Management System (QMS) Representative. Irrespective of other responsibilities, the ***QMS Representative***:

a) administers the QMS by ensuring that ***processes and procedures needed for the QMS*** are established and maintained,
b) ***reports to Top Management*** on the performance of the QMS and any need for improvement,
c) ***ensures*** that ***current versions of documents*** required by the QMS, are being used at all times,
d) ensures that ***personnel are aware of all applicable legislative and regulatory requirements*** that pertain to their duties for the operation of the drinking water systems, and
e) ***promotes awareness of the QMS*** throughout the operating authority.

Element 5.0 Document and Records Control

The Township of Hamilton's documented information for the QMS includes this Operational Plan and other information deemed necessary (e.g. standard operating procedures, work instructions and forms) for the effectiveness of our QMS and to ensure the effective planning, operation and control of our operations.

Documented information also includes evidence of results achieved ("records"), and includes ***records of***:

- ***risk assessment*** outcomes;
- ***competence*** (training, education and/or experience-related);
- ***communications*** (internal and external);
- ***infrastructure review***;
- ***sampling, testing and monitoring***;
- ***internal audits*** and ***external audits*** (including accreditation audits and Ministry inspections);
- ***management reviews***;
- ***reports to the owner*** (e.g. annual & summary and budget reports);
- ***continual improvement***, corrective and preventative actions.

For consistency, QMS-related and instructional documents maintain consistent ***features***, including the following:

- ***identification*** and description (e.g. title, a header and footer)
- ***format*** (e.g. legible and using a standard format for instructions)
- ***media*** (e.g. available electronically and/or on paper)
- ***reviewed*** and approved for ***currency***, suitability, and adequacy
    - Any employee can request new documents or changes to existing documents. The QMS Rep evaluates the request and ensures integrity of the QMS when approving changes or new documents.

Related to controlling documents and records, we ensure they are available ***where and when needed*** and are adequately ***protected*** (e.g. from loss of confidentiality, improper use, or loss of integrity).

We ***ensure*** that our ***documents*** and ***records*** are:

- ***distributed and accessible***, where required (e.g. at the Water Treatment Plants and/or QMS Rep's office)
- easily ***retrieved*** (e.g. whether in hard copy binders or from electronic locations)
- ***used***, as required (e.g. latest QMS version)
- ***stored***, ***preserved***, and ***legible*** (e.g. no pencil or other erasable marker; clearly identifying person recording)
- changes ***controlled*** (e.g. through QMS Representative, who approves any changes)
- ***retained*** for as long as retention timelines dictate (e.g. properly dated and stored by record type)
- ***disposed of*** once their retention requirements have been fulfilled

External documents, such as those issued through government regulations and approvals are controlled and identified to ensure our personnel have access to such compliance obligations. We ensure these requirements are integrated into our documents and record-keeping so that we can provide evidence that we've met these obligations.

Please refer to ***Appendix "B"*** for a listing of documents and records of internal and external origin, their locations and retention times, as applicable.

Element 6.0 Drinking Water Systems

The Corporation of the Township of Hamilton is the ***owner*** and the Township's Water Operations Department is the ***operating authority*** for the Camborne Drinking Water System and Creighton Heights Drinking Water System. This section provides an overview of both drinking water systems.

6.1 CAMBORNE DRINKING WATER SYSTEM

The Camborne Drinking Water System is owned and operated by the Township of Hamilton. The system serves the Village of Camborne, which is a residential community with approximately 71 connections servicing residences, the Camborne Public School and a church.

Water Source

The Camborne Drinking Water System obtains its raw water from two drilled wells located to the rear of treatment plant. These wells (PW1A and PW2A) are screened in the deep overburden, above bedrock. The static water level in the deep overburden aquifer is above the ground surface elevation and wells will flow naturally under artesian pressures.

The Township of Hamilton Municipal Wellfields Groundwater Studies contains maps showing the wellhead protection areas (WHPA) and identifies potential threats to source water quality. The WHPA have been identified as low vulnerability and because of the deep confined aquifer, it is considered to be well-protected.

General Characteristics of the Raw Water Supply

Camborne's raw groundwater is of good quality. Groundwater typically has hardness and iron concentrations that are higher than the Aesthetic Objective (AO) as listed in the Ontario Drinking Water Quality Standards (ODWQS) in O. Reg 169/03. Aesthetic Objectives do not pose any health risks. The Camborne Drinking Water Plant has treatment processes in place to reduce iron concentrations. Hardness is not removed in the treatment process due to the high cost of removal.

Common Event-Driven Fluctuations (resulting operational challenges and threats)

Based on historical data collected, the water source has remained stable. Other than private wells, there are no other users from the aquifer. To date, there have been Well Supply issues as a result of pressures from high artesian flow and inferior riser pipe material used at the time of construction. Wells have been restored in 2021 to resolve inferior casing and riser pipe issues.

Treatment System Processes

The Camborne Water Supply System generally consists of two municipal groundwater wells, a treatment plant and a distribution system. An overview of the system is presented in the following paragraphs.

The two wells are located on-site near the treatment plant. The treatment plant building houses treatment and pumping equipment, chemical feed systems, a filtration system for iron and turbidity removal/control, filter waste management, de-chlorination, high lift pumps, pressure tanks, instrumentation and control equipment, associated electrical controls and appurtenances, a SCADA system for onsite/remote monitoring & control and a laboratory. A filter backwash waste tank and a standby diesel generator are also located on-site, just outside the treatment plant building.

Primary Disinfection is achieved by chlorination with contact time in the reservoir. Secondary Disinfection is achieved with Free Chlorine Residual in the Distribution System. Sodium hypochlorite is injected into the common raw water header using a dedicated duplex chemical feed pump package. Following chlorination, water passes through two parallel greensand filters for removal of oxidized iron. The filters are periodically backwashed to remove captured iron particles. Filter backwash waste is directed to the filter waste tank. Supernatant from the filter waste tank is de-chlorinated and pumped out for final discharge to a local storm sewer. Settled sludge in the filter waste tank is periodically pumped out and hauled off site by septic hauler truck.

Filtered water from the greensand filters discharges to the reservoir, which provides chlorine contact time for Primary Disinfection. High Lift pumps and pressure tanks deliver treated water from the reservoir to the distribution system. Online instrumentation is installed on the treated water supply line leaving the plant for continuous monitoring and recording of flow, chlorine residual, turbidity and pressure.

Treatment System Process Flow Chart

A treatment system process flow chart for the Camborne Drinking Water System is included in **Appendix "C.1"**.

Distribution System

Three high lift pumps consisting of two duty pumps and one jockey pump, located in the treatment plant, pump treated water from the reservoir into pressure tanks which supply pressure and flow to the Distribution System.

Processed water is pumped through approximately 3 kilometres of 150mm diameter watermain to service approximately 71 connections servicing homes, the public school and the local church. All service connections are metered for water billing purposes.

A flow meter and pressure transmitter installed on the treatment plant discharge pipe, continuously monitor flow and pressure. Operation of the high lift pumps is controlled based on pressure demands of the Distribution system. The pressure entering the distribution system will vary but is typically sixty-five to seventy-five psi.

6.2 CREIGHTON HEIGHTS DRINKING WATER SYSTEM

The Creighton Heights Drinking Water System is owned and operated by the Township of Hamilton. The system serves approximately 492 connections in the communities of Baltimore, Creighton Heights, Deerfield Estates and properties along the alignment of County Road 45 including the Carleton Blvd area at the south end of County Road 45.

Water Source

The Creighton Heights Drinking Water System obtains raw water from three drilled wells in a confined aquifer and is considered a “true” groundwater source. Wells are located near the treatment plant.

The Township of Hamilton Municipal Well fields Groundwater Studies contains maps showing the wellhead protection areas (WHPA) and identify potential threats to source water quality. The WHPA have been identified as low vulnerability and as a result of the deep confined aquifer, they are considered to be well protected.

General Characteristics of the Raw Water Supply

The raw groundwater is of good quality but has levels of colour, hardness, iron and manganese shown to exceed the Aesthetic Objectives (AO) in the Ontario Drinking Water Quality Standards (ODWQS) O. Reg. 169/03. AO’s do not pose any health threats.

Colour, hardness, iron and manganese are AO’s, and these parameters may impair the taste, smell or colour of the water or interfere with good water quality control practises.

Based on the raw water data and hydrogeology information, the treatment processes in place are adequate to ensure that the water quality in the ODWQS can be achieved.

Common Event-Driven Fluctuations (resulting operational challenges and threats)

From the historical data collected, the water source has remained stable. Other than private wells, there are no other users from the aquifer. To date, with growing demand on the Drinking Water System and dry summers, water use restrictions have been implemented on an as needed basis.

Treatment System Processes

The Creighton Heights Drinking Water System generally consists of three on-site groundwater wells (Wells TW1, TW6 and TW7), a treatment plant that houses treatment and pumping equipment and a distribution system. The system is briefly described in the following paragraphs.

The treatment plant building houses the potassium permanganate chemical feed system, filtration system for iron, manganese and turbidity control/removal, sodium hypochlorite chemical feed system, UV disinfection, methane removal, high lift pumping equipment, filter waste management, de-chlorination, laboratory, instrumentation and control equipment, associated electrical controls and appurtenances, a SCADA system for onsite/remote monitoring & control and standby power.

Raw well water is injected with potassium permanganate and passes through two manganese greensand filters for removal of oxidized iron and manganese. The filters are periodically backwashed to remove captured iron and manganese particles and to regenerate the filter bed. Filter backwash waste is directed to a filter waste tank located in the plant. Supernatant from the waste tank is de-chlorinated and pumped out for final discharge to local storm drainage. Settled sludge in the waste tank is periodically pumped out and hauled off site by septic hauler truck.

UV disinfection provides primary disinfection and sodium hypochlorite provides secondary disinfection. Chloramination (chlorine-ammonia compound) is the secondary disinfection method used for approximately 11 months of the year. Chlorination (free chlorine) is used for secondary disinfection for approximately 1 month each year for control of nitrification in the distribution system. The plant is equipped with a sodium hypochlorite system capable of dosing at low rates while chloraminating or higher rates when Free chlorinating.

Sodium hypochlorite is injected just upstream of the UV Disinfection system consisting of ten independent UV units running in parallel. Following UV disinfection, water flows through a methane stripper located in a dedicated methane stripping room. Water from the methane stripper discharges to the reservoir where high lift pumps deliver it to

distribution. Online instrumentation on the treated water supply line leaving the plant continuously monitors and records flow, chlorine residual and pressure.

Treatment System Process Flow Chart

A treatment system process flow chart for the Creighton Heights Drinking Water System is included in ***Appendix "C.2"***.

Distribution System

Five high lift pumps, consisting of two duty pumps, one jockey pump and two fire pumps, located in the treatment plant, pump treated water from the Reservoir into the Distribution System.

Processed water is pumped through approximately 17.5 kilometres of watermain ranging in size from 150 to 300 mm diameter to approximately 492 service connections. All service connections are metered for water billing purposes.

Flow and pressure of treated water exiting the plant will fluctuate based on varying demand in the distribution system. There is a flow meter and pressure transmitter installed on the plant discharge line to continuously monitor flow and pressure. Operation of the high lift pumps is controlled based on pressure demands of the Distribution system. Under normal operating conditions, a high lift pump is running 24 hours per day to maintain system pressure. SCADA programming will start and stop backup high lift pumps based on system pressure. The pressure entering the distribution system will vary but is typically eighty to ninety psi.

Pressure Zone 2 was added to accommodate the next phase of the Deerfield subdivision. Additional distribution pumps were installed to service the new pressure zone, complete with process piping, pumps, valves and associated instrumentation and controls. This section will be updated when all final documentation is received from the developer, upon full build-out.

Element 7.0 Risk Assessment

At least ***once every calendar year***, the QMS Representative conducts a review of the currency of information and validity of the assumptions used in the risk assessment. The updated risk assessment outcomes are discussed at the next Management Review meeting for the "effectiveness of the risk assessment process" agenda item. The review and changes will be recorded on ***QMS 05-06 Record of Annual Risk Assessment Review***. When reviewing the currency of the risk assessment information, the following may be considered:

a) process changes;
b) changes in reliability and redundancy of equipment;
c) the occurrence of emergency events;
d) the occurrence of deviations from critical control limits; and/or
e) non-conformities identified in the QMS or related to standard operating procedures

At least once ***every thirty-six months***, the Water Operations department team reassesses the drinking water system risks using the risk rating criteria included in the table below (multiplying ratings for probability, severity and detectability). The re-assessment will be recorded on ***QMS 05-05 Record of 36 Month Risk Assessment Review.***

Consideration of the potential hazardous events and associated hazards from the latest Ministry document titled ***Potential Hazardous Events for Municipal Residential Drinking Water Systems*** is included in the risk assessment process.

Each of the drinking water system's process and program steps from source water to consumers' taps are evaluated for risks of failure (including a review of potential failures related to source water, water treatment, water distribution).

The risk assessment is completed by using the previous year's risk assessment outcomes record as a starting point.

Below is the scoring table in order to determine the risks associated with each process step.

Probability		Severity		Detectability	
1	***Rare*** - Requires exceptional circumstances to occur	1	***Insignificant*** - little operational disruption	1	***High*** - immediately detectable, SCADA alarms
2	***Unlikely*** - Might occur at some point	2	***Minor*** - easily managed operationally	2	***Moderate*** - indicated by alarms, daily reports, inhouse tests, trending and lab results
3	***Possible*** - Could occur at some point	3	***Moderate*** - managed operationally	3	***Detectable*** - visually detectable, rounds or maintenance
4	***Likely*** - Expected to occur in most circumstances	4	***Major -*** significant impact on population, difficult to manage	4	***Poor*** - would not be detected until problem occurred
5	***Certain*** - Will occur during normal circumstances	5	***Catastrophic*** - major impact on population, complete system failure	5	***Undetectable*** - cannot be detected under any circumstances

The purpose of the risk assessment is to:

- ***identify*** potential ***hazardous events*** and associated ***hazards***,
- ***assess the risks*** associated with the ***occurrence*** of the hazardous events,
- ***rank*** the hazardous events according to the associated risk,
- ***identify control measures*** to address the potential hazards and hazardous events,
- ***identify critical control points***, and
- ***identify response procedures*** when an identified risk cannot be controlled***.***

A high risk is considered to be a risk assessment score of ***twenty (20) or higher***. Some scores above 20 are out of our control and do not necessarily trigger a Critical Control Point or Limit. None the less, they require a high level of consideration and appropriate response.

The Ministry's recommended ***minimum critical control points*** are ***related to disinfection*** requirements; and therefore, regardless of risk assessment scores, any items related to ***disinfection*** are ***automatically*** considered ***Critical Control Points***.

Element 8.0 Risk Assessment Outcomes

The records from the risk assessment process are included in ***Appendix "D" Risk Assessment Outcomes*** for each drinking water system and related information about critical control points is included in ***section 8.1*** that follows.

The items a) to h) listed below are addressed in both the risk assessment outcomes and section 8.1.

a) the identified potential ***hazardous events and associated hazards***,
b) the ***assessed risks*** associated with the occurrence of the hazardous events,
c) the ***ranked*** hazardous events,
d) the identified ***control measures*** to address the potential hazards and hazardous events,
e) the identified ***critical control points*** (CCP's) and their respective ***critical control limits*** (CCL's),
f) procedures and/or processes to ***monitor the CCL's***,
g) procedures to ***respond to deviations*** from CCL's, and
h) procedures for ***reporting and recording deviations*** from CCL's.

8.1 CRITICAL CONTROL POINTS AND CRITICAL CONTROL LIMITS

Critical Control Points (CCP's) identified in the risk assessment and their respective critical control limits (CCL's) are summarized in the following tables:

CAMBORNE DRINKING WATER SYSTEM			
CCP	**Condition**	**High CCL**	**Low CCL**
CT Minimum	Both clearwells in service	NA	0.40 mg/L
	One clearwell in service	NA	0.60 mg/L
Distribution system chlorine residual – at point-of-entry (POE)	Free Chlorine	1.60 mg/L	0.60 mg/L
Distribution system chlorine residual – grab sample	Free Chlorine	1.60 mg/L	0.20 mg/L
Distribution system pressure at POE	Normal operating conditions	550 kPa (80 psi)	345 kPa (50 psi)

CREIGHTON HEIGHTS DRINKING WATER SYSTEM			
CCP	**Condition**	**High CCL**	**Low CCL**
UV Minimum	Normal flow (~11 L/s)	NA	40 mJ/cm^2 x 9 units
	Minimum flow (~4 L/s)	NA	40 mJ/cm^2 x 3 units
	Maximum flow (~15 L/s)	NA	40 mJ/cm^2 x 9 units
Distribution system chlorine residual – at point-of-entry (POE)	Chloramination Free Chlorination	2.80 mg/L 2.80 mg/L	1.80 mg/L 0.50 mg/L
Distribution system chlorine residual – grab sample	Chloramination Free Chlorination	2.90 mg/L 2.20 mg/L	0.50 mg/L 0.20 mg/L
Zone 1 system pressure at POE	Normal operating conditions	550 kPa (80 psi)	345 kPa (50 psi)
Zone 2 system pressure at POE	Normal operating conditions	772 kPa (112 psi)	586 kPa (85 psi)

Whenever possible, online monitoring equipment has alarm setpoints programed to reflect the CCL's listed in the tables above. These setpoints are operator adjustable and may be changed from time to time for maintenance activities or temporary operating conditions.

Standard Operating Procedures (SOPs) listed below describe how CCL's ***are monitored*** including ***response/reporting/recording procedures*** for when ***CCL's are reached*** related to the following situations:

- ***QMS 08-01 SOP Inadequate Primary and Secondary Disinfection***
- ***QMS 08-02 SOP Distribution System Chlorine Residual***
- ***QMS 08-03 SOP Low Distribution System Pressure***

These SOPs can be found in the OP Binder at each Plant and in the electronic version on the Shared Drive.

Element 9.0 Organizational Roles, Responsibilities, and Authorities

The organizational structure related to the Township's Water Operations is depicted below:

*__ORO__ – Overall Responsible Operator; **__OIC__ – Operator In Charge, **OIT – Operator in Training

The QMS Representative ensures that the responsibilities and authorities for the relevant roles are assigned and communicated throughout the organization.

The Township's roles, responsibilities and authorities related to provision of safe drinking water are described below:

Role	Responsibilities	Authorities
Owner – Mayor & Council	Provide the resources needed to maintain and continually improve the Drinking Water System (DWS) and Quality Management System (QMS). Ensure the operating authority is accredited. Make decisions based on Water Operations department reports.	Report to the Public on matters required by legislation.
Top Management – Chief Administrative Officer (CAO)	Carry-out the commitments described in Elements 2 and 3 of this Operational Plan. Make recommendations to the Owner ensuring the necessary DWS / QMS resources are provided. Participate in Management Reviews.	Report to council and the public

Role	Responsibilities	Authorities
QMS Rep / ORO – Water Operations Manager	Carry-out the commitments and responsibilities described in Elements 2, 3 and 4 of this Operational Plan. Act as ORO and QMS Rep, oversee DWS operations, maintenance and optimization activities. Coordinate infrastructure improvement projects and respond to water servicing requests.	Supervise and coordinate Water Operators Coordinate Water Operator training Represent Township in inspections and source protection activities Reports to Ministries, Owner, CAO
Lead Hand – Water Operations	Carry-out work in line with QMS Policy commitments. Operate and maintain treatment and distribution systems safely in accordance with requirements. Keep records of all activities (e.g. logbook entries, notes of computer records review) as required.	Evaluate and test processes and equipment to optimize performance Make operational decisions: respond to adverse conditions, alarms and report as required.
OIC's, OIT's – Water Operators	Carry-out work in line with QMS Policy commitments. OIT is to be mentored and then given limited independence until obtaining Class 1 license Operate and maintain treatment and distribution systems safely in accordance with requirements. Keep records of all activities (e.g. logbook entries, notes of computer records review) as required.	Evaluate and test processes and equipment to optimize performance Make operational decisions: respond to adverse conditions, alarms and report as required.

Element 10.0 Competencies

Competencies required for personnel performing duties directly affecting drinking water quality are described below:

Manager of Water Operations/QMS Rep	Lead Hand/Water Operators
5 or more years of related experience. Minimum Class 2 Drinking Water Operator Certificate Demonstrated experience with Ministry inspections and an in-depth knowledge of DWQMS, all relevant legislation, policies, by-law and regulations is required Experience in human resource management including performance management, training, mentoring and developing staff within a unionized environment Experience preparing and administering annual and capital budgets	Must possess secondary school diploma, or approved equivalent Lead Hand must have a minimum Class 2 Operator Certificate. Water Operators must have a minimum of operator-in-training certificate and work towards a Class 2 Operator certificate(s) in a reasonable amount of time Sound knowledge of the processes, procedures and equipment used in water treatment operations Must be familiar with regulations, policies, procedures and environmental policies that apply to this work

Excellent written communication / documentation skills Previous experience developing, submitting and presenting technical and non-technical reports to Council Computer proficiency in standard MS business applications Outstanding interpersonal skills and the ability to work effectively with rate payers	Sound knowledge of sampling techniques, analytical procedures with the ability to interpret and make process adjustments Ability to prepare detailed reports and maintain neat and accurate operating records Knowledge of basic mechanical, electrical theory and instrumentation Outstanding interpersonal skills and the ability to work effectively with rate payers

Competency records are retained by the QMS Representative and used for operator certification renewals or upgrades.

The Township of Hamilton recognizes the value of ***training and development*** of its employees. Furthermore, it is recognized that continuing education is a requirement of the members in the Water Operations Department. The responsibility for such training lies not only with the employer, but also with the individual.

The Township of Hamilton may administer certain tests, conduct interviews, verify references and/or request specific documentation as part of the hiring process to verify skills, experience and knowledge.

To meet the ongoing changes in technology, software, the requirements of applicable legislation and Water Operations processes, all Water Operators shall receive training as required by O. Reg. 128/04 Certification of Drinking Water System Operators and Water Quality Analysts. The training may be provided by qualified employees or by contracted subject matter experts.

An internal form is used to track CEUs and on-the-job practical staff training. CEU-accredited training providers issue training certificates as the record of training.

Activities to ensure that personnel are aware of the relevance of their duties and how they affect safe drinking water include:

- providing access to training on relevant legislation and related regulations
- staff meetings and orientation sessions reminding staff of roles and responsibilities related to QMS Policy commitments
- conducting internal audits with staff and interviewing them about the relevance of their duties and how their actions affect safe drinking water

Element 11.0 Personnel Coverage

This Element describes the coverage provided for the Township of Hamilton's Water Operations Department.

- The department is staffed daily by a Water Operator (***Operator-in-charge [OIC]***) who is on-call on a rotating basis
- The ***Overall Responsible Operator (ORO)*** is the Manager of Water Operations. The ORO must always be available to assist OIC's on the operations of the system and to respond immediately and effectively to emergencies
- In the event the Manager is not available as ORO, a qualified Water Operator holding a Class 2 Water Treatment certificate will be designated ORO for daytime and after hours

After-hours / Weekends/ Statutory Holiday Coverage

- The drinking water systems are controlled and monitored by SCADA. Any alarm condition is routed to an automated dialer that is programmed with both the Water on-call phone number and personal phone numbers of the Water Department staff
- A Water Operator (OIC) is on stand-by, based on a weekly rotation. The stand-by operator takes the necessary actions to investigate and address any alarm conditions
- For 'after hours' emergencies, any call from the Public is processed by a 24-hour answering service. The answering service directs the issue to the On-Call Water Operator who responds accordingly
- Weekend and Statutory Holiday coverage/sampling are the responsibility of the designated On-Call Operator

Emergency and Vacation Coverage

- The Manager (ORO) ensures that coverage of the Township Water Operations Department is continuous: 24 hours/day, 7 days/week with an OIC
- One designated ORO is available on-call 24 hours/day, 7 days/week. An alternate ORO will be designated as required. The name of the alternate ORO is recorded in the logbook
- In response to the Ministry's amendment of O. Reg 128/04, Section 32, related to the use of Emergency Substitute Operators, the Township recognizes the ability to hire Substitute Operators in the event of staffing shortages due to Emergency Situations such as a pandemic. O. Reg 128/04 will be followed regarding capabilities of substitute staff

Element 12.0 Communications

This Element describes how the Township of Hamilton communicates the Quality Management System (QMS) ***between top management and***: the Owner, Operating Authority Personnel, Essential Suppliers and Service Providers and the Public.

The Owner

- Over the course of the year, top management communicates with the owner on a number of items, including: the Annual & Summary report supplied before Feb 28th every year, capital and operational budgets through the Annual Management Review and Budget process, emergencies and health-related adverse conditions (as they occur). Monthly Co-ordinator meetings are held to provide updates on Water Department activities

Employees

- The Manager of Water Operations/QMS Representative communicates regularly with Water Operators about; scheduling, upcoming projects, updates to procedures, training opportunities, ~~during~~ emergency conditions and response, etc.

Essential Suppliers and Service Providers

- Essential suppliers and service providers receive details on what is expected by the Township for the purchase of supplies and/or services (e.g. specifications, item sizes, numbers of, delivery details, etc.).

The Public

- The Township's Water Services section of its website provides; instructions on how to report a problem, info about Distribution flushing maintenance activities, the Water Financial Plan, by-laws related to water usage, annual reports, results of Ministry inspections and this Operational Plan, to name a few

- Calls from the Public related to water quality issues are recorded by Water Operations on the Township's web based complaint management program

Element 13.0 Essential Supplies and Services

Supplies and services essential for the delivery of safe drinking water have been identified in ***Appendix "E"***.

Appendix E provides information related to each of the essential supplies and services:

- ***identification*** of the essential supply or service,
- ***how procurement*** of these is ***ensured***,
- ***providers' contact information*** of essential supplies and services, and
- description of the ***quality requirements*** for each.

Regular inventory of essential supplies is performed by Operators and a minimum of essential supplies is maintained at all times.

Element 14.0 Review and Provision of Infrastructure

At least ***once per calendar year***, the Water Operations department prepares ***capital and operational budgets*** and presents these to the Township of Hamilton Council. Budget items are selected through ***risk-based decisions*** made by reviewing: the latest risk assessment outcomes; any issues related to the drinking water system's reliability and redundancy; infrastructure conditions (e.g. age, failure, material, sizing, etc.); and any long-term infrastructure and asset analysis information available.

The prioritization of budget items is documented through ***Infrastructure Review Meeting Minutes***.

The Plan is presented to the Township of Hamilton Council by the Manager during budget deliberations.

Upon approval of the plan, the Manager begins the process of implementing the approved recommendations over the course of the fiscal year.

Element 15.0 Infrastructure Maintenance, Rehabilitation and Renewal

Maintenance check sheets (e.g. well binder/UV Binder) and reports on infrastructure rehabilitation kept on file at the water plants and/or on the Shared Drive, provide record of regular and long-term maintenance, rehabilitation and renewal programs for the drinking water systems. Documentation is kept current and is based on compliance obligations and original equipment manufacturer recommendations.

The Manager of Water Operations communicates about the performance of maintenance programs and their effectiveness (regular and long-term major maintenance) to the Owner through the budget process every year.

Service agreements exist with qualified contractors for priority items such as watermain break repairs and SCADA system maintenance.

When equipment or systems break down, ***reactive maintenance*** is carried-out (e.g. valve, hydrant, meter replacements) and activities are recorded in logbooks.

If any infrastructure maintenance or upgrades result in a change in system description (whether in facilities or in distribution system), the appropriate DWWP form is completed.

Element 16.0 Sampling, Testing and Monitoring

The Township's Water Operations department carries out its sampling and testing programs for process control and finished drinking water quality in line with the Ministry's ***Practices for collection and handling of drinking water samples*** and the ***accredited laboratory's specific instructions regarding samples*** (e.g. requirements for chain-of-custody records, standard protocols for sample collection, labelling, storage and transportation to the laboratory).

The tables included in ***Appendix "F"*** describe the current sample and test programs (based on requirements of O. Reg. 170/03 Drinking water systems and the Municipal Drinking Water License).

There are no sampling, testing and monitoring activities that take place upstream of the drinking water systems.

Monitoring programs for process control, finished drinking water quality and most challenging conditions are described below.

SCADA

The SCADA system is programmed to monitor process parameters and/or water characteristics in several locations-including raw water and treated water;

- Well levels, well pump status, flow meter data, online analyzer data, chemical dosing pump status, online pressure transducer data, etc are monitored and alarmed by SCADA. Please refer to the Control Narrative and the Operations and Maintenance (O&M) Manual for detailed information
- The Operator may adjust processes affecting water quality based upon the information and data provided by SCADA and onsite conditions
- Any adjustments made to process parameters shall be recorded in the daily logbook
- Parameters are trended by the SCADA system

Visual

- The Operator conducts a visual inspection of the treatment facilities daily
- Any unusual conditions shall be noted in the Operational Logbook and reported to the Manager

Communication

The sampling and testing results are summarized in the Annual Summary Report. As required by Regulation, the Owner is provided with a copy of the Annual Summary Report each year, no later than February 28th.

More immediate communications of sampling and testing results take place when adverse water quality incidents are identified.

Element 17.0 Measurement and Recording Equipment Calibration and Maintenance

Calibration/verification of measuring and recording equipment is provided by a ***qualified third-party service provider***.

- ***Flow measuring devices*** and ***quality measuring instrumentation*** that form part of the ***CT monitoring system*** (e.g. on-line chlorine analysers) are calibrated and/or verified at least once every 12 months (or more frequently, if specified) using the method specified by the manufacturer

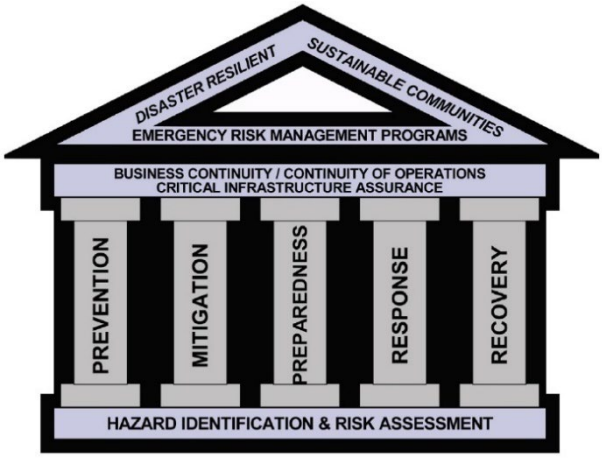
- The ***certificates of calibration and/or records of verification*** are retained on file and the instruments bear a record of the ***most recent calibration / verification date*** A tracking sheet is used to ensure all devices are calibrated/verified
- The ORO or designate is responsible for co-ordinating a ***qualified third-party*** for the required calibration and / or verification of the measurement and recording equipment

Element 18.0 Emergency Management

We maintain a ***state of emergency preparedness*** by:

a) maintaining a list of potential emergency situations or service interruptions (see ***Risk Assessment Outcomes***),
b) identifying processes for emergency response and recovery (see ***QMS 18-01 Water Contingency Plan***),
c) conducting ***emergency training and testing*** activities,
d) identifying Township of Hamilton and Water Operations ***responsibilities*** during emergency situations,
e) referring to ***municipal emergency planning*** measures for larger-scale incidents, and
f) having an ***emergency communication protocol*** in place and an up-to-date list of emergency contacts (see ***QMS 18-01 Water Contingency Plan)***.

For potential environmental emergencies, Emergency Management Ontario's five core components of emergency management are considered:



- ***Prevention*** – actions taken to prevent an emergency or disaster.
- ***Mitigation*** – actions taken to reduce the effects of an emergency or disaster.
- ***Preparedness*** – actions taken prior to an emergency or disaster to ensure an effective response.
- ***Response*** – actions taken to respond to an emergency or disaster.
- ***Recovery*** – actions taken to recover from an emergency or disaster.

In the context of our QMS, "emergencies or disasters" can contribute to potential adverse impacts.

Where possible, we plan actions to ***prevent*** or ***mitigate*** these adverse impacts and their consequences.

Where we cannot prevent or mitigate impacts and their consequences; we prepare ***response actions*** in advance of an emergency to ensure we are effective in our response (see ***QMS 08-01, 08-02 and 08-03 procedures***).

When emergencies do occur, we ***respond*** and take actions to ***recover*** from them (returning to normal operations).

In order to be prepared for potential emergencies, we ***share our QMS 18-01 Water Contingency Plan*** with staff, ***test*** our planned response actions annually and ***train*** our staff.

Element 19.0 Internal Audits

We conduct internal audits ***at least once every calendar year*** to provide information on ***whether our QMS***:

- ***conforms*** to our own QMS requirements and to the requirements of the Drinking Water Quality Management Standard (DWQMS); and
- is ***effectively implemented and maintained***.

At a minimum, the ***audit criteria*** includes the DWQMS. Various elements of the DWQMS can be evaluated as part of each internal audit conducted, as it applies to the specific process or program being audited.

The ***scope*** of the internal audit considers existing situations (e.g. system weaknesses have been recognized; process failures or emergency situations have occurred) as well as the original plan for auditing drinking water system.

The standard for conducting management system audits, ***ISO 19011:2018 Guidelines for auditing management systems*** is used as the method to carry-out internal audits. If a sector-specific internal audit training program is available, the methods presented in the training program can also be followed (e.g. Internal auditing for the DWQMS).

For each internal audit conducted, we:

- define what ***processes and programs*** form part of that ***audit's criteria and scope***
- ***Lead auditor*** and any Operator with auditor training can provide coaching and guidance to the Audit Team members as they conduct the audit
- ***review previous*** internal and external ***audit results*** (to ensure previous actions taken continue to be effective) and
- ensure that ***results of audits are reported*** (through Management Review meetings)

Following each audit conducted, an ***internal audit report*** is prepared as the record of the audit. The audit report summarizes details of the audit conducted, along with the summary of findings, as applicable: positive findings, non-conformities and opportunities for improvement.

The ***findings summarized*** (non-conformities or opportunities for improvement) in the internal audit report are linked to the ***continual improvement system***, Element 21.

A future internal and external audit will review the effectiveness of these actions taken.

Element 20.0 Management Review

Top management reviews our QMS at planned intervals (at least once every calendar year) to ensure continuing ***suitability, adequacy and effectiveness of our QMS***.

The QMS Representative prepares the required information using the ***QMS 20-01 Management Review Meeting form*** which includes consideration of items required for Management Review meetings and prompts for the required outputs of these meetings (a summary of which is documented in Management Review Meeting minutes).

Management Review Inputs

The QMS Representative provides information and data relevant to the following items, for the review:

a) incidents of regulatory non-compliance
b) incidents of adverse drinking water tests
c) deviations from critical control point limits and response actions
d) the effectiveness of the risk assessment process
e) internal and external audit results

f) results of emergency response testing
g) operational performance
h) raw water supply and drinking water quality trends
i) follow-up on action items from previous management reviews
j) the status of management action items identified between reviews
k) changes that could affect the QMS
l) consumer feedback
m) the resources needed to maintain the QMS
n) the results of the infrastructure review
o) operational plan currency, content and updates
p) staff suggestions and best management practice recommendations (e.g. from debriefs, audits, inspections, staff).

Management Review Outputs

a) ensure management review is conducted at least once every calendar year
b) consider the results of management review and identify deficiencies/action items to address these
c) provide a record of any decisions and action items related to the management review including the personnel responsible for delivering the action items and the proposed timelines for their implementation
d) report the results of the management review, the identified deficiencies, decisions and action items to the owner.

Element 21.0 Continual Improvement

We are committed to tracking and measuring continual improvement by:

a) reviewing and considering applicable ***best management practices*** (Management Review item p)
b) documenting the identification and management of ***QMS Corrective Actions*** that includes:
    i. ***investigating the cause(s)*** of an identified non-conformity,
    ii. ***documenting the action(s)*** that will be taken to correct the non-conformity and prevent the non-conformity from re-occurring, and
    iii. ***reviewing the action(s)*** taken to correct the non-conformity, verifying that they are ***implemented and are effective*** in correcting and preventing the re-occurrence of the non-conformity. ***Continual Improvement Tracking Spreadsheet*** is used.
c) documenting the identification and implementation of ***Preventive Actions*** to eliminate the occurrence of ***potential non-conformities*** in the QMS that includes:
    i. ***reviewing potential non-conformities*** that are identified to determine if preventive actions may be necessary
    ii. documenting the outcome of the review, including ***the action(s), if any,*** that will be taken to prevent a non-conformity from occurring
    iii. ***reviewing the action(s)*** taken to prevent a non-conformity, verifying that they are ***implemented and are effective*** in preventing the occurrence of the non-conformity.

When a non-conformity occurs, or a potential non-conformity is identified, or an opportunity for improvement is identified, it is added to the ***Continual Improvement Tracking Spreadsheet*** with all required details (immediate actions, root cause, corrective action, preventive action and follow-up verification). The progress on these actions reported at Management Reviews and reviewed at the next internal and external audits conducted.

Appendix "A" QMS Calendar

DWQMS Element ## and reference	Timeline requirement
01 – Municipal Drinking Water License-related	Calendar reminders set for ORO / Top Management every 5 years for: Rate Study, Fin Plan, MDWL, DWWP, PTTW expiries with application deadlines
02 – QMS policy update	Within six months of changes to Owner Representative or Top Management
03 – Commitment and Endorsement update	Within six months of changes to Owner or Top Management
05 – Document Review	As changes are required
07 – Risk Assessment update	Once every calendar year for update and once every thirty-six months for full risk assessment
09 – Communication about roles, responsibilities and authorities	With each new Operator and With each new Council (DWS overview, Stand. of Care)
10 – Competency information	Calendar reminders set for ORO and impacted OIC's: Operator certification expiries and renewal timelines
11 – Personnel coverage (staff on-call calendar)	Updated late fall for the upcoming calendar year
14 – Infrastructure review – adequacy of infrastructure necessary to operate and maintain the system	Reviewed at least once every calendar year and Reported to Owner at budget
15 – Summary of infrastructure maintenance, rehabilitation and renewal programs confirmed current; long-term forecast reviewed	Confirmed current and reviewed at least once every calendar year and Reported to Owner at budget
17 – Measurement and recording equipment calibration and maintenance	At least once every 12 months for flow meters and instruments used in CT calculation
19 – Internal audits	Conducted at least once every calendar year
19 – External audits	Conducted at least once every calendar year
20 – Management reviews	Conducted at least once every calendar year
20 – Annual & summary reports	Completed, Reported to Owner and available online by Feb. 28 every year
21 – Review / consideration of best management practices	At least once every thirty-six months (but documented every calendar year through Management Reviews)

Appendix “B” Documents and Records Listing, Internal and External Documents

Internal Documents		
Document Title	**Document #** (if applicable)	**Location (Person Responsible) or File Path**
Operational Plan	QMS 01	On S: Drive, in QMS Rep’s office, in CAO’s office & at both Water Treatment Plants (QMS Rep)
Operations & Maintenance Manuals (including equipment manuals)	NA	S: Drive & at Water treatment plants (QMS Rep)
Standard Operating Procedures, Work Instructions, Forms	NA	S: Drive and in OP Binder at Water treatment plants (QMS Rep)
Township Water Use Restrictions by-law	By-law #2004-28	www.hamiltontownship.ca
County Backflow Prevention by-law	NA	Northumberland County by-law
Water Contingency Plan	QMS 18-01	S: Drive & at Water Treatment Plants (QMS Rep)
Township of Hamilton Emergency Plan	NA	Township of Hamilton (Fire Chief)

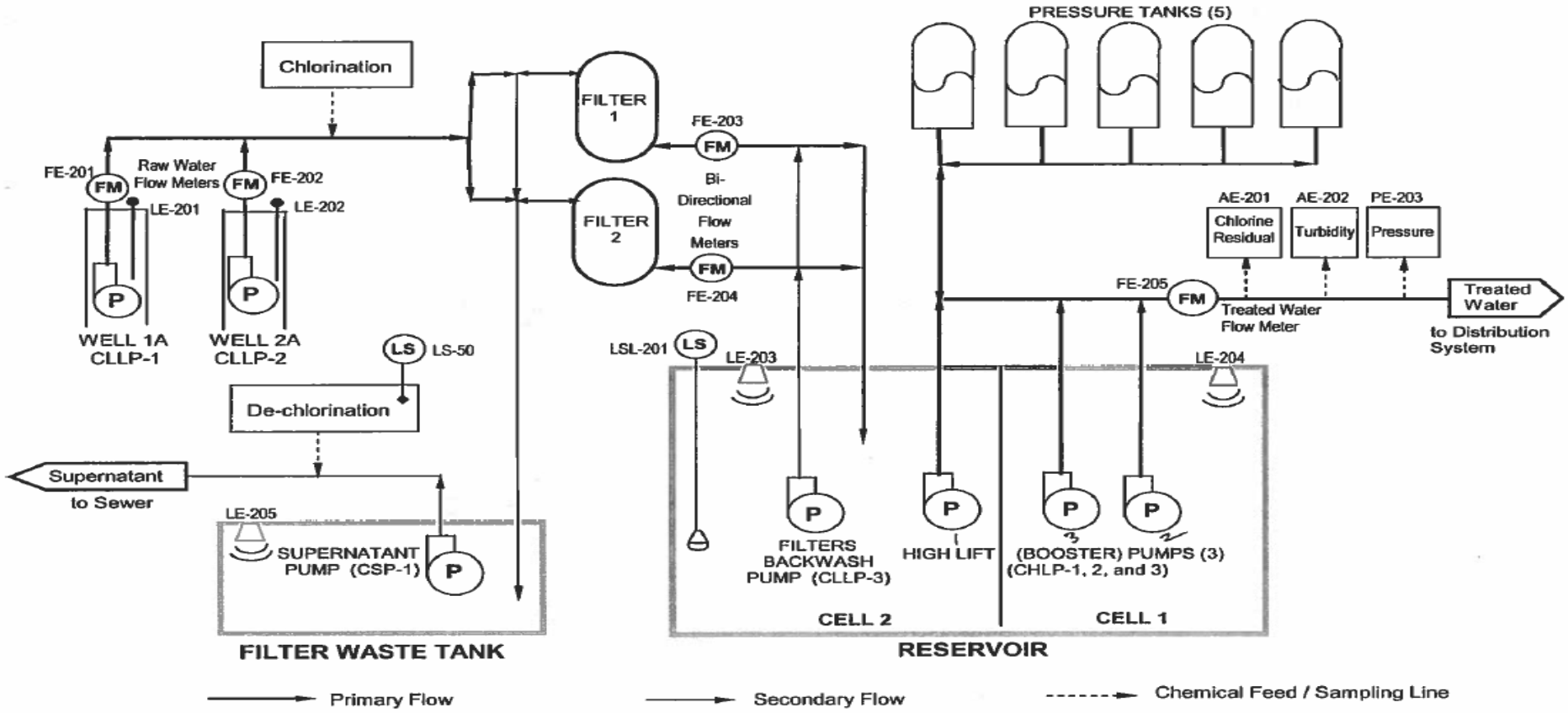
External Documents			
Document Title	**Document #** (if applicable)	**Date**	**Location, (Person Responsible) or File Path**
Drinking Water Quality Management Standard	DWQMS 2.0	2017	ontario.ca/page/drinking-water
Accreditation certificate, Corporation of the Township of Hamilton (accred. Op. authority)	139-OA1	Ongoing	Accreditation body issues (QMS Rep)
Municipal Drinking Water License – Camborne Drinking Water System	139-103	August 12, 2021	MECP issues (QMS Rep)
Municipal Drinking Water License – Creighton Heights Drinking Water System	139-102	August 12, 2021	MECP issues (QMS Rep)
Drinking Water Works Permit – Camborne Drinking Water System	139-203	August 12, 2021	MECP issues (QMS Rep)
Drinking Water Works Permit – Creighton Heights Drinking Water System	139-202	August 12, 2021	MECP issues (QMS Rep)
Permit to Take Water – Wells 1A, 1A Artesian Flow, 2A, 2A Artesian Flow	2140-AP5P6D	July 11, 2017	MECP issues (QMS Rep)
Permit to Take Water – Wells TW-1, TW-6, TW-7	2320-CGPMQ5	July 26, 2022	MECP issues (QMS Rep)
Financial Plan	139-301A	Feb 12, 2021	Owner approval
Safe Drinking Water Act, 2002	SDWA, 2002	S.O. 2002, Ch. 32	ontario.ca
O. Reg. 128/04 Certification of Drinking Water System Operators and Water Quality Analysts	O. Reg. 128/04	NA	ontario.ca
O. Reg. 169/03 Ontario Drinking Water Quality Standards	O. Reg. 169/03	NA	ontario.ca
O. Reg. 170/03 Drinking Water Systems	O. Reg. 170/03	NA	ontario.ca
O. Reg. 205/18 Municipal Residential Drinking Water Systems in Source Protection Areas	O. Reg. 205/18	NA	ontario.ca
O. Reg. 248/03 Drinking Water Testing Services	O. Reg. 248/03	NA	ontario.ca

Records				
Record Name	***Filing Method***	***Location***	***Retention Period (years)***	***Maintained by***
Operational Plan – as audited	Electronic	QMS Rep. office/archive	10 years	QMS Representative
Risk assessment outcomes	Electronic	OP Appendix “C”	10 years	QMS Representative
Competence / training	Hard copy and electronic	QMS Rep. office/archive	E + 3 years (E = Operator’s last day)	QMS Representative
Financial records (purchasing, budgets, reports)	E-mail request in Outlook, hard copy and electronic	Accounts Payable	7 years	Township Finance dept.
Infrastructure records (as-built drawings, distribution system map, DWWP records – Forms 1, 2, 3)	Hard copy and electronic	QMS Rep. office/archive/ Water Plants	Permanent: as-builts 10 years: maps, forms	QMS Representative
Infrastructure maintenance (incl. calib. / verification)	Hard copy and electronic	Logbook/QMS Rep. Office	15 years	QMS Representative
Infrastructure reviews	Electronic	QMS Rep. office/archive	10 years	QMS Representative
Sampling, testing, monitoring (chains of cust., results)	Hard copy and electronic	QMS Rep. office/archive	15 years	QMS Representative
Emergency preparedness training and testing	Hard copy and electronic	QMS Rep. office/archive	10 years	QMS Representative
Audit reports (internal, external, Ministry inspections)	Hard copy and electronic	QMS Rep. office/archive	10 years	QMS Representative
Management review minutes	Hard copy and electronic	QMS Rep. office/archive	10 years	QMS Representative
Annual & Summary reports	Hard copy and electronic	QMS Rep. office/archive	15 years	QMS Representative
Continual improvement (completed forms)	Hard copy and electronic	QMS Rep. office/archive	10 years	QMS Representative

Appendix “C” Treatment System Process Flow Charts

C.1 CAMBORNE DRINKING WATER SYSTEM

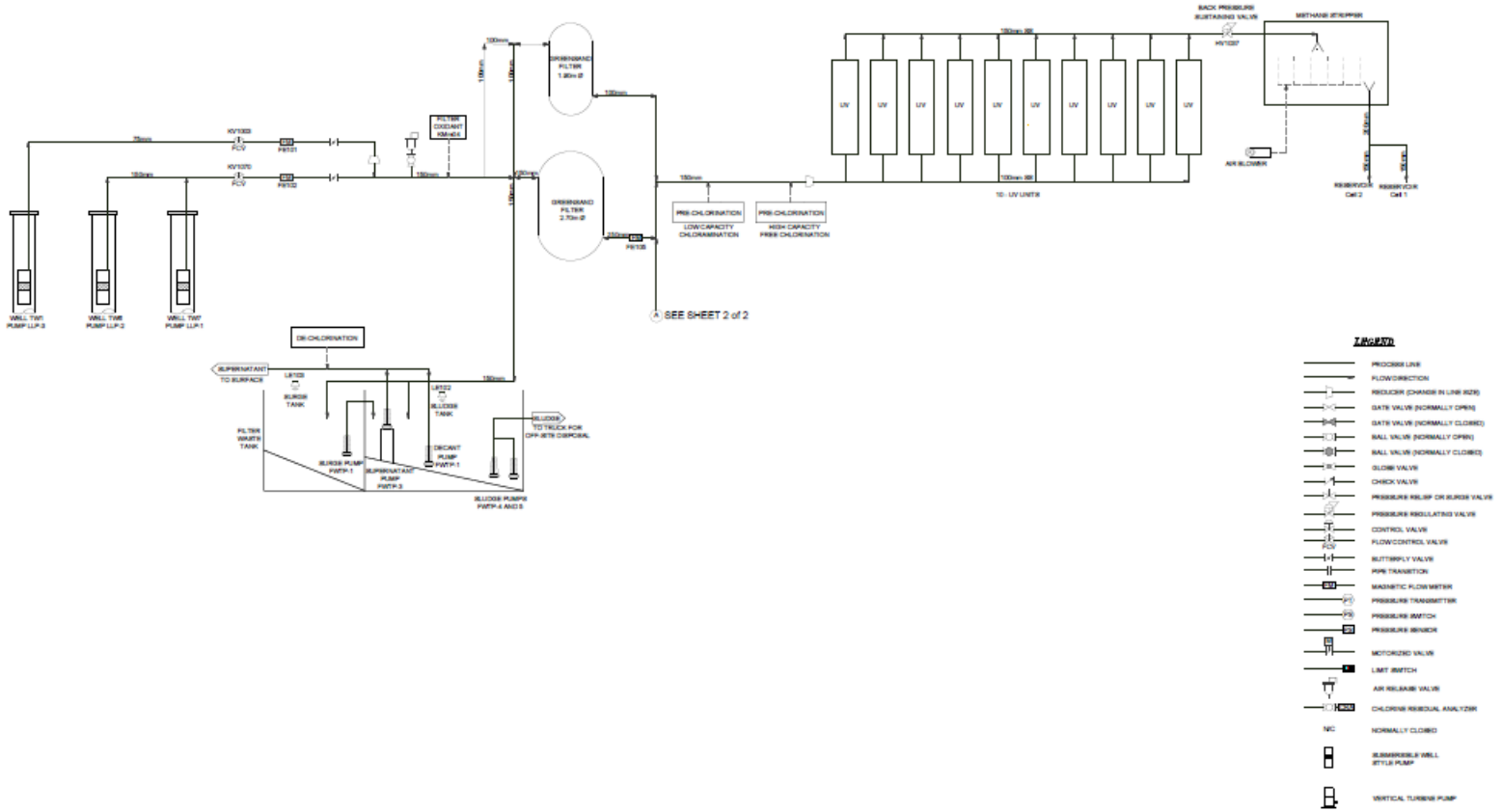
FIGURE 2 : CAMBORNE WATER SUPPLY SYSTEM
PROCESS FLOW DIAGRAM



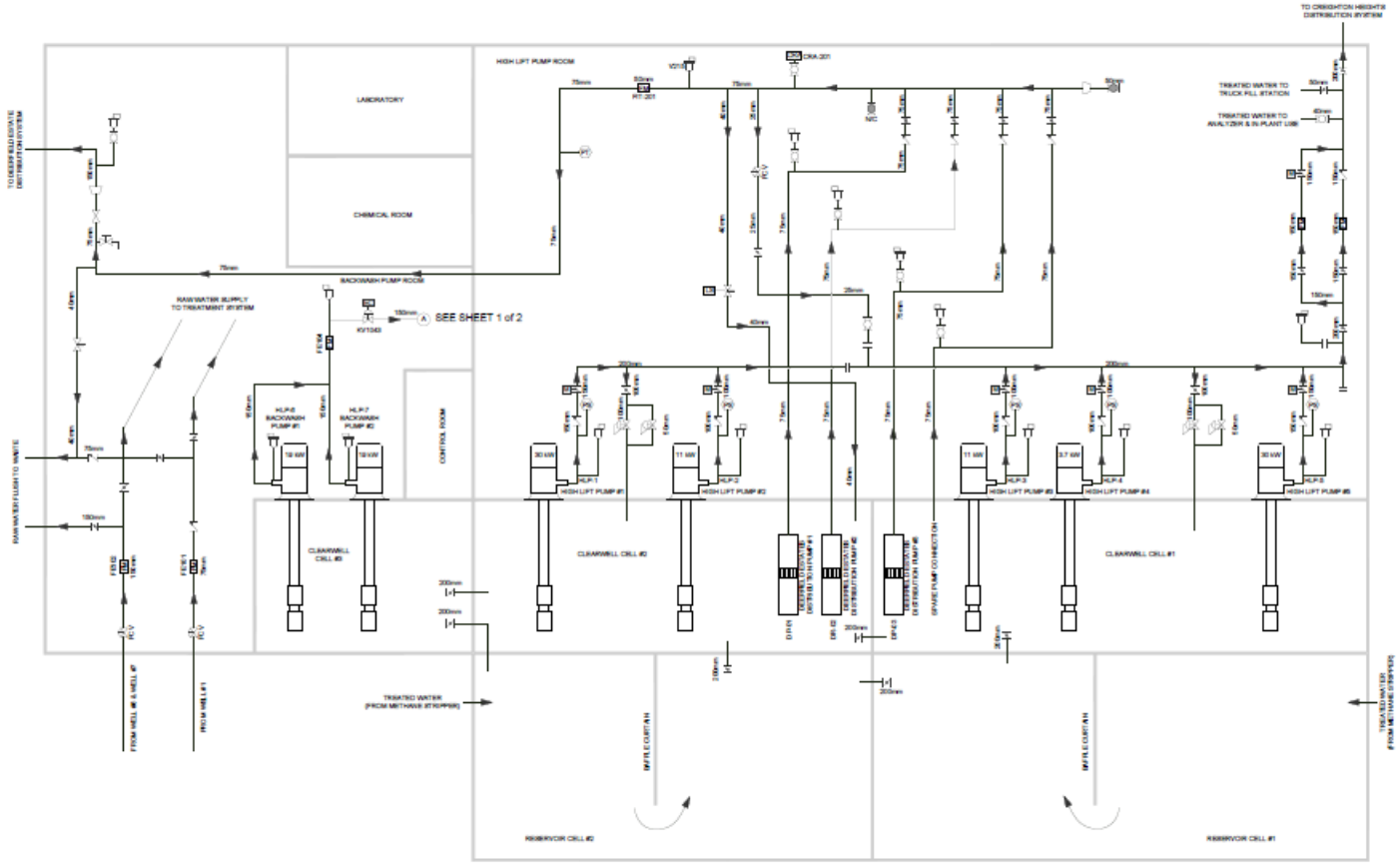
CONTROL NARRATIVE (April 2006)
TOWNSHIP OF HAMILTON - CAMBORNE WATER SYSTEM

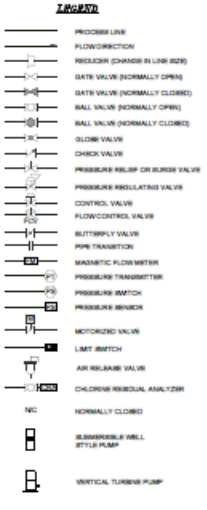
GAMSBY AND MANNEROW Limited
CONSULTING PROFESSIONAL ENGINEERS

C.2 Creighton Heights Drinking Water System



QMS 01 Operational Plan





Appendix "D" Risk Assessment Outcomes

D.1 CAMBORNE DRINKING WATER SYSTEM (REFER TO SCORING CHART ON PAGE 10)

Activity or process step	Hazardous Event / Hazard	Control Measures	Probability	Severity	Detectability	Total	CCP	CCL	Monitoring procedures / processes	Response procedures
Raw Water	Well casing failure – loss of raw water	Back-up well and pump	2	3	1	6	N	NA	Maintenance plan & condition assessment	Contract out to Well Tech
	Sudden changes to raw water characteristics (pH, turbidity)	Back-up well, filters	3	3	2	18	N	NA	Monitoring and sampling	Investigate, contract out to Well Tech
	Well pump failure – loss of raw water	Back-up well and pump	3	3	1	9	N	NA	Maintenance plan & condition assessment	Contract out to Well Tech
	Chemical spill – contamination of aquifer	Wellhead protection plan	1	4	3	12	N	NA	Monitoring and sampling	Water Contingency plan
	Agricultural run-off – contamination of aquifer	Wellhead protection plan	1	4	4	16	N	NA	Monitoring and sampling	Water Contingency plan
	Source water supply shortfall	Source Water Protection Plan, Well level monitoring	1	4	1	4	N	NA	Monitoring and data review	Haul potable water
Primary disinfection	Chemical feed pump failure	Back-up feed, online monitoring and controls	3	3	1	9	Y	OP E 8.0 Table 8.1	Maintenance Monitoring and sampling	QMS SOP 08-01 Primary and Secondary Disinfection Response

Activity or process step	Hazardous Event / Hazard	Control Measures	Probability	Severity	Detectability	Total	CCP	CCL	Monitoring procedures / processes	Response procedures
Primary disinfection	Chlorine analyzer failure – non-compliance	Continuous grab samples every 5 minutes	2	3	1	6	Y	OP E 8.0 Table 8.1	Analyzer maintenance	Repair if possible or replace with spare
Clearwell	Clearwell cell integrity failure	If possible, use one clearwell cell, increase dosage rates, increase volume in operating cell	2	3	3	18	Y	OP E 8.0 Table 8.1	Monitoring, sampling & regular maintenance	QMS SOP 08-01 Primary and Secondary Disinfection Response
Highlift Discharge	All HLPs fail – loss of treated water flow & system pressure	Temporary use of BW Pump until HLP repair	2	4	1	8	Y	OP E 8.0 Table 8.1	Regular Highlift Pump Maintenance	QMS SOP 08-03 Low distribution system pressure, BWA
	Header failure – loss of treated water flow & system pressure		3	5	1	15	Y	OP E 8.0 Table 8.1	Maintenance, condition assessments	QMS SOP 08-03 Low distribution system pressure, BWA
Distribution	Saddle/Watermain break – loss of system pressure, possible contamination of drinking water	Throttle break, contractor available for repair, maintain air gap	2	3	2	12	Y	OP E 8.0 Table 8.1	Follow 2020 Ontario Watermain Disinfection Procedure	QMS SOP 08-03 Low distribution system pressure
	Loss of chlorine residual	Distribution system maintenance	1	3	4	12	Y	OP E 8.0 Table 8.1	Maintaining primary disinfection procedure	QMS SOPs 08-01 & 08-02

Activity or process step	Hazardous Event / Hazard	Control Measures	Probability	Severity	Detectability	Total	CCP	CCL	Monitoring procedures / processes	Response procedures
Control systems	Loss of PLC	Spare cards & PLC components	3	3	1	9	N	NA	Immediately detectable through SCADA Alarms	QMS SOP 08-01 Primary and Sec Disinfection, Water Contingency plan
	Generator Failure – no power, loss of flow and pressure	Rental of genset	2	5	1	8	Y	Y	Testing and maintenance	QMS SOPs 08-01, 08-02 and 08-03
Entire system	Long-term impacts of climate change	Liaise with MECP re: Climate change updates	2	2	3	12	N		See Appendix G	See Appendix G
Entire System	Extreme weather events	Back-up generator	3	3	1	9	N		See Appendix G	Township emergency plan
	Prolonged extreme heat / cold	Water use by-law, manage amt of flushing	3	2	1	6	N		Monitoring and data review	See Appendix G
	Backflow	Backflows in Treatment Plants	1	4	4	16	N		Backflow Preventors tested/certified each year	
Facility security	Vandalism, terrorist threat, introduction of contaminant – damage to equipment, inability to produce water, potential contamination	Locks, alarms, lighting	1	5	3	15	Y	NA	Well Inspections	Water Contingency plan

Activity or process step	Hazardous Event / Hazard	Control Measures	Probability	Severity	Detectability	Total	CCP	CCL	Monitoring procedures / processes	Response procedures
Cyber-security	Risk of criminal hacking or unauthorized use of SCADA	Proper log out procedure at end of each SCADA session by Operators, continued monitoring and protection by SCADA Integrator	1	5	3	15	Y	NA	Careful daily check of SCADA function with good computer log out practices	SCADA provider's cybersecurity policies and procedures, QMS SOPs 08-01, 08-02 & 08-03

D.2 CREIGHTON HEIGHTS DRINKING WATER SYSTEM (REFER TO SCORING CHART ON PAGE 10)

Activity or process step	Hazardous Event / Hazard	Control Measures	Probability	Severity	Detectability	Total	CCP	CCL	Monitoring procedures / processes	Response procedures
Raw Water	Well casing failure – loss of raw water	Back-up well and pump	3	3	1	9	N	NA	Maintenance	Contract out Well Technician
	Sudden changes to raw water characteristics (pH, turbidity)	Back-up well, filters	2	3	3	18	N	NA	Monitoring and sampling	Investigate, contract out Well Technician
	Well pump failure – loss of raw water	Back-up well and pump	3	3	1	9	N	NA	Maintenance	Contract out Well Technician
	Chemical spill – contamination of aquifer	Wellhead protection plan	1	4	4	16	N	NA	Monitoring and sampling	Water Contingency plan

Activity or process step	Hazardous Event / Hazard	Control Measures	Probability	Severity	Detectability	Total	CCP	CCL	Monitoring procedures / processes	Response procedures
	Agricultural run-off – contamination of aquifer	Wellhead protection plan	1	4	4	16	N	NA	Monitoring and sampling	Water Contingency plan
	Source water supply shortfall	Source Water Protection Plan, Well level monitoring	2	4	1	8	N	NA	Monitoring and data review	
Primary disinfection	UV light failure – loss of disinfection	Interlock with raw pumps	1	3	1	3	Y	OP E 8.0 Table 8.1	Daily Visual and weekly checks, maintenance	QMS SOP 08-01 Primary and Secondary Disinfection
Clearwell	Clearwell integrity failure	If possible, use one clearwell, increase dosage, increase volume in operating cell	3	2	1	6	N	NA	Maintenance, condition assessments	QMS SOP 08-01 Primary and Secondary Disinfection
Highlift discharge	All HLPs fail – loss of system pressure & treated water flow		3	5	1	15	Y	OP E 8.0 Table 8.1	Regular Highlift Pump Maintenance	QMS SOP 08-03 Low Distribution System Pressure, BWA
	Header failure – loss of treated water flow & system pressure		3	5	1	15	Y	OP E 8.0 Table 8.1	Maintenance, condition assessments	QMS SOP 08-03 Low Distribution System Pressure
Secondary disinfection	Chemical feed system failure – inadequate disinfection	Back-up feed system, online monitoring and controls, new pump on shelf	3	3	2	18	Y	OP E 8.0 Table 8.1	Online analyzer Grab samples	QMS SOP 08-01 Primary and Secondary Disinfection

Activity or process step	Hazardous Event / Hazard	Control Measures	Probability	Severity	Detectability	Total	CCP	CCL	Monitoring procedures / processes	Response procedures
	Chlorine analyzer failure – non-compliance	Collect and test for residual once/hour, spare Cl17 is available	2	3	1	6	N		Analyzer maintenance	Replace faulty analyzer with spare
Distribution	Watermain break – loss of system pressure, possible contamination of drinking water	Throttle break, contractor available for repair, maintain air gap	2	4	1	8	Y	OP E 8.0 Table 8.1	Follow 2020 Ontario Watermain Disinfection Procedure	QMS SOP 08-03 Low Distribution System Pressure
Distribution	Loss of chlorine residual	Distribution system maintenance	2	3	4	24	Y	OP s.8.1	Maintain primary disinfection procedure, Distribution Grab Samples	QMS SOP 08-02 Low Distribution System Chlorine Residual
Control systems	Loss of PLC	Spare cards & PLC components, UPS maintenance	3	3	1	9	N	NA	Immediately detectable by SCADA alarms	Water Contingency plan
	Generator failure – no power, loss of pressure	Rental of genset	2	5	1	10	Y	OP E 8.0 Table 8.1	Testing and maintenance	QMS SOPs 08-01, 08-02 & 08-03
Entire System	Long-term impacts of climate change	Liaise with MECP re: Climate change updates	2	2	4	16	N		See Appendix G	See Appendix G
	Extreme weather events	Back-up generator	3	3	1	9	N			Township Emergency Plan
	Extreme temperature – heat / cold	Water use by-law, manage flushing rates	3	2	1	6	N		Monitoring and data review	

Activity or process step	Hazardous Event / Hazard	Control Measures	Probability	Severity	Detectability	Total	CCP	CCL	Monitoring procedures / processes	Response procedures
	Backflow	Backflows in Treatment Plants	1	4	4	16	N		Backflow Preventors tested/certified each year	
Facility security	Vandalism, terrorist threat, introduction of contaminant – damage to equipment, inability to produce water, potential contamination	Locks, alarms, lighting	1	5	2	10	N	NA		Water Contingency plan
Cyber-security	Risk of criminal hacking or unauthorized use of SCADA	Proper log out procedure at end of each SCADA session by Operators, continued monitoring and protection by SCADA Integrator	1	5	3	15	Y	QMS SOPs 08-01, 08-02, 08-03	Careful daily check of SCADA function with good computer log out practices	QMS SOPs 08-01, 08-02 and 08-03, SCADA provider's cybersecurity policies and procedures

Appendix "E" Essential Supplies and Services

Essential Supply or Service	Quality Requirements	Contact: Supplier or Service Provider	Means to Ensure Procurement
Plant Chemicals and Equipment	All process chemicals and materials that come into contact with water must meet applicable AWWA and ANSI standards (NSF/60, NSF/61 and NSF 372). Safety data sheets are required for each chemical product used.	**Sodium Hypochlorite:** Swish Maintenance Ltd., Peterborough (705) 745-5763 / (800) 461-7695 **Cleartech**, (800) 387-7503 email: orders@cleartech.ca **Potassium permanganate / Sodium Thiosulphate:** Brenntag Canada Inc. Brampton (416) 243-9615 or (416) 259-8231 **Cleartech**, (800) 387-7503 email: orders@cleartech.ca **UV Parts:** Rideau Group Inc./AccuPump Stratford – (519) 272-1005 or (800) 436-7648 **Reagents:** HACH Canada, Mississauga 800-665-7635 / infocanada@hach.com	A minimum 7-day supply of chemicals is always maintained. Chemicals can be moved from one facility to another in the event of a shortage or an emergency An inventory of essential supplies is kept in stock; the operator-in-charge orders as required
Distribution System Repair	All process chemicals and materials that come into contact with water must meet applicable AWWA and ANSI standards (NSF/60, NSF/61 and NSF 372).	**Distribution Emergency Maintenance:** Behan Construction Ltd, Cobourg Kevin Robinson: (905) 377-5494 Tom Behan: (905) 377-5446 CDS Ltd, 609 William St, Cobourg (905) 372-4848	Contractor supplies qualified Operators, parts, chemicals meeting the specification requirements of the Municipal Drinking Water License

Laboratory	Licensed and accredited as per O. Reg. 248/03 Drinking Water Testing Services. Proof of licence, accreditation and authorization to conduct tests requested verified with each new contract.	**Accredited laboratory:** SGS Lakefield Research Limited, Lakefield 705-652-2000 / info@lakefield.com	Contract with qualified, licensed, accredited labs Drinking water tests required are verified on the lab's listing of authorized tests
Regulatory Equipment Calibrations	Instrument calibrations and/or verification by qualified third-party.	**Calibrations:** Franklin Empire, Peterborough (705) 745-1626 Hach, Customer # 40165381, (800) 655-7635 Lakeland, Cobourg for BFP's (905) 377-5957	Tracking of verification / calibration dates, once every 12 months Must have unexpired verification reagents in stock
Well/Well Pump Issues	Technical and mechanical ability to provide planned and unplanned service	Lotowater Technical Services, Paris, (519) 442-2086 Herb Lang Well Drilling, Omemee, (705) 799-7088	Well pump removal/replacement, liner and casing issues

Appendix "F" Sample and Testing Program

CAMBORNE DRINKING WATER SYSTEM **Routine On-Site Water Testing Schedule**

Frequency	Parameter	Location
Continuous	Chlorine Residual Turbidity	Treated Water (inspect sample lines daily to ensure free flow)
Daily	Chlorine Residual – free and total	Clearwell Cell 1A Treated Water (to verify analyzer) Distribution System-2 samples weekly, at least 48 hours apart
	Turbidity	Treated Water Post filter
	Taste and Odour	Treated Water
	Iron	Post filter
Weekly	pH, Iron Colour Turbidity	Raw Water taken from each well – Turbidity, Iron, Colour and pH taken from the duty well
	pH Colour	Treated Water
Quarterly	Free Chlorine Residual - grab	Supernatant Discharge at Storm Sewer Outlet

1. *This chart summarizes key operational requirements. Please refer to Regulation 170/03 for full details.*
2. *The above noted testing program in some cases exceeds the minimum testing requirements stipulated in Regulation 170/03.*

CAMBORNE DRINKING WATER SYSTEM **Routine Water Testing Schedule at Accredited Laboratory**

Frequency	Parameter	Location
Weekly/Monthly	**Microbiology (Sch. 11)** E. coli Total Coliform HPC **Note:** a grab sample must be collected & tested for chlorine residual for each distribution bacteriological sample collected	Raw Sample from each well (no HPC), once /month 1 Distribution System sample taken at a sample station or at the Old Camborne Schoolhouse.
Quarterly	**Chemical (Sch. 13)** Trihalomethanes (THM) Haloacetic acids (HAA) Nitrate and Nitrite Total Suspended Solids Total Chlorine Residual	THM's and HAA's shall be sampled from a point in the distribution system that is likely to have an elevated potential for the formation of these compounds. As Camborne is a Small System, if there has been 12 consecutive quarters of results less than 0.050mg/L for THM's and 0.04mg/L for HAA's, sampling can be ceased for 8 consecutive quarters. Refer to Schedule 13 of O. Reg 170, 13-6.1 for details. Nitrate and Nitrite shall be sampled from treated water at the plant Total Suspended Solids (composite) and Total Chlorine Residuals (grab) are to be sampled from storm sewer discharge outlet
Annual	**Chemical (Sch. 15.1)** Lead	Lead shall be sampled according to Schedule15.1 and any regulatory relief approved for this system.
Once every 5 years	**Chemical (Sch.13)** • Schedule 23 – Inorganic Chemistry • Schedule 24 – Organic Chemistry • Sodium, fluoride	These parameters shall be sampled from treated water at the plant

1. *This chart summarizes key operational requirements. Please refer to Regulation 170/03 for full details.*
2. *The above noted testing program in some cases exceeds the minimum testing requirements stipulated in Regulation 170/03.*
3. *Please refer to CAM 002 Camborne Sampling Plan that the QMS Rep supplies before the start of each year. Please refer to Regulation 170/03 for full details on sampling requirements.*

4 *TSS and total chlorine residual limits are listed in the MDWL. A calculation of the annual average must be completed quarterly. If the result is above the limit it needs to be reported to the local MECP office.*

CREIGHTON HEIGHTS DRINKING WATER SYSTEM **Routine On-Site Water Testing Schedule**

Frequency	Parameter	Location
Continuous	Chlorine Residual	Treated Water (inspect sample lines daily to ensure free flow)
Daily	Chlorine Residual – free and total	Treated Water (to verify analyzer) SP5 –Total (dip Cell 1 and also test for Free when denitrifying Dist.) Distribution System - 4 taken one day followed by 3 taken another day, at least 48 hours apart. Can be taken at sample stations, yard hydrants, Township facilities and blow-offs.
	Taste and Odour	Treated Water
	Iron and Turbidity	Post filter
Weekly	pH and Iron Colour Turbidity	Raw Water taken from each well – Colour, turbidity, iron and pH taken from the duty well
	pH, Turbidity Colour	Treated Water
Quarterly	Total Chlorine Residual (grab)	Supernatant Discharge at Storm Sewer Outlet
	Static Water Level	Record for each well (Wells TW1, TW6, and TW7)
As Required	Chlorine Residual	At Methane Stripper whenever the chlorine pump settings are changed or when changing between free and combined chlorine residual.
	Manganese	Treated Water, Post Filter, and Raw (each well)
	Monochloramine, Free Ammonia	Raw, treated or distribution

1. *This chart summarizes key operational requirements. Please refer to Regulation 170/03 for full details.*
2. *The above noted testing program in some cases exceeds the minimum testing requirements stipulated in Regulation 170/03.*

CREIGHTON HEIGHTS DRINKING WATER SYSTEM **Routine Water Testing Schedule at Accredited Laboratory**

Frequency	Parameter	Location
Weekly	**Microbiology (Sch. 10)** E. coli Total Coliform HPC **Note:** a grab sample must be collected & tested for chlorine residual for each treated and distribution bacteriological sample collected	Raw Sample from each well (no HPC) Treated Sample at the Plant 2 or 3 Distribution System samples. A total of 9 per month in various prescribed location HPC on one distribution sample each week
Quarterly	**Chemical (Sch 13)** Trihalomethanes (THM) Haloacetic acids (HAA) N-Nitroso-dimethlyamine (NDMA) Nitrate and Nitrite Total Suspended Solids Total Chlorine Residual	THM's, HAA's and NDMA shall be sampled from a point in the distribution system that is likely to have an elevated potential for the formation of these compounds. Nitrate and Nitrite shall be sampled from treated water at the plant. Total Suspended Solids (composite) and Total Chlorine Residuals (grab) are to be sampled from storm sewer discharge outlet.
Annual	**Chemical (Sch. 15.1)** Lead	Lead shall be sampled according to Schedule15.1 and any regulatory relief approved for this system.
Once every 3 years	**Chemical (Sch. 13)** Schedule 23 – Inorganic Chemistry Schedule 24 – Organic Chemistry	These parameters shall be sampled from treated water at the plant
Once every 5 years	**Chemical (Sch. 13)** Sodium, fluoride	These parameters shall be sampled from treated water at the plant
As Required	Nitrate, Nitrite, Nitrate + Nitrite Ammonia, Free ammonia (unpressurized) DOC, TOC, pH, Bromide Alkalinity, Colour	Distribution system monitoring to track potential for nitrification

1. *This chart summarizes key operational requirements. Please refer to Regulation 170/03 for full details.*
2. *The above noted testing program in some cases exceeds the minimum testing requirements stipulated in Regulation 170/03.*
3. *Please refer to CH 002 Creighton Heights Sampling Plan that the QMS Rep supplies before the start of each year. Please refer to Regulation 170/03 for full details on sampling requirements.*
4 *TSS and total chlorine residual limits are listed in the MDWL. A calculation of the annual average must be completed quarterly. If the result is above the limit it needs to be reported to the local MECP office.*

Revision History (only 10 previous revisions to be recorded)

#	dd-mth-yyy	Description	By
81	24May2023	Pg 11, added Deerfield system pressure to the Creighton Heights Table	Anita Schoenleber
82	24May2023	Pgs 28-32, made minor changes to scoring as a result of the Annual Risk Assessment conducted earlier in 2023	Anita Schoenleber
83	24May2023	Pg 34, added additional suppliers to the Essential Suppliers and Services as suggested by External Auditor during the 2023 NSF Annual QMS Audit	Anita Schoenleber
84	6Nov2023	Pg 13, minor change to order of wording under 'Water Operator's, 4th paragraph down from top	Anita Schoenleber
85	6Nov2023	Pg 14, added 'CEUs' in 5th paragraph from top	Anita Schoenleber
86	28Mar2024	Pg 29, changed NA to OP s.8.1 under CCL for Highlift Header. Added 'Follow 2020 Ontario Watermain Disinfection Procedure' under Distribution Watermain break	Anita Schoenleber
87	28Mar2024	Pg 30 & 33, changed Backflow 'Control Measures' to 'Backflows in Treatment Plants'. Under Monitoring Procedure/Processes row added Backflow Preventors tested/certified each year	Anita Schoenleber
88	11Apr2024	Pg 32, under Secondary Disinfection row, changed Chemical feed pump to Chemical feed system. Under Secondary Disinfection row, added 'Replace faulty CL17 with spare on the shelf' to Response Procedure. Under Distribution-Watermain break row added 'Follow 2020 Ontario Disinfection Procedure for Watermains under Monitoring Procedures/Processes. Under Control Systems row removed 'and backup generator' from Loss of PLC heading	Anita Schoenleber
89	03Mar2024	Various minor improvements as a result of int/ext audits as well as general improvements as determined by Water Staff. 36mth Risk Assessment generated changes to scoring and some wording	Anita Schoenleber
90	01Apr2026	Various updates to the OP based on findings from the int/ext audits. Removed some SOP's listed in 8.1, added document review in Appendix A, created new Endorsement Document, removed document change form references, removed hyperlinks, removed Appendix G, added reference to 05-05 and 05-06, added Lead hand to E9 and E10, updated distribution sampling and TSS/Total chlorine.	Janine deBoer