COMMUNICATION UPDATE

TO:	Mayor and Members City Council
DATE:	March 16, 2023
SUBJECT:	Update: Provincial Officer's Order #1-142403769 - HW.23.02
WARD(S) AFFECTED:	City Wide
SUBMITTED BY: **SIGNATURE:**	Nick Winters Director, Hamilton Water Public Works Department 

As you are aware, the City of Hamilton was served with a Provincial Officer's Order #1-142403769 (Order) from the Ministry of the Environment, Conservation and Parks (MECP) related to the Burlington Street spill on November 22, 2022 which can be found on the City's Ministry Order webpage (here).

The City has been actively working to comply with all Order item due dates since it has been issued. In addition, the City has continued ongoing work related to the risk-based inspection program pilot that focuses on other areas of the combined sewer system where similar sewer cross connections could be present.

City staff completed Items No. 1 and No. 2 of the Order in February 2023 and as of today, have fulfilled all necessary requirements of Items No. 3 and No. 4 which includes developing a sampling program within the sewage system of the City that discharges to the Natural Environment. The sampling program aims to:

(a) Identify Spill(s) and unauthorized discharges of untreated sewage within the City of Hamilton storm and combined sewer system that discharges or potentially discharges to the Natural Environment.

(b) Outline requirements for in-pipe representative sampling of storm and combined sewers that discharge to the natural environment during dry weather, where upstream, downstream samples cannot be collected at the receiving water body.

(c) Identify trigger conditions, parameters, and/or limits to initiate further investigation to identify Spill(s) and unauthorized discharges of untreated Sewage.

(d) Outline investigation procedures for identifying Spill(s) and unauthorized discharges of untreated Sewage.

A copy of the recommended sampling program has been submitted to the MECP today in advance of the March 17, 2023 compliance due date. It has also been attached to communications update HW.23.02 as Appendix "A" for your convenience and uploaded to the Ministry Order webpage.

To ensure Council remains informed of the City's progress on the Order, staff will provide further updates as additional requirements are fulfilled. After the recommendations required by Items No. 5 and 6 have been completed and submitted to the MECP by the May 12, 2023 due date, Hamilton Water plans to submit a Recommendation Report to the Public Works Committee (PWC) for consideration that details the resources that will be required to implement the identified new programs. Staff estimate that this report will be presented to PWC in June 2023.

As always, the City remains committed to working with the MECP to fulfill all requirements set out in the Order.
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APPENDICES AND SCHEDULES ATTACHED

Appendix "A" to Communication Update HW.23.02 -	Report for the City of Hamilton on the January 18, 2023, Provincial Officer's Order # 1-142403769 Item #3

DiCaro & Associates Inc.

March 16, 2023

Report for the City of Hamilton on the

January 18, 2023, Provincial Officer's Order # 1-142403769

Item #3

Table of Contents

1.0 Introduction 3

2.0 Hamilton Proactive Programs to Detect, Mitigate or Eliminate Sewage Pollution into the Natural Environment. 4

3.0 Key Issues about Hamilton Storm Sewers under influence by Combined Sewers 5

4.0 Dry Weather In-Pipe Storm Sewer Inspection and Sampling Program in CSS 7

4.1 Dry Weather Definition 8

4.2 In-Pipe Inspection and Sampling Procedures Within Storm Sewer System Catchment Areas Key Health & Safety Training: 8

4.2.1 Inspection of Storm Sewer Outfalls and MHs 9

4.2.2 Documenting Lake Level Influence on upstream MH 10

4.2.3 Non-Lake water influence MH Inspection and Sampling 10

4.2.4 In-Pipe Inspection Checks for Non-Lake influenced Storm MH Procedure 11

4.2.5 In-Pipe Inspection and Sampling: 11

4.2.6 Is the Flow a Spill? 12

5.0 Program Logistics, Operation and Resources Required 14

6.0 Technology Recommendations 15

6.1 Aerial Infrared Thermography 15

6.2 Real-time monitoring In MH Level sensing equipment with overflow alarms in Dry Weather 16

6.3. References 18

1.0 Introduction

On January 18, 2023, the Ontario Ministry of Environment, Conservation & Parks (MECP) issued Provincial Officer's Order 1-142403769 ("Order") to The Corporation of the City of Hamilton ("City" or "Hamilton") in relation to dry weather overflow of the combined sewer system into the storm sewer system, at Burlington Street East and Wentworth Street North, and ultimately, into the natural environment (Hamilton Harbour). This report addresses specifically Item No.3 of the Order.

MECP Order Item No.3:
Develop a sampling program within the sewage works of the City of Hamilton that discharges to the Natural Environment. The program shall include at a minimum but not limited to:

i. Identifying Spill(s) and unauthorized discharges of untreated sewage within the City of Hamilton storm and combined sewer system that discharges or potentially discharges to the Natural Environment.
ii. In-pipe representative sampling of storm and combined sewers that discharge to the natural environment during Dry Weather Flow(s), where upstream, downstream samples cannot be collected at the receiving water body.
iii. Trigger conditions, parameters, and/or limits to initiate further investigation to identify Spill(s) and unauthorized discharges of untreated Sewage.
iv. Investigation procedures for identifying Spill(s) and unauthorized discharges of untreated Sewage.
v. Timelines to implement the sampling program.

Under the Order, sewage is defined under the Ontario Water Resources Act (OWRA) that which includes drainage, stormwater, commercial wastes, industrial wastes and such other matter or substances as is specified by the Regulations.

It should be noted that Hamilton's sanitary/combined sewer system, like other older Ontario cities, is a complex system which was designed with regulators to intentionally allow for overflows into the storm sewer system to occur under certain wet weather conditions. These overflows allow for relief basement flooding and in Hamilton's case, prevents the Woodward Avenue Wastewater Treatment facility from flooding during heavy rains. Regulators provide intentional interconnections between the combined sewer and storm sewer and exist only at maintenance access hole chambers.

2.0 Hamilton Proactive Programs to Detect, Mitigate or Eliminate Sewage Pollution into the Natural Environment.

The City has undertaken numerous initiatives over the years to detect, mitigate and eliminate sewage/wastewater pollution from entering the natural environment. Below is a synopsis of the City's extensive efforts:

- Enforcing a Sewer Use Bylaw since 1989. The City has a long history of regularly presenting to City Council amendments to strengthen the Sewer Use Bylaw against emerging issues or pollutants. The City has increased staffing levels within the Environmental Monitoring & Enforcement (EME) unit over the years to enforce the Sewer Use Bylaw. It also added Environmental Enforcement Officers on a weekly on-call rotational basis, 24 hours, 7 days per week, to provide spills response to protect the City's natural environment.

- In 2001, the City created a Sewer Lateral Cross Connection (SLXC) Program within the separated sewer areas which were developed post World War II: Ancaster, Binbrook, Stoney Creek and Waterdown, and parts of the top of the Escarpment (Source – Stantec Report, 2021). This Program has found sewage entering the storm sewer system from improperly connected residential sewer laterals and has repaired 471 cross connections which diverts over an estimated 105 million litres of sewage out of the storm sewer and back into the sanitary sewage collection system thereby protecting and improving the natural environment (Source: March 7, 2023, Hamilton Water Division Program staff).

- Asset Management of the City has professional contractors who use closed-circuit television (CCTV) contractors to visually inspect storm sewer conditions for infrastructure condition assessment. The CCTV contractors have been instructed to make additional notes in the 'Remarks' field under the inspection condition record at connections where signs of sanitary cross connection are visible, e.g., 'Sanitary Waste' and inform the City's Asset Management group. Further, the SLXC Program coordinates water quality sampling at storm sewer outfalls to check for elevated levels of E.coli and the presence of caffeine (as an indicator for human sewage contamination). These results help to prioritize storm sewer catchment areas for a detailed in-pipe CCTV inspection. The CCTV inspections assess and document overall mainline sewer condition while also looking specifically for physical evidence in the storm sewer of sanitary sewer cross connections (e.g., 'Sanitary Waste' or dark staining around cross connected laterals). When these connections are identified, City staff initiate a follow-up dye test inspection of the address to confirm and coordinate the required repair of sewer lateral cross connections.

- In 2020, Hamilton initiated a Surface Water Quality Program (SWQP) to monitor 33 surface water quality areas, consisting of rivers, tributaries, and the Hamilton Harbour nearshore environment, adjacent to City sewer infrastructure. The SWQP is integrated with Hamilton Water's Spill Response protocol and identifies, but not limited to:

  - hot spots and whether these are from the City's infrastructure, heavy industry and international ships or other sources
  - seasonal trends (e.g., saltwater pool discharges in residential areas versus road salt application to the environment)
  - baseline ambient surface water conditions
  - data collection of both dry and wet weather events

  The SWQP data is shared with surrounding area water quality partners (local conservation authorities, academia, Royal Botanical Gardens, Environmental Groups, select Provincial Ministries) and the public.

- In December 2022, a risk-based proactive sewer inspection pilot program was created to investigate combined and storm sewer maintenance access holes (MH) during dry and wet weather, within a specific area of the combined sewer area. This program focuses on MHs based on risk, stemming from the findings of the November 2022 Burlington Street East combined sewer cross connected to storm (a dry weather finding). The risk basis was also derived from the available SWQP data. The pilot covered the area known as SWQP Urban Core (UC) Surface Water (SW) UC-SW 6, 7, 8 & 9, which demonstrated high levels of E. coli and common industrial/commercial wastewater pollution. 292 MHs in the combined sewer and 346 storm sewer MHs were identified to be inspected. Between two (2) to six (6) staff were utilized for the inspections and as of early March 2023, Program staff advised approximately 90% of the pilot program MH inspections have been completed. The Program has resulted in the finding of three (3) improper cross connections and identified nine (9) previously unchartered critical regulators (source: February 21, 2023 Program Staff communications).

3.0 Key Issues about Hamilton Storm Sewers under influence by Combined Sewers

A dry weather inspection and sampling program, of the City's storm sewers under influence by combined sewers, must consider the following key issues**:**

1) 53 storm sewer outfalls discharge to receiving waters within the Urban Core, Chedoke Creek, Westdale/McMaster University area and Red Hill Creek during wet weather events.

Some storm sewer outfalls built within the combined sewer system (CSS) may be influenced by wet weather from the combined sewer system.

2) Regulators within the CSS are designed to overflow into the storm sewer system during wet weather and may become influenced in dry weather due to a condition in the combined sewer system such as, downstream blockages, significant volumes of sewage in short duration exceeding sewer design criteria, or grease build up restricting flows.

3) Some storm sewer outfalls within the Urban Core of Hamilton that discharge into Hamilton Harbour are submerged and not visible. These outfalls are also directly influenced by the Great Lakes water level. Lake Ontario water levels vary with annual Great Lakes water levels and seasonality.

4) Storm sewer MHs are generally located on roadways rated 40 to 60 Km/hr necessitating strict Occupational Health & Safety Act compliance using Ministry of Transportation Ontario Traffic Manual Book 7 (Traffic Control Planning). When observations of MHs are required on the roadway, inspections will take time as a result.

5) Other storm sewer outfalls and their associated MHs may be in ravines and steep sloped settings, necessitating very specific health and safety training. Speciality equipment for inspection and / or sample collection in these areas, may be required.

6) Animals nest/live in storm sewers and contribute to the presence of E. coli bacteria.

7) Other discharges to the storm sewer during dry weather may occur as a result of the following conditions or situations and many of these discharges would fall within the OWRA definition of sewage:

    a. City issued permits for construction dewatering,
    b. Residential/business overuse of potable water at a property,
    c. illicit sewer connections,
    d. illicit discharges/spills,
    e. infiltration from connected foundation drains,
    f. infiltration through sewer joints,
    g. seasonal swimming pool discharge,
    h. watermain leaks, and
    i. vehicle/car washing or washing equipment.

4.0 Dry Weather In-Pipe Storm Sewer Inspection and Sampling Program in CSS

The CSS is bounded by Hamilton Harbour (Lake Ontario), the top of the Mountain from the brow of the Niagara Escarpment up to Mohawk Road, Red Hill Creek to the East, and Wilson Street East (Ancaster/West Hamilton) to the West.

A proactive Dry Weather In-Pipe Storm Sewer Inspection and Sampling Program for Hamilton is recommended to be implemented within the CSS, in a phased approach. Further, the City's December 2022 risk-based Pilot program involving proactive MH inspections in a high-risk Urban Core area remains active at the time of writing this report. It is recommended that the In-Pipe Inspection and Sampling Program begin to expand outside of the current Pilot program area.

Phase I of this Program would comprise of:

- Westdale/McMaster University area storm sewer outfalls that discharge to Chedoke Creek, and to the south side of Cootes Paradise.

- A storm sewer MH inspection within a portion of the Urban Core (UC) of the City, which extends to the upper Hamilton Mountain (Niagara Escarpment), (Source: Stantec Combined Sewer System Characterization Study Report, 2021, Figure 3.3).

- Areas along western portion the Red Hill Creek from the Escarpment brow

The brow's storm sewer system and that of the western side of Red Hill Creek from the brow were selected as these have not been intensely monitored in the past compared to the lower City storm sewer systems. This presents an opportunity to understand if the CSS can impact the storm in dry weather in those residential communities. Moreover, the Westdale/McMaster University area was also selected for the same reasons as the latter locations, with the exception of a higher density in population due to the University campus and associated housing, as well as the presence of commercial businesses. Many of these businesses generate grease which may block or restrict flow in the combined sewers to potentially impact the storm sewers in dry weather. Targeting these areas in Phase I is expected to yield valuable logistical and resource information within the lower parts of the City where the CSS is complicated.

The In-Pipe Inspection and Sampling Program would start at an accessible outfall or at the first MH entering the storm sewer system at the bottom of the Mountain. Please refer to Figure 1 which identifies storm sewer outfalls and the associated upstream MH, as well as each outfall's catchment area within the CSS. The circled areas within Figure 1 depict the three areas of the Program's Phase I.

Following Phase I of the In-Pipe Inspection and Sampling Program, it is recommended to inspect and sample the remaining areas of the CSS, which discharge to the natural environment. For example, several SWQP UC sampling zones not covered by the December 2022 risk-based pilot program, starting with UC SW10 working westwards and UC SW1 working eastwards. Other CSS storm sewer MH inspections can be added to the Phase II scope, as the program matures.

SWQP data should be reviewed on an ongoing basis along with sampling data collected from the In-Pipe Inspection and Sampling Program.

The In-Pipe Program is expected to cycle through all storm sewers possibly influenced by the CSS in dry weather, within 2 to 3 years. It will assist the City in complying with MECP's Ontario Water Resources Act and Environmental Protection Act by locating, mitigating, and preventing unauthorized discharges to the natural environment.

The In-Pipe Program will supplement existing efforts and programs in which the City has undertaken since 1989 to find and eliminate wastewater pollution sources from entering the storm sewer system and into the natural environment.

4.1 Dry Weather Definition

Dry Weather for the In-Pipe Storm Sewer Inspection and Sampling Program, is defined as:

- 24 hours following a 10 mm or less precipitation event and/or no significant snow melt*
- 48 hours following a 10.1mm up to 14.9 mm precipitation event and/or no major snow melt
- 72 hours following a 15 mm or greater precipitation event and / or following significant snow melt event

***(in keeping with Hamilton Water EME dry weather definition for permits)

The In-Pipe Inspection and Sampling program operates in dry weather only**.**

4.2 In-Pipe Inspection and Sampling Procedures Within Storm Sewer System Catchment Areas Key Health & Safety Training:

For MH inspections on roadways, all staff must follow the Ontario Occupational Health and Safety Act (OH&SA) requirements (e.g., MTO Book 7 Traffic Control Planning). For inspection and sampling in ravines and steep/high areas, fall arrest training and equipment may be required, as well as any other applicable OH&SA training and equipment identified by the Program Supervisor and City H&S specialists.

4.2.1 Inspection of Storm Sewer Outfalls and MHs

When inspecting a storm sewer outfall and/or MH, document all observations of flow, no flow, debris build up at the base of the outfall, staining, and any odours. Take a photograph of the full outfall pipe, if safe to do so. If vegetation or tree build up is obstructing the outfall, or erosion around the outfall structure has occurred, contact the appropriate City team to rectify.

If there is no flow from the outfall, document that there is no flow on the specific day and time for the Asset ID and move upstream to inspect the first accessible upstream MH.

If there is flow at the outfall or within an upstream MH:

- Take a photograph of the infrastructure (outfall or MH Interior);
- Collect an initial sample in a clear observatory sample jar (not for laboratory submission) to determine if olfactory and visual observations of the flow can be made;
- Estimate the approximate flow rate (using known volume sample bottle / container and stopwatch approach);
- Sample for In-Pipe Sampling Program parameters;
- Take a photograph of the collected Program sample bottles lined up; and,
- Document all findings:
    - Date
    - Asset ID number
    - Staff member's name
    - Street name; park name of MH location (add additional reference point if possible)
    - non-natural odours (e.g., sewage, chemicals, raw materials)
    - vegetation obstruction/excessive vegetation
    - erosion around outfall
    - cloudiness
    - colour
    - foam
    - suds (non-natural)
    - sanitary waste
    - orange staining
    - oily sheen
    - oil separated layers
    - floatables
    - algae
    - approximate flow rate
    - Time sample was collected

Once the outfall has been inspected, sampled (if flow observed), and all documentation completed, proceed to the next upstream MH for inspection and sampling, if required. Continue to systematically inspect next upstream storm MH in dry weather, to complete the storm sewer outfall catchment area. Follow Section 4.2.6 for Spill determination.

4.2.2 Documenting Lake Level Influence on upstream MH

Documenting the influence of Lake levels and possible ship crossings wakes on the storm sewer system is important to establish baseline conditions at submerged outfalls. This documentation will create an official baseline record for the Program. It is understood that over time, outfalls and MHs influenced by lake water, may change depending on Lake Ontario water levels. Due to changing lake levels, inspections will begin at the visible Outfalls for this Program and will then move upstream to the MH. From the submerged storm sewer outfalls, the first upstream MH influenced by Lake water, is to be documented as such and then work backwards, upstream, inspecting, and documenting conditions in each upstream MH. This upstream MH inspection will continue until a MH, not influenced by lake water levels, can be properly inspected and sampled, if flow is present.

4.2.3 Non-Lake water influence MH Inspection and Sampling

Once the first, non-Lake water influenced, upstream storm sewer MH from a submerged CSS storm sewer outfall catchment area is determined, it is to be inspected and where it is found to contain a flow, in dry weather, it shall be sampled, and observations documented:

- Date
- Asset ID number
- Staff member's name
- Street name; park name of MH location (add additional reference point if possible)
- non-natural odours (e.g., sewage, chemicals, raw materials)
- cloudiness
- colour
- foam
- suds (non-natural)
- sanitary waste
- orange staining
- oily sheen
- oil separated layers
- floatables
- algae
- approximate flow rate
- Time sample was collected

4.2.4 In-Pipe Inspection Checks for Non-Lake influenced Storm MH Procedure

- Is there flow in the MH?
- Is there the presence of detectable odours of sewage, chemicals, or raw materials within or emanating from of the MH, regardless of flow or absence of flow in the storm sewer?
- Record sewer conditions and observations.
- Take photograph of internal MH condition.

If no observations are made of flow or odours, document these conditions; continue to systematically inspect next upstream storm MH in dry weather, to complete the storm sewer outfall catchment area.

4.2.5 In-Pipe Inspection and Sampling:

If a flow is present in the storm sewer MH, in dry weather, samples are to be collected. Table 1, below references a list of parameters recommended for sampling in the Dry Weather In-Pipe Program which will assist in identifying illicit connections, illicit ICI (industrial/commercial/institutional) discharges/spills, groundwater infiltration, watermain breaks, and sewage:

Table 1: In-Pipe Sampling Program Parameters, Rationale and Trigger Condition

Parameter	Rationale	Trigger Condition
o Metals Group*	o Representative of ICI discharges and are within Hamilton's Sewer Use Bylaw & meets definition of OWRA Sewage	o Storm parameter exceedances of Hamilton Sewer Use Bylaw 14-090 limits o Presence of other metals without storm limits that should not be in the storm sewer and potentially a spill
o Total Mercury	o Recent findings of dental practices in Hamilton using low pH cleaners and solubilizing Mercury and meets definition of OWRA Sewage	o Greater than 0.05 ug/L (microgram per Litre), which is the detection limit for Mercury. o Mercury should not be present in the storm sewer and is an indicator of a spill
o Caffeine	o Caffeine is only found in Human Sewage	o Presence of Caffeine at or above the analytical detection level of 5 ug/L
o Biochemical Oxygen Demand (BOD_5)	o Indicator of sewage	o BOD_5 exceeds 15 mg/L. o A number of Greater Toronto Area municipalities have this limit in their storm section of Sewer Use Bylaws

		and this would be an indicator of a sewage spill.
o E. coli	o Indicator of sewage and animals	o Over 3400 counts/100 ml to account for animal sewage
o pH	o Representative of ICI discharges and within Hamilton the Sewer Use Bylaw and meets definition of OWRA Sewage	o Exceedance of the Hamilton Sewer Use Bylaw 14-090 storm sewer limits o An indicator of a spill
o O-Phosphate	o Indicator of potable water leak due to use of substance for lead control in watermains and an opportunity to find and fix non-revenue water losses.	o Presence of O-Phosphate will indicate a leak of potable water or contributions from fertilizers or ICI discharges.
o Chloride	o Indicator of saltwater pool discharge, road salt, and industrial dischargers and meets definition of OWRA Sewage	o Greater than 1500 mg/L to detect industrial discharges, excessive road salt or saltwater pool discharges
o Temperature	o Indicator of sewage, spill, or potable water leak and meets definition of OWRA Sewage	o Greater than 40^{o}C. A number of Greater Toronto Area municipalities have this limit in their storm section of Sewer Use Bylaws and would be indicative of Sewage under OWRA.

* Hamilton Water's Laboratory has a predetermined list of metals it automatically analyzes when metals are selected for analysis. Metals Group is comprised of: *Aluminium, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium Calcium, Chromium, Cobalt, Copper, Iron, Potassium, Lead, Magnesium, Manganese, Molybdenum, Nickel, Silver, Sodium, Selenium, Strontium, Thallium, Tin, Titanium, Vanadium, and Zinc.*

4.2.6 Is the Flow a Spill?

When determining if the flow is a spill in the storm sewer, in dry weather:

- An observatory clear and known volume sample jar should be used to collect a sample from the storm sewer MH flow to:
  a) Estimate the flow rate; and,
  b) observe for any olfactory observations of non-natural odours

  This sample bottle will not be submitted to the Laboratory for analysis.

- Should the initial observatory clear jar sample show cloudiness, colour, oily sheen, oil separated layers, foam, suds (non-natural foam determined from shake test), sewage odours, non-natural odours, suspended material or solids:
  - Take a photo of the MH condition.
  - Take a grab sample to be analyzed for the In-Pipe Program parameters.

- Photograph filled sample bottles, which are lined up.
- Document observations, time of sampling and sampling actions before proceeding to upstream MH.
- Mandatory tracing upstream to find the source in dry weather is required.

o When Source Not Found:

- When working in the office to review sample data of flow in MH with no source found, determine if sample parameter trigger conditions, per above, were detected. Add to master tracking spreadsheet that flow was detected, and whether trigger exceedances were recorded.

- When no trigger exceedances of the program parameters occur – return to inspecting the next upstream MH in the catchment area and inspect MH and sample if flow is present and continue moving upstream inspecting and sampling as required.

- When exceedances are detected return to MH displaying exceedances and check for flow again and if present collect a sample for comparison with original sample and then attend upstream MH and determine if flow is present and if so, collect sample and trace upstream to find the source.

o When Source is found from tracing and deemed a spill under the Hamilton Sewer Use Bylaw and other Legislation:

- Report to MECP Spills Action Centre (SAC) at 1-800-565-4923 immediately.
- Report to the City Spill Reporting Centre (905-540-5188) for spill response initiated through Hamilton Water.
- Spill containment and cleanup may be required along with an updated report to MECP SAC.
- Information is recorded in the master tracking spreadsheet of spill found (add date) contributing to source of exceedance(s).
- Following spill remediation and clean-up and sampling data review return to catchment area and re-check that the MH which had flow deemed as a spill to ensure no other flows exist and to confirm the spill had been the source of the observed flow. If flow exists, repeat 4.2.5.

o Should the flow be traced to be between two MHs, (meaning there is no flow in upstream MHs, but there is flow in two downstream MHs), then this is to be documented in the master tracking sheet and a request for CCTV work is to be made to determine if the flow is from damaged infrastructure or unknown connection in between the two MHs.

- Following CCTV work and conclusion that infrastructure repairs are required and made, the master tracking spreadsheet is updated, and the downstream MH is re-inspected to confirm

if the flow has ceased. If flow exists upon repairs being made, this is likely indicative of another event occurring and the steps in 4.2.6 are repeated.

Data management and review is key for the In-pipe Inspection & Sampling Program to evaluate data and trends and evaluate together with the SWQP.

5.0 Program Logistics, Operation and Resources Required

The Program should commence when staffing and equipment resources are approved by Council and secured. Ideally the Program should take advantage of dry weather periods using existing resources, if possible, before resource approvals secured.

Phase I of the Program contemplates four (4) temporary Full Time Equivalents (FTEs) and two (2) dedicated students (summer or co-op). Specifically, the FTEs are:

- 1 FTE for a temporary data analytical position to review data and trends and prepare presentations, graphs, maps, reports etc., as required.
- 1 FTE for a temporary Supervisor to oversee and manage the team and ensure OH&SA training and equipment is provided.
- 2 FTEs for temporary field staff with experience in water/wastewater sampling, knowledge of sewer infrastructure and environmental law training
- 2 summer or co-op students with experience in water/wastewater sampling and/or knowledge of sewer infrastructure.

One full time temporary field staff member would be teamed with a student for training and experience, such that there are two teams. This would also build experience for students in a unique and limited profession. Due to OH&SA requirements, specifically traffic control planning, teams of two employees should work together in the tracing and sampling of a storm sewer catchment area. Each team is responsible for its own storm sewer outfall catchment area.

Phase I would operate in dry weather until all catchment area MHs are inspected, and sampled where applicable, to allow City management to assess the Program needs, equipment, length of time to complete MH inspections and sampling, lessons learned, impacts to the Laboratory or other units in Hamilton Water and staffing resources. This would allow for Hamilton Water to present to Council a fact-based resource needs Recommendation Report to operate the program year-round.

It is recommended that staffing resources be from existing position classifications within the City.

This is a year-round Program, very much weather dependent, and it is understood that certain months of the year will not permit for extensive field operations due to rain, snow melt or snow-covered MHs.

Non-field days are an opportunity for data entry, to reassess or review data, to complete training, and to hold team meetings for collaboration, brainstorming and sharing updates.

Once Phase I of the Dry Weather In-Pipe Storm Sewer Inspection and Sampling Program is completed, it is recommended to move onto the remaining outfalls and MHs associated with the CSS as outlined in Section 4.0.

It is anticipated that it should take 2 to 3 years to complete the CSS In Pipe Inspection and Sampling Program, based on the size of the area. Should the technology outlined in this report be utilized or future technology prove to be assistive, the timeframe for complete program completion may shorten.

Expected Minimum Equipment Resources:

- Vehicles for sampling and inspection field work
- Sampling equipment
- Health & Safety equipment
- Cameras
- Smartphones
- Field laptops/Tablets*

Inspections sheets and electronic repository needs:

- Inspection summary information fields on a summary form to capture infrastructure information or tablet with built in and customized form*
- Centralized and shareable electronic repository of MH inspection reports

*Field tablets with a customizable form able to be uploaded to a centralized and shareable electronic repository system is recommended to maximize field staff efficiencies and reduce duplication in the office with data entry of collected information.

6.0 Technology Recommendations

6.1 Aerial Infrared Thermography

It is recommended that the City research aerial infrared (IR) thermography technology with drones, by way of a contractor offering such service, to monitor the outfalls entering surface

waters surrounding the CSS to determine if unauthorized discharges are occurring during dry weather. Multiple sectors utilize this technology including the MECP to visually assess pollution sources, leaks, etc.

Wastewater pollution will have a higher temperature from the surrounding area and any release of wastewater or sewage into surface waters from outfalls can be visualized as visible coloured plumes through the variations depicted by temperature. "The amount of radiation emitted by an object increases with temperature, therefore thermography allows one to see variations in temperature" (Source: 2009, Lega & Napoli).

Lega & Napoli provided numerous examples in their September 2009 article of the use of IR technology to discern sanitary wastewater and wastewater pollution in surface waters. In one case, during dry weather, a catch basin connected to the sea at a popular tourist town was found to display a temperature variation using IR, concluding that a pollution event had occurred.

Several United States municipalities have utilized IR on a short-term basis to assist in finding illicit wastewater discharges. A Greater Toronto Area Municipality utilized the technique in late 2000 with the use of a helicopter in a one-time event which yielded images in one watershed with sewage outfalls at night. However, the use of IR at that time was cost prohibitive due to the helicopter and pilot rental to consider for long term use. More recently IR has been used with drones making it practical and generally more affordable. Nassau County, New York utilized the technique with great success, in 2020, through various grant programs available to it.

After Phase I of the In-pipe Inspection & Sampling Program, is completed and if the City has had an opportunity to investigate IR technology and available contractors in Ontario, the use of IR may assist in determining which storm sewer outfalls to prioritize for the In-Pipe Inspection and Sampling Program Phase II. Further, the use of IR may assist the City in identifying if other sources are contributing actively to discharges within Hamilton Harbour.

6.2 Real-time monitoring In MH Level sensing equipment with overflow alarms in Dry Weather

It is recommended that the City investigate the use of battery operated, real-time remote monitoring MH level sensors, in storm sewers to provide information on possible dry weather overflow, in areas within the CSS which may be subjected to extreme high sanitary flows. For example, during a Tim Horton's Field event or an event at the FirstOntario Centre, where potentially excessive flows causing surcharge may occur and areas with known heavy grease discharges from restaurants and/or grocery stores are known to cause blockages. These latter types of situations may cause the combined sewer to rise to a level which may then trigger the regulator to overflow into the storm sewer during dry weather. The real-time in sewer monitor in the combined sewer and storm sewer systems alarm to a computer monitoring network and to smart phones. Satellite or cellular systems are used to transmit information. Upon an alarm condition, key dedicated sampling staff could be mobilized to assess the alarm and if an overflow

into the storm sewer is occurring, or about to occur, they can initiate sampling, inspection, tracing, and spill control at the storm sewer until the cause of the overflow or potential overflow is determined. The goal of this dry weather pilot is to assess if there are overflow/surcharge conditions in the examples provided to take proactive measures through the use of alarm notifications of potential overflow. Also, a proactive sewer cleaning program may result from the data if it proves valuable.

Following the City’s investigation of the real-time monitoring MH level sensing technology as potential assistance to it dry weather programs, it could explore with a vendor a trial demonstration of four (4) real-time monitoring systems, in the downstream portion of a combined sewer regulator, and in the nearby receiving storm sewer downstream of the regulator, to determine if this technology is an option for future use as opposed to potentially hiring more Program staff.

Approximately 20 Ontario municipalities are utilizing this technology for overflow conditions.

6.3. References

1. Stantec Consulting Inc. Combined Sewer System Characterization Study Report, June 4, 2021
2. Hamilton Water, Surface Water Quality Program Council Report PW2258, 2021
3. September 2009, *Aerial Infrared Thermography In The Surface Waters Contamination Monitoring*, M. Lega and R.M.A. Napoli

Figure 1

Legend

- CSO Tank
- Storm main
- Combined main
- Upstream Asset
- Parkdale Pumping Station
- Sample Location
- Phase 1 Inspection Locations
- CSO Tank OUTFALL
- SPS Emergency Overflow & CSO OUTFALL
- SPS Emergency Overflow OUTFALL
- STORM OUTFALLS

CSS and Storm Sewer Overview

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