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MEMORANDUM

TO: Rob Greenwood **RVA:** 184167.04

FROM: Kimberly Sayers, P.Eng., P.M.P.

DATE: November 30, 2020

SUBJECT: October 2020 – One Year Aeration System Performance Review

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As requested by the Town, the following memorandum is provided to review the performance of the Aeration System since its installation in the fall of 2019, and to provide an update on the discussion of other THM removal alternatives.

1.0 AERATION SYSTEM INSTALLATION

Process upgrades were undertaken at the Mill Street Reservoir, as part of the Tottenham Interim Water Quality Improvement Project. The primary objective of the upgrades was the reduction of Total Trihalomethane (TTHM) levels in the Tottenham Water System through the installation of an aeration system.

The aeration system was installed in the fall of 2019. The system was initially tested on September 17th, 2019 (Q3 – 2019). This was followed by start up testing and staff training on October 7th, 2019 (Q4 – 2019). After this time, the system has been shut down periodically to perform final upgrade and installation works, regular maintenance activities and when low chlorine levels are measured in the reservoir.

Bench scale simulated distribution system testing was performed on one water sample in late October 2019 to compare the aeration system performance against un-aerated water. The bench scale testing indicated that the potential reduction of THMs from the addition of the aeration process could be in the order of 5 – 10%, based on the results for that water sample. This bench scale testing only provided a narrow snapshot of the system at the time of sampling and could not comprehensively capture the overall operation of the system.

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2.0 AERATION SYSTEM OPERATION

The installation of the aeration system changed the water treatment process and has had an impact on the stability of the chlorine residual levels in the reservoir.

When the HLPs were off, the chlorine residual in the reservoir was found to drop below the disinfection setpoints. As a result, the aeration system programming was updated to shutdown the aeration system whenever the chlorine residual approaches the minimum residual setpoint.

The chlorine residual in the reservoir is critical to achieve primary disinfection, and these programming changes were required to provide reasonable control of the process. As a result of continuous work by Town Operations Department Staff to adjust the process, the aeration system has been able to successfully increase the Aeration equipment runtime to approximately 95%. This is an acceptable target for the system to be operating, as it accounts for time when the system is shut down for typical maintenance activities.

3.0 AERATION SYSTEM PERFORMANCE

The aeration system has been operating for approximately 12 months. THM monitoring results have been reviewed to see how the THM levels have been impacted by the installation of the aeration system.

Figure 3.1 shows the quarterly average and running annual average THM results from 2014 to Q4 2020. It is noted that before Q2 2018, all sample results in Figure 1 are for the Nolan Road location.

The current running annual average THM levels are below the Ontario Drinking Water Quality Standard for THMs of 100 micrograms/L (µg/L or ppb), as shown as the green line in Figure 3.1**;** however, some individual readings shown in some of the subsequent figures are above this value.

The methodology for calculating regulatory THMs in Ontario utilizes a Running Annual Average (RAA) approach, with quarterly (3-months) divisions throughout a 12-month period. This provides a composite measurement that is more reflective of yearly THMs levels and is described in detail in the following MECP document " Trihalomethane and haloacetic acid sampling and reporting requirements technical bulletin" that can be accessed at https://www.ontario.ca/page/total-trihalomethane-thm-reporting-requirements-technical-bulletin.

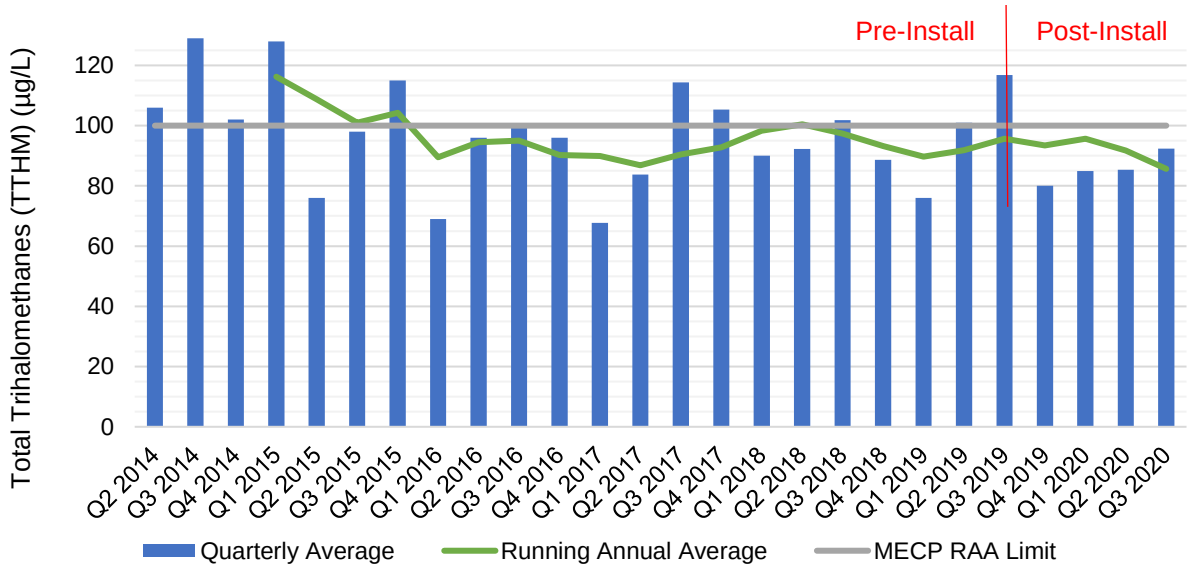

Figure 3.1 – Quarterly and Running Annual Average THM Results (All Locations)

Figure 3.2 shows the THM monitoring results taken by the Town at the Tower at Nolan Road over the last 2 years, and the quarterly averages. These two locations have more historical data available compared to the other locations around the distribution system.

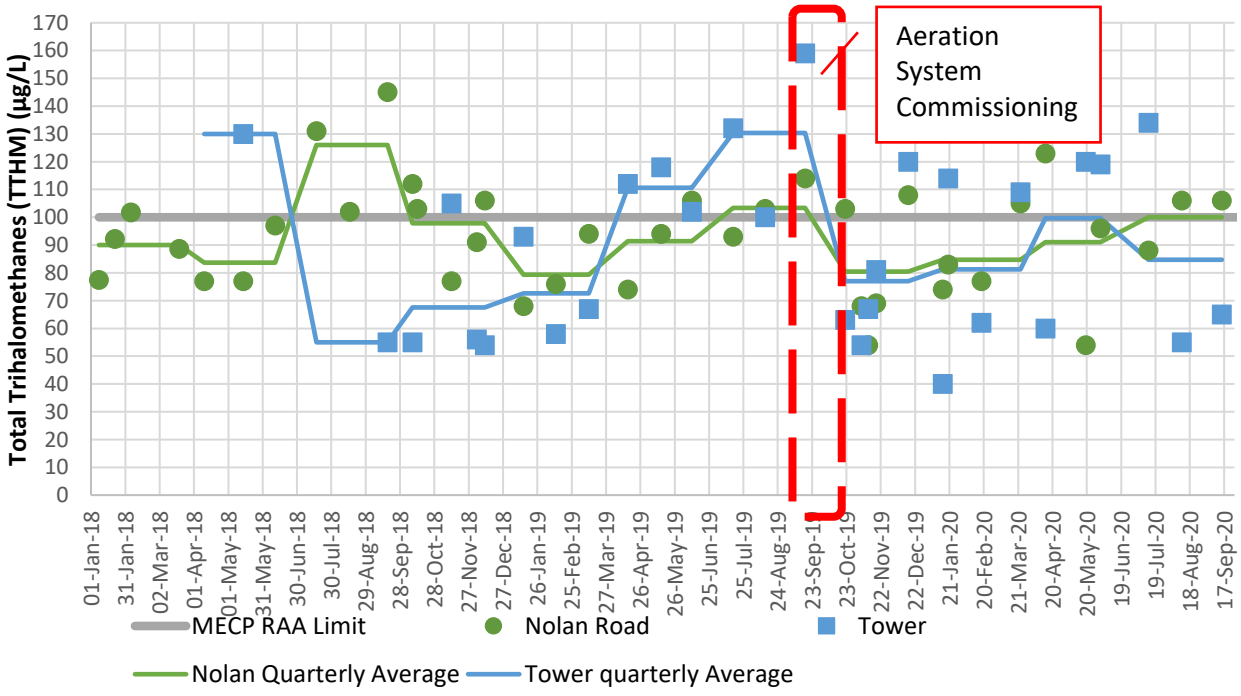

Figure 3.2 – THMs measured at Nolan Road and the Tower

Figure 3.3 shows both the individual and quarterly average THM monitoring results for various locations in the Tottenham distribution system. Figure 3.3 also includes THM results from the Mill St Reservoir. It is noted that the Drinking Water Works Permit requires that THM tests be taken from Nolan Road, and the Town did not begin taking occasional samples from the identified locations in the distribution system until 2018. As a result, there are only a limited number of historical THM results from the identified locations in the Tottenham distribution system that can be used to compare the performance of the aeration system.

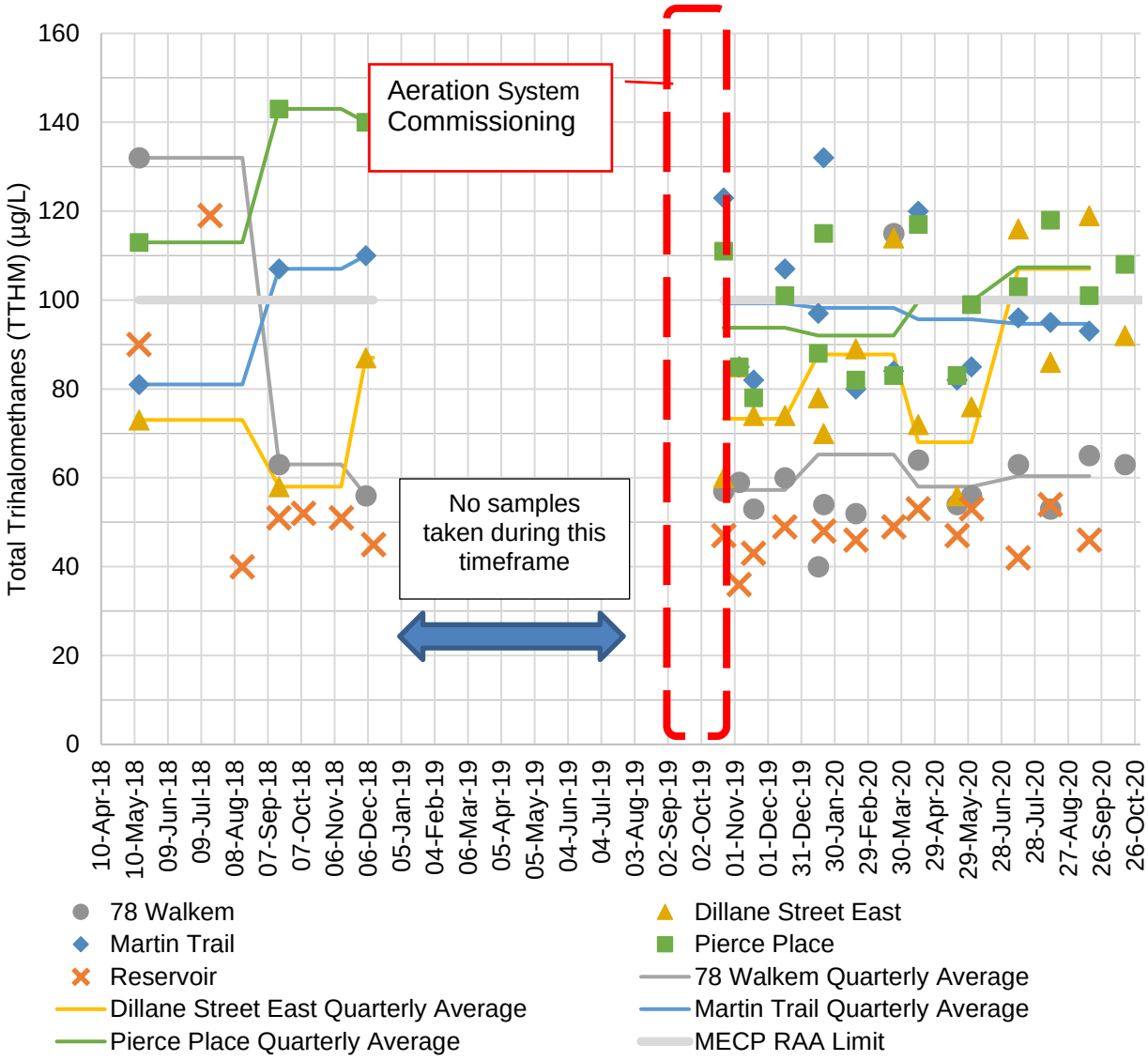

Figure 3.3 – THMs measured in Tottenham Distribution System

Figure **3.4** shows the historical quarterly average THMs at Nolan Road from 2014 to identify if there are any seasonal historical trends. In particular, this location has had more extensive historical monitoring.

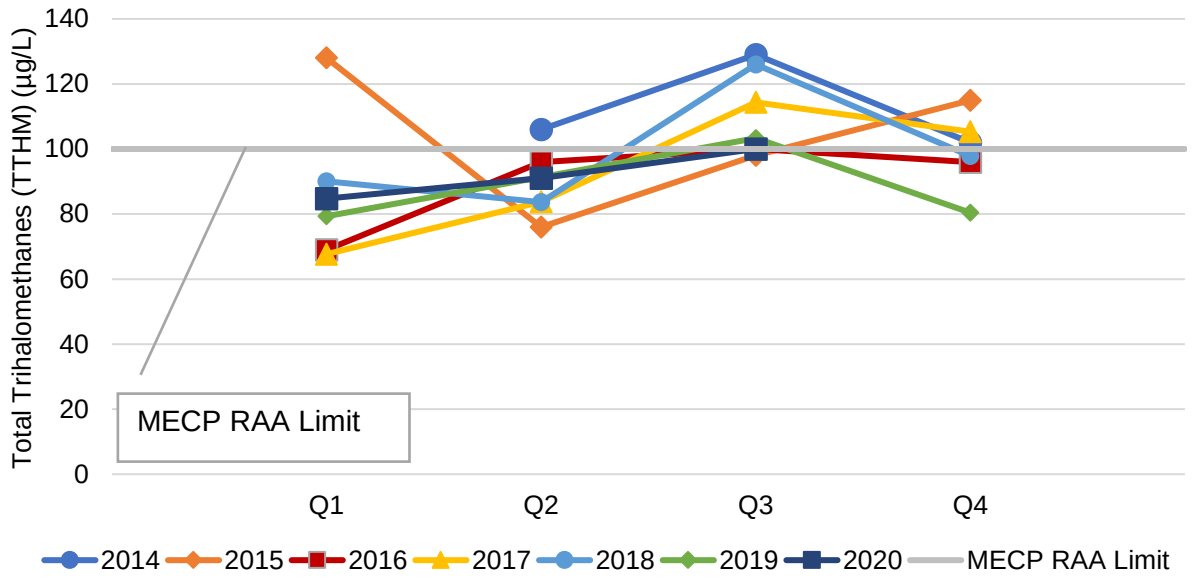

Figure 3.4 **– Historical Quarterly Average THMs at Nolan Road**

From the figures, the following observations can be made:

- As shown in Figure 3.1, the THM Running Annual Average (RAA) at the time of the Aeration System installation in Q3 – 2019 was 95.6 ppb. The Q3 RAA following 1-year of operation of the Aeration System is 85.6 ppb. This indicates that the THM RAA has decreased over this period by approximately 10%; however, individual results continue to be variable. This is also the lowest THM RAA reported between the years 2015 – 2020.
- Historically, THM results at Nolan Road have fluctuated significantly from 68 – 145 ppb, as shown in Figure 3.2. THM levels have continued to fluctuate after the Aeration System was installed between 54 – 123 ppb. Additionally, THM levels in the Tower continue to be highly variable ranging from 40 – 140 ppb. This is similar to historical results which ranged between 54 – 159 ppb; however, Tower and Nolan Road THM levels have decreased as evidenced in the quarterly averages. This represents a 10% decrease in the overall variability.

- Historical analysis of the quarterly system wide and Nolan Road THM (Figure 3.1 and Figure **3**.**4**) shows that THMs tend to be the highest in Q3. It is anticipated that this is due to higher water demand and increased draw from the aquifer in the summer months which could impact the source water quality, as well as slightly higher temperatures in the water system. Similarly, THMs tend to be the lowest in Q1, when water usage it at its lowest. Post Installation, this trend appears to be continuing.

- There is limited historical data for other locations in the distribution system as shown in Figure 3.3 and interpretation should be cautioned. Historically, maximum and minimum THM levels have fluctuated by 143 ppb – 56 ppb and this has diminished slightly after the installation with fluctuations of 132 ppb – 40 ppb. This indicates a 6% decrease in the overall variability. This reduction may also be exhibited in the reduced quarterly averages. With only partial data the trends may be convoluted by seasonal variations.

- THM levels in the reservoir (Figure 3.3) are fairly consistent at around 45 to 55 ppb. In the past, reservoir THM levels ranged from 40 to 120 ppb. The reason for the high values is unknown, and it could potentially be an anomaly.

Variations in THM levels could be influenced by variations in source water age and source water quality.

- Based on the single test performed during simulated distribution bench scale testing completed by RVA in the Fall of 2019, THM levels increased sharply in the first 2 days, and continued to form with modest increases over the following 5 days

- Water demands in Tottenham are continually increasing as the community grows, this can put different pressure on the aquifer. Higher withdrawal rates can result in poorer quality groundwater being pulled into the wells. A separate memorandum regarding historical ground water quality is appended to this document.

Based on the overall reductions in the Running Annual Average (RAA) observed for the Tottenham Distribution System, it appears that the Aeration System is achieving a reduction in THMs.

The THM removal performance through the aeration system should continue to be tracked by the Town, as removal rates would be expected to change depending on raw water quality, seasonality, water demand and the operation of the facility.

4.0 OTHER THM CONTROL OPTIONS

The Town continues to use operational practices to help control THMs in the Tottenham distribution system:

- The Town is addressing water age by modifying the operating levels of the elevated tank to reduce the volume of stored water and to increase the turnover rates (and reduce overall water age).
- The Town has also addressed water age by installing automatic blow offs to reduce water age in watermains. These are pre-programmed to run multiple times per day. Minimum main sizing is dictated by fire flow requirements, which are greater than typical flow requirements, which can lead to increased water age.
- The Town continues to flush and swab the distribution regularly.

The Town continues to proceed with the construction of the Tottenham Transmission Main, which will significantly reduce THM levels in Tottenham. Construction is approximately 30% complete and is scheduled to be completed by the end of 2021 with final testing and commissioning in Spring 2022.

Additional treatment to remove the THM pre-cursor material was investigated in the Master Plan. The recommended solution was to proceed with the Transmission Main as the treatment system required to remove organics and ammonia is a highly complex system, and would take years to design, procure and commission.

The Town has recently investigated the solar mixer in the elevated tank to get it back in operation. This mixing in the tank would provide a more consistent water age, THM level and chlorine residual. However, it is noted that it could result in an increase in THMs compared to some samples, as it could increase the overall water age in the tank. Aeration at the elevated tank could also be considered; however, due to the limited success observed in the Mill St reservoir, THM removal rates may not be significant and the timelines, cost and potential issues related to chlorine residuals and water age may provide limited benefit.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Since the installation of the Aeration System in the fall of 2019 the following statements can be made:

- THM levels have declined, with an overall reduction in the Running Annual Average of 10% compared to the previous year.
- The variability of THM levels has also been reduced by 6% – 10% within the distribution system compared to the previous two years.
- THM reductions are less than the anticipated maximum reductions predicted by the equipment supplier.

It is recommended that the Town:

- Continue with the construction of the Transmission Main as the primary solution to reduce THMs by replacing the existing groundwater supply with water from Alliston and Beeton.
- Continue monitoring the THM levels to assess the full impact on the running annual average (RAA) TTHM level.
- Continue to optimize the system operations through flushing, tower level control, and well operation to assist with minimization of THM levels.