Agenda – Executive Policy Committee – May 13, 2015

Report – Standing Policy Committee on Infrastructure Renewal and Public Works – May 5, 2015

Item No. 6 Comprehensive Assessment of the City of Winnipeg Water System as it relates to recent Boil Water Advisories

STANDING COMMITTEE RECOMMENDATION:

On May 5, 2015, the Standing Policy Committee on Infrastructure Renewal and Public Works concurred in the recommendation of the Winnipeg Public Service and submitted the following to Council:

1. That this report be received as information.

Agenda – Executive Policy Committee – May 13, 2015

Report – Standing Policy Committee on Infrastructure Renewal and Public Works – May 5, 2015

DECISION MAKING HISTORY:

STANDING COMMITTEE RECOMMENDATION:

On May 5, 2015, the Standing Policy Committee on Infrastructure Renewal and Public Works concurred in the recommendation of the Winnipeg Public Service and submitted the matter to the Executive Policy Committee and Council.

ADMINISTRATIVE REPORT

Title: **COMPREHENSIVE ASSESSMENT OF THE CITY OF WINNIPEG WATER SYSTEM AS IT RELATES TO RECENT BOIL WATER ADVISORIES**

Critical Path: **Standing Policy Committee on Infrastructure Renewal and Public Works – Executive Policy Committee - Council**

AUTHORIZATION

Author	Department Head	CFO	CAO/COO
T. W. Shanks, P. Eng. Manager of Water Services	G. K. Patton, P. Eng. Acting Director, Water and Waste Department	n/a	M. Jack A/COO

RECOMMENDATIONS

That this report be received as information.

REASON FOR THE REPORT

The investigation and report on the recent precautionary boil water advisories is complete. The Comprehensive Assessment of the City of Winnipeg Water System as it relates to Recent Boil Water Advisories Final Report prepared for the City by AECOM Canada Ltd. ("Comprehensive Assessment Report") has been submitted to the provincial Office of Drinking Water. This Administrative Report is being submitted to provide Council with information about the results of the Comprehensive Assessment Report.

IMPLICATIONS OF THE RECOMMENDATIONS

The Executive Summary of the Comprehensive Assessment Report is attached for information. The Comprehensive Assessment Report provides compelling evidence the positive samples that led to the recent boil water advisories did not originate in the water distribution system and concludes they were most likely related to either sampling or analytical processes.

HISTORY

On January 27, 2015, the Medical Officer of Health for the Winnipeg Regional Health Authority issued a precautionary boil water advisory for the City of Winnipeg, which was lifted two days later after repeated water quality tests indicated normal results. On February 3, 2015, the Manitoba Office of Drinking Water issued an order to carry out an investigation of the water system, to be completed in accordance with US EPA's Revised Total Coliform Rule Assessments and Corrective Actions Guidance Manual.

On February 18, 2015, the Executive Policy Committee received a verbal update from Mrs. D. Sacher, Director of Water and Waste on the recent Boil Water Advisory.

AECOM Canada Ltd. was retained to perform a Level 2 Assessment as per the revised coliform rule (RTRC). The Comprehensive Assessment of the City of Winnipeg Water System as it relates to Recent Boil Water Advisories Final Report prepared for the City by AECOM Canada Ltd. is complete and has been submitted to the Office of Drinking Water on the required due date of April 30, 2015.

Upon completion of the regulatory review process, it is the intent of the Water and Waste Department to release the Comprehensive Assessment Report except for those Appendices which contain sensitive information, the disclosure of which could have a negative impact on the security of the water distribution system.

FINANCIAL IMPACT

Financial Impact Statement **Date:** **April 30, 2015**

Project Name:

COMPREHENSIVE ASSESSMENT OF THE CITY OF WINNIPEG WATER SYSTEM AS IT RELATES TO RECENT BOIL WATER ADVISORIES

COMMENTS:

There is no financial impact associated with this recommendation.

"Original signed by M. L. Geer, CA"
Moira L. Geer, C. A.
Manager of Finance and Administration

js
30-Apr-15

CONSULTATION

In preparing this report there was consultation with:

Legal Services (as to legal issues)

SUBMITTED BY

Water and Waste Department
Water ServicesDivision
Prepared by: Tim Shanks, P. Eng.
Date: April 30, 2015
File No. W-872

APPENDIX A

Executive Summary

Water samples collected from the City of Winnipeg (City) water distribution system on January 26, 2015, and analyzed by the contract laboratory ALS Canada Ltd (ALS) on January 26, 2015 showed a highly unusual pattern of detection for Total Coliform (TC) and *Escherichia coli* (*E.coli*, EC). Of the 42 samples collected, 6 were positive for TC, and of these 6, 5 were positive for EC. Heterotrophic Plate Counts (HPC), free chlorine residuals, and turbidity levels (all indicators of bacterial water quality) were normal, as were other water quality and system operations parameters. The Medical Officer of Health for the Winnipeg Regional Health Authority (WRHA) issued a precautionary boil water advisory for the City of Winnipeg, which was lifted after two days of repeat samples produced normal results (no TC/EC positive samples, and continued normal levels of turbidity, free chlorine residuals, and HPC). The Manitoba Office of Drinking Water (ODW) followed on February 3, 2015 with an order to: *"…carry out an investigation of the water system which shall be completed in accordance with the US Environmental Protection Agency's Revised Total Coliform Rule Assessments and Corrective Actions Guidance Manual (September 2014) … adapted as necessary to accommodate the regulatory regime in Manitoba."* The City retained AECOM Canada Ltd. (AECOM) to lead the investigation.

The overall investigation included initial assessments and detail review of the entire water system from supply to distribution to sampling and laboratory procedures. While water quality events such as these can be difficult or impossible to ultimately explain with certainty, this investigation concluded that it was very unlikely that the water supply was contaminated or that public health was at risk.

The preliminary investigations were conducted by AECOM to identify areas of the water system that presented a vulnerability and for which more detailed analysis was required. City staff compiled records on water quality, water sampling locations, water system facilities, and water system operations and maintenance data and provided them to AECOM. These data were reviewed and a preliminary report was provided to the City on February 18, 2015.

AECOM conducted a review of select City facilities and processes on February 24-27, 2015 during which time the sampling procedures, laboratory analytical procedures, and several key facilities were observed. Results of the site visit were summarized and presented to City staff on February 27, 2015 at which time various scenarios were developed to systematically evaluate all data and information pertinent to the January 26, 2015 event, noting that this event was the most recent and conditions affecting the event were readily available. Also reviewed were conditions surrounding two positive TC/EC events that occurred in 2013 and 2014.

Facilities review sheets (as requested by ODW) were completed for facilities near the sample sites that tested positive for TC/EC. These assessments included investigations of sampling sites (investigation of plumbing, cross connections, filters), pumping stations, water reservoirs, distribution system infrastructure (air relief valves, valve chambers, pipe materials), groundwater wells, operations and maintenance activities, pressure monitoring, and environmental factors. City staff provided computer simulations of typical distribution system hydraulic patterns, along with records on distribution system (DS) operation and maintenance activities, customer water quality complaints, and facilities in the DS. City staff provided graphical illustrations of these data to allow analysis of associations between any suspect activities/facilities and the positive water quality samples of January 26, 2015.

The major findings of the facility reviews are summarized as follows:

- Operations and maintenance records were reviewed for any activities that might have been associated with a potential contamination of the water supply. System records were reviewed and found to be normal for the 2 weeks prior to the January 26, 2015 event.
- An evaluation of the City's Standard Operating Procedures (SOP) and Safe Work Procedures (SWP) as they relate to distribution system maintenance was conducted. Overall, it was noted that SOPs and SWPs were robust, although some greater documentation and regular review was recommended.
- A hydraulic modelling analysis was conducted by the City that evaluated flow patterns during the day of the January 26, 2015 event. Based on a hydraulic analysis of likely contamination scenarios, the probability that a single contamination event can be attributed to the January 26, 2015 event is low.
- Discoloured water complaint data for 2 weeks prior to the January 26, 2015 event were examined to see if there was any correlation between discoloured water and the event. No link could be found between historical discoloured water complaints and historical positive bacteriological samples.
- Cross connection inspections were conducted at each of the sampling locations where positive TC/EC samples were collected. These inspections provided no indication of a problem associated with the January 26, 2015 event.
- Pressure monitoring points were evaluated to determine if significant pressure losses in the distribution system occurred. No unusual pressure readings/losses were noted immediately before or after the January 26, 2015 event. All available system pressure readings were found to be within acceptable ranges.
- An evaluation of the air relief system and its associated valve pits was conducted in order to review the possibility of air release valves having played any part in the January 26, 2015 event. While some deficiencies were noted, no evidence of direct contamination related to the January 26, 2015 event was found.
- Groundwater wells upstream of positive sampling points showed no record of cross connection, impacting the January 2015 event.
- No confirmed extreme changes in reservoir levels were noted, or were likely to be a cause of contamination.

While no major system deficiencies were found a number of recommendations for improvement were identified for existing facilities, sampling and analytical procedures and documentation.

Independent reports were also secured regarding laboratory and sampling processes associated with the January 26, 2015 event. A number of areas for improvement were noted.

To gain insight into the possible causes of the positive TC/EC detections of January 26, 2015 and to focus efforts on the assessment, all available data and records were systematically reviewed against a series of hypothetical contamination scenarios to identify how these data tended to support or refute each scenario analyzed. Three general contamination scenarios were considered; single point, multiple point, and sampling/laboratory.

Single Point-Source of Contamination: In this scenario, the source of the contamination occurred at a single point-source in the DS, resulting in the positive TC/EC samples observed. Review of the data indicated that this particular scenario was highly unlikely, noting:

- The detection of contamination at sample locations on January 26, 2015 followed by the disappearance of contamination on January 27, 2015 is not consistent with normal flow patterns and water travel time in the DS. Computer simulations indicate that the age (time of travel) of water at the sample sites which tested positive on January 26, 2015 varies by as much as two days, presenting an

impossible timeline if associated with a single contaminant source flowing through the system, particularly considering the presence of a strong chlorine residual;

- The geographical location of positive samples surrounded by negative samples was inconsistent with contaminated water flowing through the pipes;
- Other water quality parameters (normal chlorine, low HPC, low turbidity) associated with the positive samples are not consistent with a contamination of the DS; and
- Public health data provided no indication of a widespread contamination of the DS.

Multiple Point-Sources of Contamination: in this scenario, a surge or drop in pressure triggered multiple point sources of contamination randomly spread throughout the DS. Under this scenario, the pattern of detection and disappearance of the contamination in 24 hours is plausible, if it is assumed that the surge disturbed contaminant-laden sediment in the bottom of the pipes, or allowed contaminated water to flow into the DS as the lower pressure associated with a surge passed through the system. The disappearance of the contamination is consistent with the presence of a strong chlorine residual in the DS, which would have been effective in killing microbes introduced during the event. This scenario could have been triggered by a hydraulic condition consistent with a power failure at one of the pumping stations, a large break in the DS, or the rapid closing of a large valve in the DS. A review of all available operations data indicated that this scenario was highly unlikely, noting:

- No significant events were observed in the DS capable of providing such a hydraulic surge;
- Turbidity data were normal, indicating that there was no sediment stirred up in the positive samples;
- Pressure readings at the 11 pressure monitoring stations (recorded every 2 minutes) indicated no period of unusually low or high pressures during the 2 week period prior to January 26, 2015; and
- As with the single source scenario, none of the other water quality or public health data indicated that a contamination event occurred in the DS.

It was thus concluded that it was highly unlikely that any contamination event occurred in the DS itself, and that other than the TC/EC water quality analyses, all other water quality and operational data indicated no public health risk was associated with the positive EC results of January 26, 2015.

Sampling/Laboratory Contamination Scenario: it is plausible that contamination was inadvertently introduced into samples collected and analyzed on January 26, 2015. The samples could have been contaminated randomly, and thus not be associated with the time of collection or the geographic location of the samples, consistent with what was observed. This scenario is also consistent with public health data, which provided no evidence consistent with contamination in the DS. The other water quality data collected with the samples (HPC, chlorine residual, and turbidity) are consistent with what would be expected in certain sampling/lab contamination scenarios, as noted below:

- Two City staff collected the 42 samples taken on January 26, 2015; all of the positive samples were taken by a single sample collector and those samples were analyzed on January 26, 2015. The second sample collector samples were analyzed on January 27, 2015. This implicates either the one sample collector, or the lab analysis on the January 26, 2015.
- In a sample collection contamination event, it is typically expected that HPC and TC data are both elevated, but in this event the HPC samples were normal and counter-indicative of a sample-collection related contamination;
- In a sample collection contamination event, normal chlorine levels would be expected, as the sample is dechlorinated as soon as it enters the sample bottle. Thus normal chlorine readings, which are

taken immediately prior to bacterial sampling, would be expected in both a sample collection contamination or a laboratory contamination event; and

- The mixed genetic strains found in the 5 positive EC samples are indicative of a complex contaminant source containing multiple strains of EC, as opposed to a single strain of EC. This indicates that it is unlikely that the source of contamination was the positive control used by the laboratory; but may have been a complex source of contamination from either a sample collection or lab event.

Conclusion and Recommendations

It is impossible to retrospectively prove or disprove any of the above scenarios. Water quality data, operational records, and public health records, however, provide compelling evidence that the positive TC/EC samples detected on January 26, 2015 did not originate in the distribution system, and were not indicative of a contamination event of the City water supply. A similar conclusion was drawn from the data trends from the October 2013 event.

It appears most likely that the source of the positive samples originated in either a sample collection or laboratory contamination event. Available data are no more convincing for either of these two possibilities, and expert reviews are split regarding which is the most likely.

The event of May 2014 involved only one positive sample, and thus the possibility of a localized contamination event cannot be definitively ruled out. The presence of a strong chlorine residual, low turbidity, no operations or maintenance issues and negative repeat samples, along with no indication of an increase in public health impact, favor a scenario where the positive sample was caused by sample collection or laboratory contamination.

The facility assessment and sampling/analysis process review resulted in a number of recommendations for improvement, many of which have been implemented or are underway. The recommendations include:

- An annual review focussing on system water quality vulnerability. This review should be performed by City staff involving a cross section of appropriate employees most familiar with the processes as performed in the field, along with managers and supervisors.
- Periodic evaluation of the water system SOPs and practices in the field. This review should be conducted annually in order to reflect the most current standards and best practices. The City's current operational procedures generally follow good industry practice.
- Remediation of minor contamination risks identified in the City's facilities, including reservoirs and valve chambers.
- Improvements in the sampling collection and laboratory analysis processes.
- A periodic review of vulnerabilities to the sampling points should be considered to ensure changes to plumbing are not affecting tested water quality. Such a review should be conducted as part of an annual assessment, and would likely require its own Standard Operating Procedure.
- An evaluation of the City's quality control (QC) process should be conducted to improve sample collection, start to finish.
- Determining the business case for the creation of an in-house general testing facility within the City's facilities.
- Working with the third party analytical laboratory conducting water quality testing to identify and reduce the possibility of contamination at the laboratory.