



SAINT JOHN



West Saint John Corrosion Control Investigation

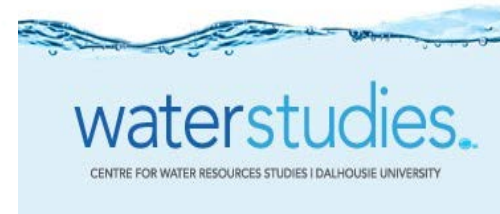
February 11, 2019

Background

- In January 2018, Saint John Water began to receive an increased number of calls from West Saint John residents reporting leaks in private plumbing.
- 4% of the 5,400 West Saint John Water customers reported leaks.
- Saint John has no baseline for premise copper pipe leak data therefore there is no ability to compare reported leaks to a historic baseline.
- Reported leaks were not localized to any one neighbourhood in West Saint John
- There were no abnormal increases in watermain breaks or in leaks in City - owned copper water services.
- SJW had not increased the water pressure in the water system during or after the switch from Spruce Lake to the South Bay Wellfield.
 - Water pressures in West Saint John are governed by the water levels in the water storage tanks which have remained the same for many years.

Background cont'd

- SJW immediately engaged Industry Experts to begin studying reported copper pipe leaks in late January 2018 when majority of concerns were received.
- **Dalhousie University's Centre for Water Resources Studies** was engaged to provide preliminary analyses and reporting.
- **CBCL Limited** was engaged to review the results of the studies, comment on industry best practices for corrosion control and to provide recommendations moving forward.
- Industry experts reviewed, recommended and the City installed an orthophosphate treatment system in March 2018 to help promote copper pipe scale stabilization.



Background cont'd

- CBCL Limited finalized the report titled “West Saint John – Corrosion Control Investigation” on February 5, 2019.
- Appendices A & B are the Dalhousie University’s Centre for Water Resources Studies reports.

West Saint John – Corrosion Control Investigation Final Report

182814.00 • Final Report • February 2019

Prepared for:
 SAINT JOHN

Prepared by:

CBCL LIMITED
Consulting Engineers

Final Report

Evaluating the effect of pH on copper release
in West Saint John

January 21, 2019

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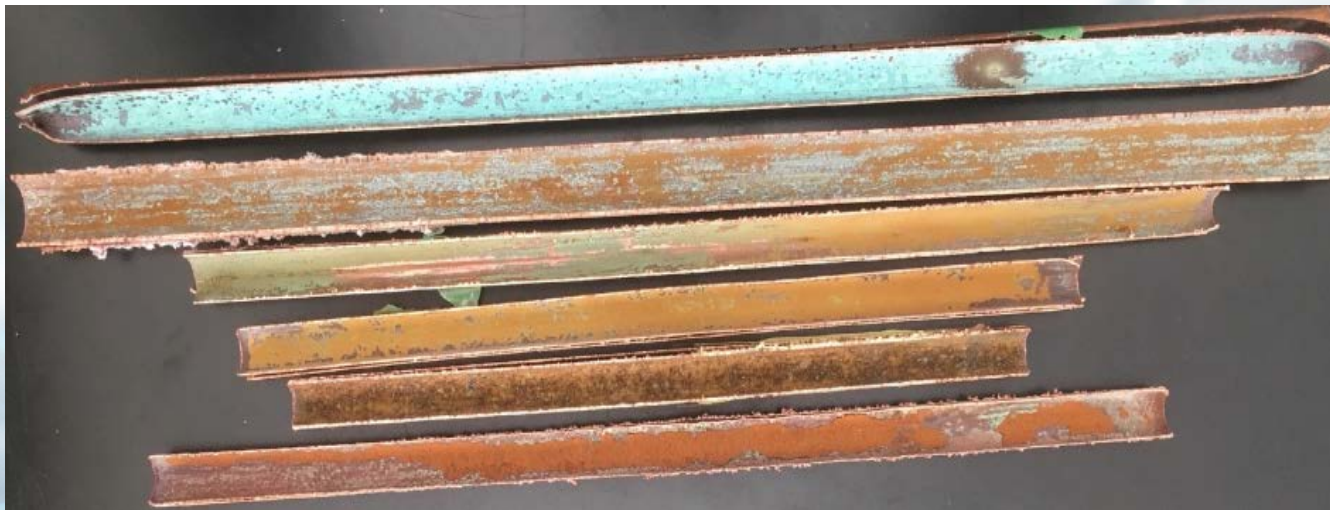
Investigation Analyses

Dalhousie University's Centre for Water Resources Studies completed two bench scale experiments.

1. **Analysis of copper corrosion scaling** in West SJ pipe samples.
2. **Stagnation study** to study copper release using surface water from Spruce Lake and ground water from the South Bay Wellfield.

Copper Corrosion Scale Analyses - Findings

- The scale which had formed in the copper pipes removed from private citizens' homes is largely amorphous (does not have a distinct, identifiable crystalline structure) with some common copper scale materials present.
- Analyzed scale did not match copper scale typically cited in literature.
- There is little research and limited literature available on amorphous scaling and copper solubility.



Stagnation Study Findings

Stagnation study was performed in two phases.

1. First phase investigated the effects of pH, free chlorine concentration and orthophosphate addition on copper release to ground water.

Finding: Addition of orthophosphate was statistically significant in decreasing copper release to the ground water.

2. Second phase investigated the difference in copper release when the pipes were conditioned with surface water (SW) and ground water (GW).

Findings:

- Results showed aged pipes conditioned with GW released more copper than the pipes conditioned with SW.
- Results varied from copper solubility models in literature (which predicted SW to have higher copper release levels).

Note: Unknown if copper measured was comprised of new corrosion or decomposition of pre-existing scale.

Stagnation Study Findings

- In the first round of testing the pH level (pH 6.8) for the surface water tested represented the surface water at the time of the switch to ground water.
- pH was higher than what was historically experienced by West Saint John.
- To understand the effect of the difference, supplemental testing was completed by Dalhousie at pH of 5.5.

Findings:

- For aged pipe the copper release was highly variable at either pH level and there were no clear differentiation. This indicates an effect of pre-existing scale.
- For new copper pipe copper release was consistently higher at the lower pH as expected.
- The copper release from aged pipe in the supplemental testing, at both pH values was substantially higher than the initial testing, and similar to initial copper release with ground water.
- The West Saint John results differ from industry cuprosolvency models used to predict cuprosolvency in premise plumbing.

Stagnation Study Findings

- Existing pipes in West Saint John had developed a stable scale over years which appears to have helped limit leaks and maintain structural integrity.
- When the switch from SW to GW took place, the scale existing in the pipes was likely disrupted before a new scale (based on changed water quality) could form.
- When the existing scale was disrupted, the previously corroded pipe in the system would have been exposed and leaks would have occurred. This was likely a short-term transitioning event.



Stagnation Study Findings

Finding:

- Study showed that the addition of orthophosphate reduced copper release from both mature and new West Saint John pipe.



Water Quality - Role in Corrosion

Changes in pH, alkalinity and dissolved inorganic carbon (DIC) can play a significant role in either limiting or promoting corrosion.

1. **pH** – low pH increases corrosion of copper pipes .
 - The switch from SW to GW resulted in a pH change from 6.5 to 7.9.
2. **Alkalinity** – measure of the waters ability to resist pH changes.
 - Low alkalinity water can be challenging to control corrosion.
 - The South Bay Wellfield has moderate to high alkalinity providing additional buffering compared to the low alkalinity of Spruce Lake.
3. **DIC** – moderate concentrations can be a benefit for reducing copper corrosion as it can help buffer pH changes and form scales.
 - Spruce Lake has low DIC levels and the South Bay Wellfield has moderate DIC levels.

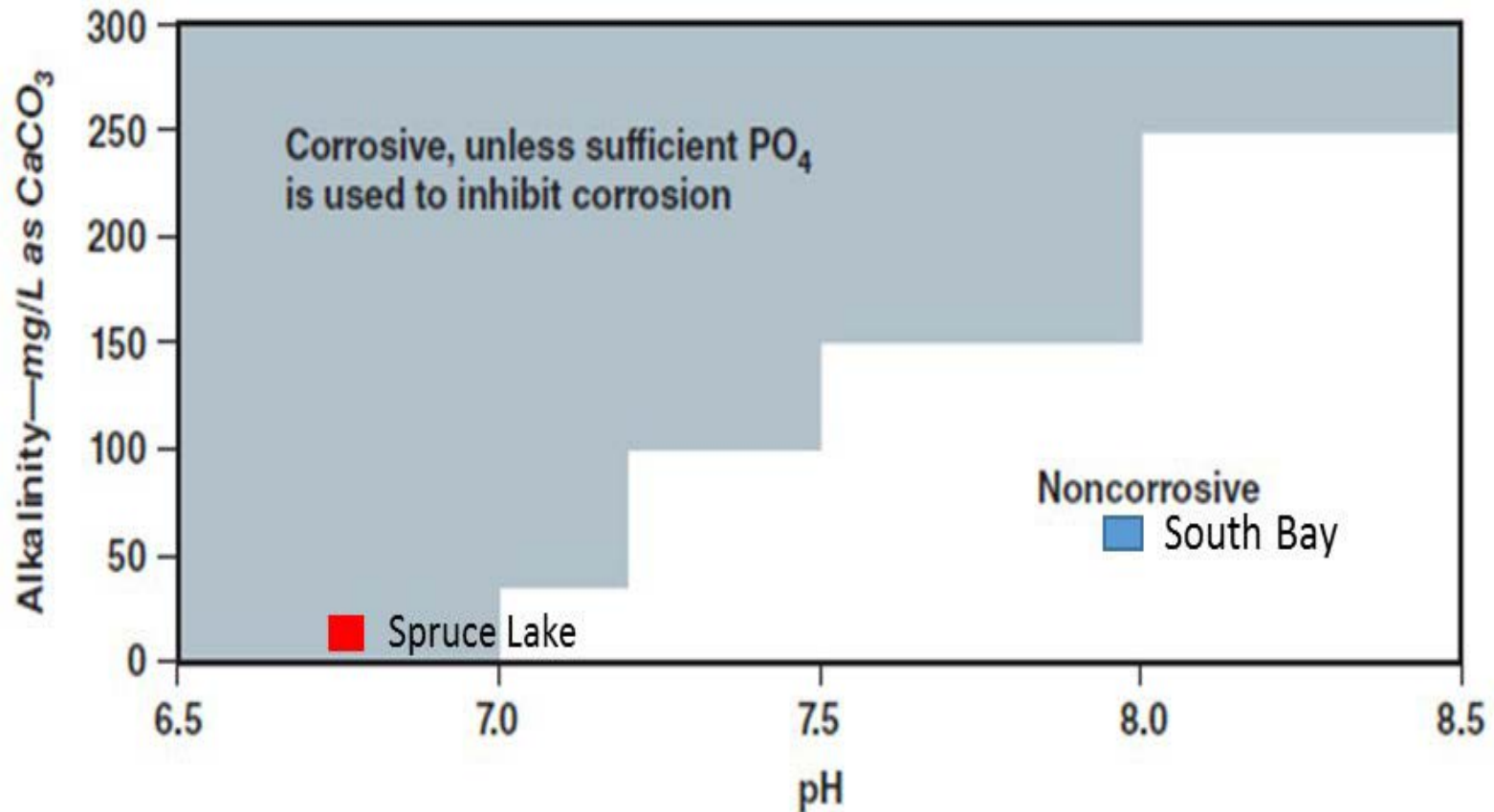
Switching of Source Waters

- From a water quality standpoint, the switch from Spruce Lake to the South Bay Wellfield was considered low risk as the water quality was changing from a corrosive water to one that is less corrosive.
- Saint John completed an evaluation of the distribution system focusing on public infrastructure, including an assessment of existing pipe corrosion scales prior to the switch in water quality.
- There is limited literature, research and documents available to assess plumbing system impacts for utilities permanently switching a water source (surface to ground water).

Atlantic Canada Municipal Experiences

- Examples of municipalities that have switched from disinfection (chlorine) only SW to GW over the last 20 years.
 - Sydney, NS
 - Bridgetown, NS
 - Annapolis Royal, NS
- These utilities did not experience major reports of copper pipe leaks within premise plumbing systems.
- These municipalities did not employ the use of orthophosphates.
- There are no known municipalities with a ground water source using orthophosphates in the region, a reflection of the lower corrosion potential of ground water sources.

Orthophosphate Addition Guidance



Orthophosphate Addition Guidance

- Guelph, Ontario and Charlottetown, PEI have similar water quality as West Saint John but do not use a corrosion inhibitor.
- Several municipal water utilities within Atlantic Canada have switched from surface water to groundwater. None have required the use of orthophosphate.

Switching of Source Waters

When reports of copper leaks occurred, the City promptly looked to develop a prevention strategy to mitigate the reports.

- An orthophosphate system was implemented as a corrosion control method.
- SJW continued to monitor the distribution system and premise plumbing for further copper pipe leaks.
- Reports of leaks occurring in West Saint John appeared to peak in January 2018.
- Reports of leaks dropped off to the point of no leaks being reported since June of 2018 and only one new civic address leak reported for the months of April, May and June 2018.

Switching of Source Waters

In the period during the switch of source waters:

- SJW performed extensive system flushing to limit impacts to water quality during the switch.

Since the switch occurred:

- A heightened monitoring program has been implemented.



Recommendation

It is recommended that Common Council receive and file this report.



Saint John Water

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