Recommended Lead Reduction Plan for the City of Sarnia

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Background and Context

Why is lead important?

Lead can impact the healthy development of the brain in fetuses, infants, and children under 6 years old, possibly leading to lifelong neurological impacts. For this reason, the MOECC limits the maximum concentration of lead in drinking water to **10 µg/L** (equivalent to 10 parts per billion).

How does lead get in the drinking water?

Usually, the "source water" that eventually becomes our drinking water does not contain lead. In Sarnia, the source water is Lake Huron. The water usually remains lead-free after the treatment process and as it travels through the City's watermains on its way to a customer's home.

The water picks up lead when it flows through the smaller pipes that connect a house to the City's watermains. Before the mid-1950s, these pipes—known as "service lines"—were often made of lead. The water can also pick up lead as it flows through plumbing inside the house, for example, from lead solder and brass or bronze faucets. Figure 1 shows typical infrastructure connecting a house to municipal watermains.

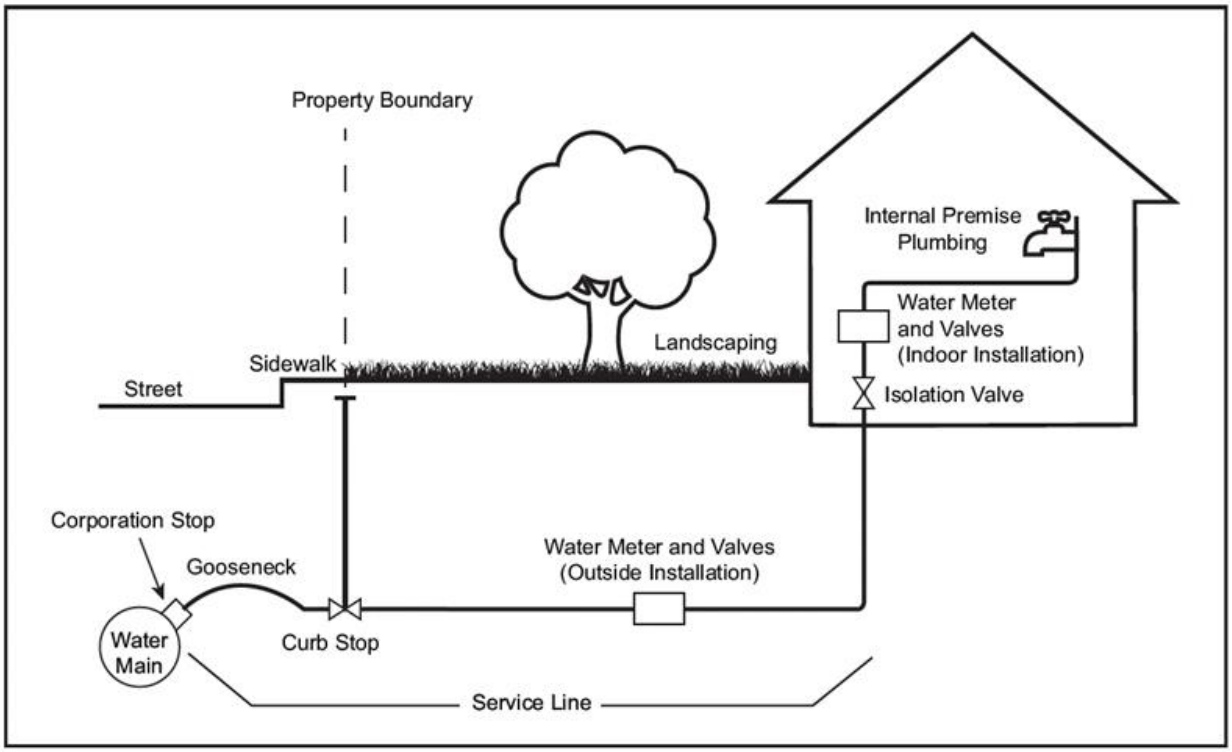

Figure 1. Water picks up lead when it flows through the service line and household plumbing

Source: Figure is from AWWA Standard C810-17.

What can be done to lower the level of lead in drinking water?

There are two ways to reduce the level of lead in drinking water:

1. Remove the sources of lead
2. Apply a corrosion control treatment

Each of these methods has pros and cons. In many municipalities, both methods are used together.

What are the challenges with removing lead sources?

Shared ownership. Usually, a portion of the service line is owned by the City and the other portion is owned by the homeowner, with the division of ownership based on the property line. In other words, the lead sources—the service line and the household plumbing—are partially located on private property.

This means that removing the lead is a shared responsibility between the City and the homeowner. The City of Sarnia currently removes the City-owned portion of **lead service lines (or "LSLs")** encountered during watermain construction projects and replaces the LSL with copper pipe. The City of Sarnia *encourages* homeowners to replace their side of the LSL and household plumbing, but does not have the authority to *force* the homeowner to do so.

Partial replacements and "lead spikes". If the homeowner does not replace their side of the LSL, this creates a "partial LSL". Replacing only a portion of the LSL might:

1. Lower lead levels,
2. Have no impact on lead levels, or
3. Increase lead levels

Increased lead levels are usually short-term—on the order of months to a year—and are called **"lead spikes"**. This happens when small particles of lead are dislodged from the service line and household plumbing due to vibrations during the replacement.

Lead spikes pose a serious health concern because they can expose customers to very high lead levels, often many times higher than Ontario's limit of 10 µg/L.

It takes a long time. Replacing LSLs is labour-intensive and time-consuming. Most municipalities don't have records of where the LSLs are located. In Sarnia, staff estimate that there could be as many as:

- 8,643 homes with an LSL **on the homeowner's side**
- 4,483 homes with an LSL **on the City's side**

In developing this estimate, staff cautiously assumed that *all* homes in areas built prior to 1957 *might* have lead, unless proven otherwise through sampling or visually checking the pipe material during construction projects. The actual number of LSLs in Sarnia is likely much lower.

At the City's current rate of replacement, it could take over 100 years to replace all 4,483 potential City-owned LSLs. This is an unacceptably long period of time. In the absence of corrosion control treatment, the MOECC usually accepts a maximum period of 15 years to replace all LSLs.

What are the challenges with corrosion control treatment?

Corrosion control treatment involves changing the water chemistry to lower the level of lead that gets into the water. This happens when a protective scale layer builds up on the inside of the pipes, acting as a barrier between the lead pipe and the water. Lead levels can usually be lowered within a period of months to years.

Challenges of corrosion control treatment include:

- The protective scale will dissolve if the treatment is ever stopped.
- "Lead spikes" can still happen when LSLs are replaced.
- Discoloured water and other water quality impacts may occur until the watermains stabilize under the new water chemistry.
- Sarnia does not own the LAWSS water treatment plant, which is shared between six municipalities. Treatment applied at LAWSS to lower lead in Sarnia could inadvertently create water quality problems for the other municipalities.

Options Considered

The team followed the MOECC's recommended approach for developing a Lead Reduction Plan. This considered Sarnia's unique water system features and water chemistry, and was supplemented by lessons learned from other municipalities that have undertaken lead reduction programs.

The project team initially developed seven options for lowering lead levels measured at the tap in Sarnia. Four options were carried forward for further consideration:

- **Option A:** Replace all LSLs within 15 years
- **Option C:** Corrosion control treatment using phosphate (indefinite) with LSL replacement within 50 years
- **Option E:** Corrosion control treatment using pH adjustment (indefinite) with LSL replacement within 40 years
- **Option F:** Continue replacing LSLs for 3 years while collecting more information, then re-evaluate the options

All four options include LSL replacement, some at higher replacement rates than others. As summarized in Figure 2, the options have many key features in common to address the challenges associated with **LSL replacement**. This includes:

- **Finding** the LSLs through "verification sampling"
- **Replacing** the "public" (City) side of LSLs
- **Encouraging** homeowners to replace their side of the LSL through a financial incentive (loan)
- **Protecting** against lead spikes by offering homeowners temporary filters that remove lead
- **Communicating** health risks with the public and encouraging their participation
- **Monitoring** lead levels after replacement

	Option A *Replace LSLs*	Option C *Phosphate*	Option E *pH*	Option F *Investigation*
Verification sampling	590 /yr	180 /yr	220 /yr	1,200 /yr
Replace public LSLs	150 /yr	40 /yr *(current practice)*	60 /yr	85 /yr
Private LSL loan	50 /yr			50 /yr
POU filters	250 /yr	140 /yr	160 /yr	185 /yr
Public outreach	✓	✓	✓	✓
Monitoring	Residential	Residential Dist. System	Residential Dist. System	Residential
Municipal impact study		✓	✓	✓
Treatment trial		✓	✓	✓
Design & construction		✓	✓	
Watermain flushing	✓ *(current practice)*	✓ *(increased)*	✓ *(increased)*	✓ *(current practice)*
Re-evaluate				✓
Program duration	15 yrs	Treatm't: Indefinite LSLR: 50 yrs	Treatm't: Indefinite LSLR: 40 yrs	3 yrs
Up-front costs	$0.08M	$2.63M	$2.48M	$0.53M
Annual costs	$1.73M	$0.52M	$0.58M	$1.17M

Figure 2. Summary of Lead Reduction Plan Options A, C, E, and F

As summarized in Figure 2 and below, the treatment options (C and E) included some additional items that would be required before **corrosion control treatment** could be implemented at LAWSS. Some of these items were also included in the investigation option (F).

- **LAWSS member municipality impact study** to determine how corrosion control treatment at LAWSS might impact other LAWSS municipalities
- **Treatment trial** to determine design criteria for corrosion control treatment at LAWSS
- **Design and construction** of a new corrosion control treatment system at LAWSS
- **Watermain cleaning** (hydrant flushing) to resolve discoloured water and other water quality impacts from corrosion control treatment
- **Communicating** health risks with the public and encouraging their participation
- **Monitoring** the distribution system for discoloured water and other water quality impacts from corrosion control treatment

Recommended Plan

After careful consideration, **Option F** was recommended as the preferred option, because there are too many unknowns at this time to defensibly justify:

- The expense associated with accelerated LSL replacement within 15 years under Option A, since the current estimate for the number of LSLs is very conservative.
- Implementing corrosion control treatment (under Options C or E) without sufficiently identifying and quantifying impacts to the other LAWSS municipalities.

Option F is based on eliminating all suspected LSLs within 15 years, by:

- Confirming non-leaded material, and
- Where LSLs are present, replacing the LSL

In contrast, Option A assumes that all 4,483 suspected City-side LSLs will need to be replaced within 15 years.

The recommended components for Option F are described in Table 1. The objective of Option F is to collect information needed to defensibly commit to a suitable Lead Reduction Plan, by:

- **Refining the LSL estimate** to a more realistic number upon which to build a financially sound plan.
- **Confirming the level of homeowner participation** in conducting private LSL replacements.
- **Confirming the level of public health protection** provided by LSL replacement in combination with temporary protection measures such as filters.
- **Assessing the feasibility** of LAWSS implementing corrosion control treatment, in terms of:
    - Understanding the impacts of corrosion control treatment on the LAWSS member municipalities.
    - The ability of different corrosion control treatment alternatives to control lead measured at the tap, within the Sarnia Distribution System.

Table 1. Recommended Interim (3-Year) Lead Reduction Plan

	Lead Reduction Plan Component	Description
	**LSL verification program**	• Verification sampling (starting in 2019) will aim to verify 1,200 homes annually. Pre-construction verification sampling will occur in summer 2018. • Records review to refine the LSL database will commence summer 2018, and will continue on an ongoing basis.
	**LSL replacement program**	• It is estimated that between 75 to 85 public LSLs, and approximately 60 private LSLs will be replaced annually during the three-year program, starting in 2019.
	**LAWSS member municipality impact study**	• The City will negotiate with LAWSS for the completion of a member municipality impact study in 2019, to determine whether corrosion control treatment is feasible in the LAWSS system by assessing and quantifying potential impacts to the member municipalities of LAWSS.
	**Treatment trial**	• If treatment is determined to be feasible, the City will negotiate with LAWSS for the completion of a pipe loop study (commencing in 2020) to investigate the ability of the treatment alternatives to control lead in the Sarnia Distribution System.

Lead Reduction Plan Component	Description
Private LSL replacement loan program	• A loan program for private LSL replacement is recommended to be developed in 2018 for rollout in 2019. It is estimated that 50 loans will be offered per year, at a maximum cost of $2,000 per loan.
Point-of-use filter program	• A point-of-use filter program is recommended to be developed in 2018 for rollout in 2019. • This will consist of a filter rebate program (estimated at 100 filter rebates for $40 each) that will be offered annually to households with vulnerable populations following the detection of lead through verification sampling. • Additionally, filters are recommended to be provided to homeowners for free for a period of six months following any City-side LSL replacement, to reduce exposure to "lead spikes".
Public outreach program	• A communications plan will be developed in 2018, for rollout in 2019. This plan will document target audiences, key messaging, communication formats and mediums, the timing of communications, communications protocols and lines of communication, and internal training needs. Additional communication materials for the public outreach program (as defined in the communications plan) will be developed. • An initial public outreach campaign will be rolled out in 2019. • A communication blast will occur annually to solicit participation in the verification sampling program and LSL replacement program.
Post-replacement monitoring program	• Residential post-replacement sampling will use the Schedule 15.1 sampling protocol at approximately 6 and 12 months following replacement. Samples will be analysed for total lead and total iron.
Re-evaluate options	• The interim lead management strategy will be re-evaluated in 2021 based on the information gathered during the three-year period.

During the three-year period, key programs to support LSL replacement—***which would be required regardless of the option selected***—will be developed and rolled out, including public outreach, the private LSL replacement loan, temporary filters, and post-replacement monitoring. Accelerated LSL replacement will also continue at replacement rates higher than current levels but lower than required through Option A.

As shown in Figure 3, the commitment to replace all LSLs in 15 years (by 2034) will be **re-evaluated** at the conclusion of the three-year period, based on the information collected over the first three years.

If the re-evaluation concludes that the remaining LSLs cannot be removed by 2034 (12 years starting in 2022) and/or that LSL replacement on its own does not provide a sufficient level of public health protection, a course correction can be made and corrosion control treatment will be negotiated with the LAWSS Board.

Alternatively, if replacing the remaining LSLs by 2034 is determined to be feasible, the City can develop a realistic, fiscally-sound plan to replace the remaining LSLs in 12 years.

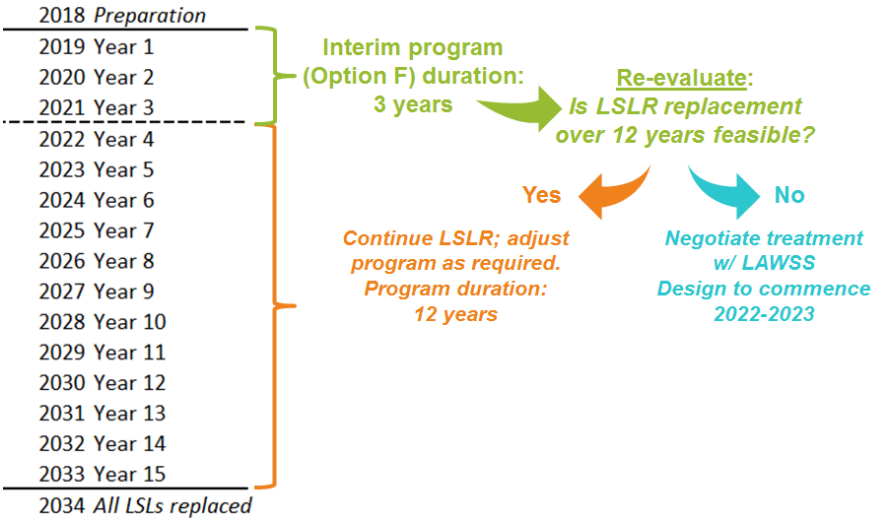

Figure 3. Overview of Option F (Interim 3-Year Plan)

Financial Impact

The (previously allocated) lead management budget for 2018 ($300,000) will be used for 2018 program development activities in support of implementing the three-year plan in 2019. Program costs for Years 1, 2, and 3 (see Figure 4) are estimated to be approximately $1.14M, $1.12M, and $1.17M, respectively. The City may refine these estimates as the program progresses and more information/experience is gained. For example, additional funding for the loan and for LSL replacements may be sought for Years 2 and 3 if homeowner participation in Year 1 is higher than expected.

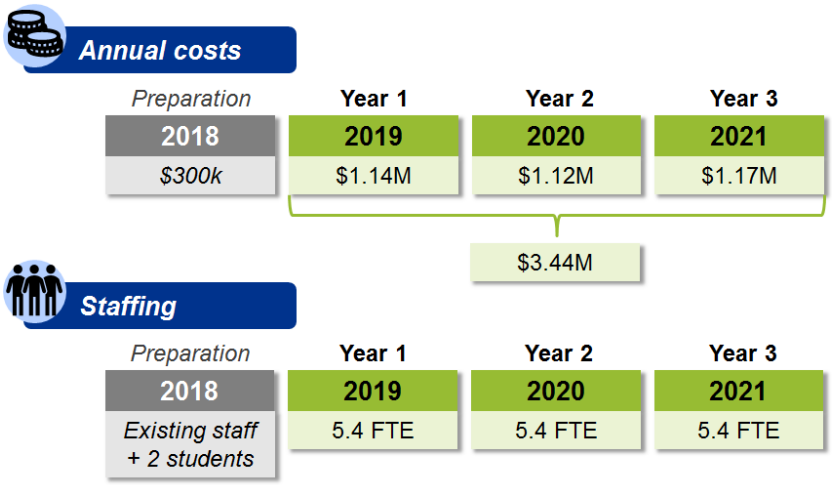

Figure 4. Phased Cost and Staffing Impact for Option F (Interim 3-Year Plan)

The staffing requirements shown in Figure 4 represent an **estimate which will be refined by the City as the program progresses**. These staffing estimates exclude full time equivalents (FTEs) for staff that will be carrying out LSL replacements.

It is noted that the staffing requirements shown in Figure 4 **do not necessarily represent hiring needs**. It is assumed that some level of support (if not all) can be provided through existing staff. Where additional staff are required, these gaps may be filled through temporary staff such as students or temporary operators. Staffing needs (existing vs. new staff) will be assessed as the program evolves.