Health Canada Santé Canada

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Guidelines for Canadian Drinking Water for Lead

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Water and Air Quality Bureau
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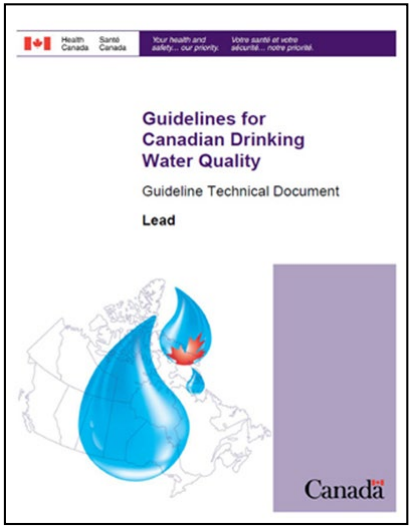
YOUR HEALTH AND SAFETY... OUR PRIORITY.

Lead Health Effects

- Lead internationally accepted as non-threshold toxicant by many agencies (Health Canada, U.S. EPA, CDC)
  - no safe level of Pb in children's blood established
- Lead exposure is associated with many health effects but decreased IQ is considered the critical effect:
  - Strongest evidence for a causal effect
  - Children were affected at the lowest blood lead levels studied

Guideline for lead

- Maximum acceptable concentration (MAC) of 0.005 mg/L (5 ppb)
- Sampling for typical exposure
  - At population level
- Includes:
  - Factors affecting exposure
  - Sampling considerations
  - Lead variability (particulate/dissolved)
  - Monitoring considerations



Exposure

- Lead in drinking water needs to be measured at the tap
- Lead service lines can contribute at least 50–75% of lead in drinking water
  - Leaded brass and lead solder can also be important sources of lead in drinking water, especially in buildings
- Lead levels can be highly variable

Sampling considerations

- Different sampling protocols will achieve different objectives
  - Some may achieve more than one objective
- Sampling protocol depends on objective
  - Exposure
  - Investigative/diagnostic
  - Treatment performance
  - Compliance

- Sampling protocol should capture
  - Variability → because exposure varies
  - Total lead → dissolved and particulate fractions

Sampling protocols and objectives

Objective	Sampling type	Protocol
Regulatory compliance for lead and/or Corrosion control efficacy	First draw (U.S. EPA)	6+ hr stagnation Collect 1 L
	RDT (UK/EU)	Random sample collection without prior flushing; Captures variable stagnation; Collect 1 L
	30MS (Ontario)	2–5 min. flush; 30 min. stagnation; Collect first two liters
Determination of lead sources (plumbing/lead service line) and/or Identification of type of lead	Profile (or sequential) sampling –traditional	Defined stagnation time 10–20 sequential samples of a defined volume (125 mL, 250 mL, 1 L, etc.)
	Profile sampling that stimulates particle release	Traditional profile sampling at increasingly higher water flow rate (low, medium and high)
	Fully flushed sampling	5 min. flush; Collect 1 L and compare to validated threshold for presence of LSL
	3T's for schools and childcare facilities: revised manual, U.S. EPA	Overnight stagnation; Collect first 250 mL from all taps and fountains; Sample results from each facility should be compared to prioritize follow-up sampling and remediation
Exposure assessment	Composite proportional	Captures actual water use (and variability); Device collects 5% of every draw from the tap for consumption during 1 week
	30MS	5 min. flush; 30 min. stagnation; captures inter-use time Collect first two liters and average results
	RDT	Random sample collection without prior flushing; Captures variable stagnation and inter-use time; Collect 1 L

Factors affecting lead release

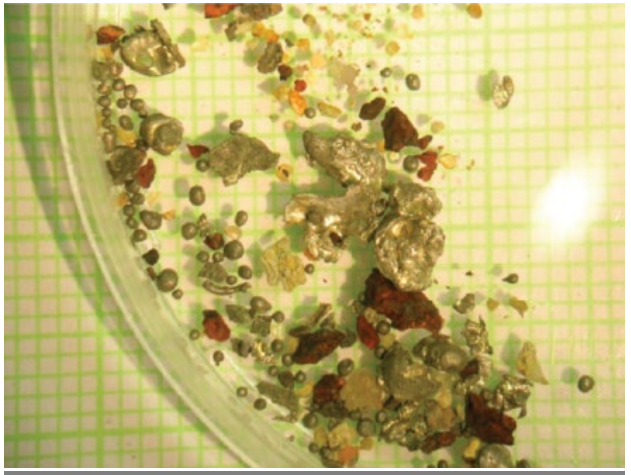
- Dissolved lead release
  - Water quality
  - Surface area of lead surface (pipe length, diameter)
  - Stagnation time of water

- Particulate lead release
  - Physical disturbances (hydrant flushing, road work, etc.)
  - LSL replacement (full or partial)
  - Galvanic corrosion (connection of two different metals)
  - Hydraulic disturbances and transport of particles
  - Stagnation time of water

Lead variability

- Dissolved lead release is reasonably well characterized
- Particulate lead release is random and mostly unpredictable
  - Usually defined as > 0.45 µm
  - Increases with stagnation, flow rate, galvanic corrosion
  - Can be the main form of lead
  - Linked to lead spikes
  - Challenges with analysis (i.e., acidification)

One single aerator…



TOTAL Pb =
SOLUBLE Pb + PARTICULATE Pb

Source: Deshommes et al., 2010

Correlation between particulate lead and metals

- Metals can accumulate on top of iron and lead in distribution system
- Iron (Fe) and manganese (Mn) scales accumulate lead
  - Fe and Mn scales can be released after full or partial LSL replacement
- Increased release of particulate lead
- Red water/discolouration events result in release of metals such as lead
  - Need to monitor these events

Sampling

- What does a sample result tell you?
  - Depends on how it was taken
- 6 hours first and second draw
- 30 minutes first and second draw
- 5 minutes fully flushed samples
- Random daytime
- Profiling sampling after 30 min and 6 hour stagnation

Conclusions of sampling studies

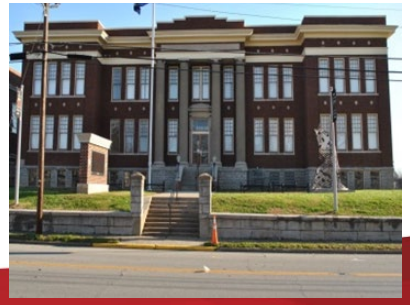
- Fully flushed protocol not representative of average exposure
- 30MS representative of average exposure and reproducible but underestimates exposure
  - representative of average inter-use stagnation time
- RDT representative of average exposure but less reproducible, so need more samples
- RDT captures variability but over-estimates
  - representative of average inter-use stagnation time
- Cannot use RDT and 30MS interchangeably

Monitoring

- Needs to address residential sites
  - Single family homes
  - Multi-dwelling residences
- Needs to consider practicality/customer acceptability
- Should include buildings and schools
  - Capture vulnerable population
  - Different challenges (fittings, faucets, bubblers)
- Should address variability, building type, seasonal differences, occupancy/water use
- Target high risk areas/zones

Monitoring considerations

- Sampling type, locations and number
  - Identify priority sites & locations
  - Homes with LSLs (full or partial) should be prioritized
  - Guidance on site selection when can't sample homes with LSLs
- Protocol for large buildings and schools
  - Difficult to assess 'representative' sample
  - Needs be practical/realistic for large buildings and schools



Strategies to reduce lead

- Full lead service line replacement is best approach
- Partial lead service line replacement reduces lead
  - May cause release of lead for several months
  - Reduction may not mirror percentage of line removal
- Corrosion control
  - May not be sufficient to reduce lead concentrations when water is supplied through a lead service line
- Use low lead materials (comply with NSF 372 and NSF 61) for plumbing and distribution systems
- Filters work well but a temporary measure

System basics

- Characterization of water quality (pH, alkalinity, cations, anions, Fe, Mn, etc.) is critical
  - Provides information on possible issues
  - Can inform best strategies for mitigating lead
  - Measure pH onsite for accuracy
- Get to know your system materials
  - LSLs present?
  - Galvanic connections?
  - Brass fittings (faucets, valves, etc.)

Challenges

- Fewer resources to address issues
  - May require consultant, additional staff
- Footprint of treatment plant may limit corrosion control strategies
- Training may limit options
  - Treatment chemicals that can be used
  - Adjustments to water quality
  - Sampling capacity

Small systems strategies

- Manganese and iron removal have many benefits!
  - Key to making pH adjustment easier
  - Minimizes accumulation and release of metals
  - Can reduce disinfectant /oxidant demand
- CSMR can help predict galvanic corrosion
  - Need to know chloride and sulfate anion concentrations
- Detection of LSLs can be done with simpler sampling methods
  - Sequential sampling is ideal but flushed sample are also a good tool
    - Need to determine screening threshold for lead
- Sampling plans that cover more than 1 year

Questions?

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Corrosion control strategies

- pH adjustment
  - Sodium silicate (cold water)
  - KOH (cold water and handling requirement advantages)
  - Aeration can be used if there is free CO_2
    - Can calculate free CO_2 using pH and alkalinity
- Alkalinity adjustmtent
  - Limestone contactors
  - Lime softening
- Avoid use of copper in high alkalinity ground waters
- Orthophosphate may be only option in some cases

Lead Sampling Survey in Children's Facilities, 2018

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Presentation Outline

- Role of ISC FNIHB
- Purpose of Sampling Survey
- Overview of Sampling Plan
  - Resampling Protocol
  - Communication of Results
- Challenges
- Resource Demands
- Advice & Lessons

Role of ISC, FNIHB

- The Environmental Public Health (EPH) program is mandated public health program in First Nations communities and responsible for the implementation and oversight of drinking monitoring activities.
- The purpose of the monitoring program is to ensure safety of the drinking water supply and to protect public health.
- This is achieved through routine sampling, interpretation of data and reporting to the communities.
- Monitoring is done for all water system types including public and private systems, as well as potable water hauling vehicles.
- Testing for bacteriological and chemical quality.

Role of ISC, FNIHB

- Due to our regular sampling activities of all drinking water systems and ongoing monitoring of water quality parameters, we had existing data on baseline levels of all health-based parameters of the GCDWQ.
- No lead exceedances or concerns were identified in any public or semi-public water system in the region based on routine bi-annual sampling.
- Not aware of any lead service lines, as much of the distribution infrastructure in communities was put in after the era of lead piping.

Project Overview

- Sampling was completed at all children's facilities including schools, daycares and head starts on First Nations communities in the Alberta Region.
- Children are at highest risk of negative health impacts such as CNS, kidney, reproductive system effects/adverse neurodevelopment and behavioural outcomes from exposure to lead therefore monitoring these facilities was prioritized.
- Sampling was conducted between May – June 2018.
  - Short timeline for completion.

Project Purpose

- The sampling survey was completed in anticipation of MAC change in the GCDWQ from 0.01 mg/L to 0.005 mg/L.
- The objective was to screen children's facilities for lead in taps used for drinking, establish a baseline of existing conditions, identify exceedances and provide guidance on mitigation.
- Where exceedances were identified, our EPHOs would make recommendations for remedial measures that reduce or eliminate exposure.

Sampling Plan

- All outlets used for drinking and/or cooking purposes were identified for sampling such as:
  - drinking water fountains.
  - kitchen taps.
  - bathroom taps.
  - home economics rooms.

- EPHOs consulted with facility operators / administrators to determine which sites needed testing.

Random Daytime Sampling

- RDT method was used per Annex 5 (FNIHB guidance document).
- Intended to represent a typical exposure scenario with no prior flushing before sample collection.
- Samples collected while facility in normal operation, during warmest months.
- Two duplicate samples collected immediately after opening cold water tap.
- Average of the two samples used to calculate lead concentration.

Resampling Protocol

- Random daytime samples that exceeded the proposed MAC were resampled twice:
  - after a 30 second flush and a 2 minute flush.
- Purpose additional sampling:
  - Confirms the presence of the lead exceedance.
  - Provide insight on where lead might be getting into water (i.e. service line vs the fixture itself vs. upstream interior plumbing.)
  - If 30 second flush exceeded but 2 minute flush did not, it was deemed to come from the fixture.
  - If 2 minute flush sampled exceeded but 30 second flush did not it was deemed upstream source.

Resampling Protocol

- Flush Sampling Protocol was referenced in the EPA document “3Ts for Reducing Lead in Drinking Water” and was used as guidance for our survey.

Sampling Plan

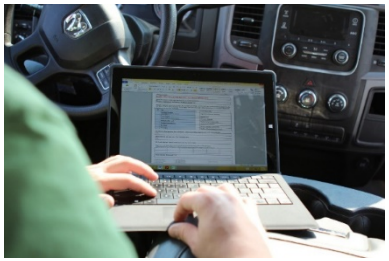
- Total number of samples taken: 1422
- Total number of facilities sampled: 132
- Number of Exceedances (RDT): 239 (17%)
- Total number of re-samples taken (flush samples): 239
- Total number of samples exceeding on resampling: 41 (17%)
- Total number of all sampling points with confirmed lead exceedances was 41/1422 (2.9%)

Sampling Plan

- No reported exceedances that were in an order of magnitude that represented an acute health risk.
- In most cases of exceedances, it was concluded that source of lead was related to the fixture versus the building plumbing system.

Tools and Technology

- All samples were test at ALS labs, our contract service provider
- Palintest for lead analysis was used a quick measurement following remediation.
- Garmin handheld was used to collect GPS coordinates at all facilities where lead was sampled.
- Surface Pro tablets used to collect and store information.
- SharePoint – Microsoft's web-based platform for data storage and management.



SharePoint

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Communicating Results

- EPHOs informed community contacts directly that lead sampling was going to take place and why.
- Letter containing results, interpretation and recommended remedial actions were set to community contacts.
- Engagement and sharing of results with colleagues in ISC, Regional Operations (formerly Indian and Northern Affairs Canada).
- Worked with Regional communications personnel to develop media lines in case they were needed.

Communicating Results

- Sample sites with no exceedances were informed that no remedial actions were required.
- Handouts shared explaining the upcoming changes to the guideline.

Communicating Results

- Sample sites with exceedances after resampling were provided guidance on short and long-term remedial measures to reduce lead exposure.
- Short term/immediate mitigation strategies:
  - Turning off the water valve so water cannot be accessed from a particular fixture;
  - Signage to inform users to not drink water/handwash only;
  - Implement a flushing program for the affected facility/fixtures;
  - Use bottled water for drinking and cooking purposes;
  - Where appropriate, work with water plant operators to control corrosivity of the water.

Communicating Results

- **Medium to long term mitigation strategies may include:**
  - Identification and replacement of lead containing faucets or fixtures with lead – free materials.
  - Installation of point-of-use devices that meant NSF – 53 for lead reduction. E.g. carbon filters, reverse osmosis. (http://www.nsf.org/)

- EPHOs were available to conduct follow-up sampling and interpretation following remedial work.
- Our program remains available to provide support to communities on lead.

Stakeholders

- First Nations Communities
  - Health, Public Works, School Administrators, Health Protection Subcom. of HCOM, Assembly of Treaty Chiefs (AoTC)
- ISC - Regional Operations (Education, Capital Program for water and wastewater)
- Regional Communications
- Regional Senior Management
- Medical Health Officers
- EPHS data team

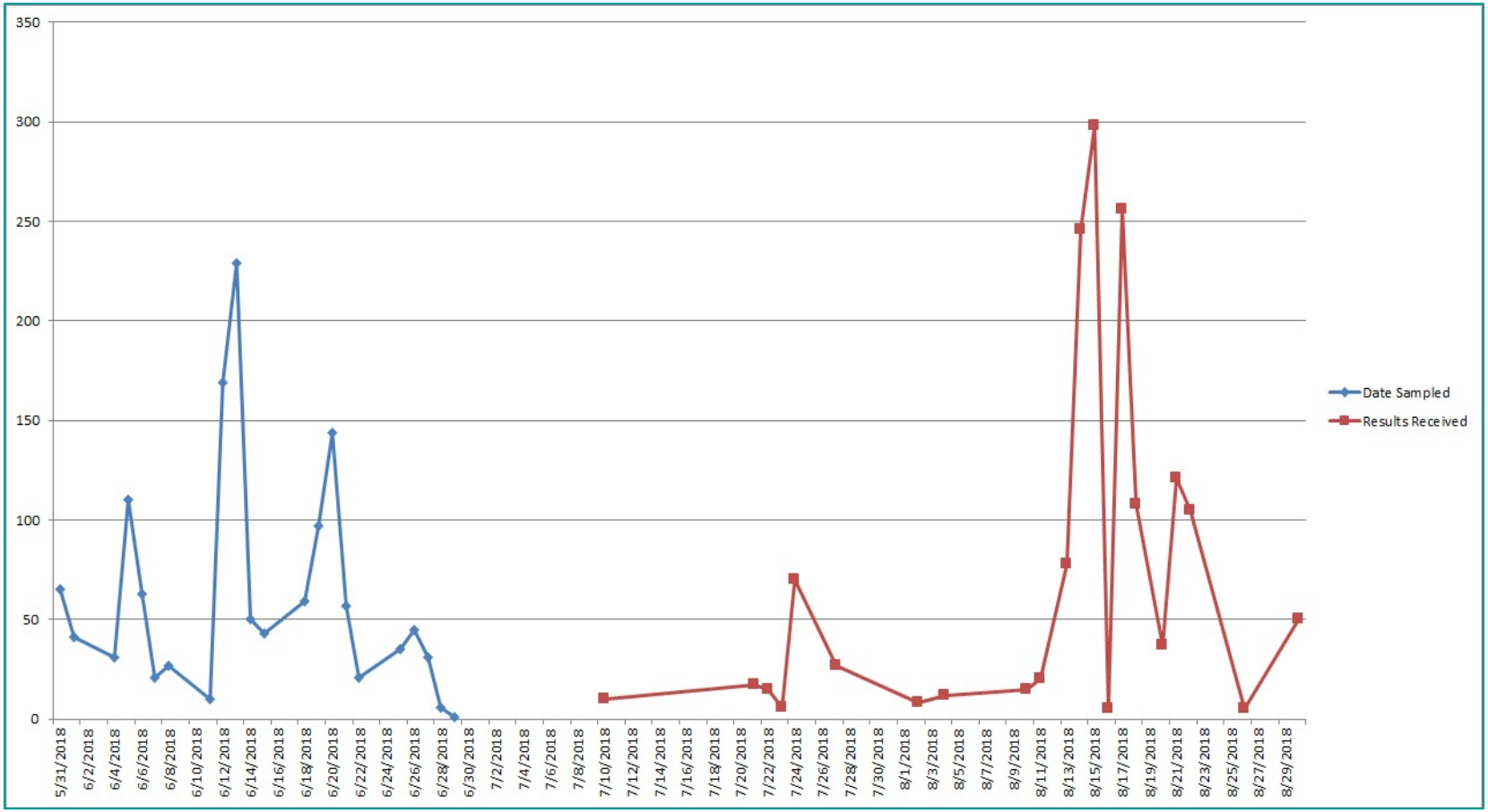
Communication to Stakeholders

- The issue of lead in drinking water was prolific at the time (Flint, Michigan).
- EPHS was required to ensure all tables of leadership were informed of the sampling program and follow up plan (AOTC, HCOM).
- Effective risk communication was (is) paramount.

Challenges

- Development and completion of pre-sampling surveys at all community facilities.
- Development of results management plan.
- Major delays with contracted laboratory. (Capacity issues, bottle shortage and reporting delays).
  - Causing a huge bottleneck/influx of results (graph).
- Completion of sampling by the end of summer timeline.
- Annex 5 did not address follow up sampling.

Challenges



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Challenges

- Communities approaching ISC, Regional Operations seeking funding.
- ISC, Regional Operations felt they were not well informed, despite regular communication which led to some frustrations.

Resource Demands

- All members of EPHS including EPHOs, data team, admin. team, summer students and management team were involved in completing this project comprehensively and within timeline.
- Upon completion, the approx. number of hours spent on the project were:
  - 441 on pre-sampling surveys;
  - 136 on sampling;
  - 37 on resampling;
  - 100 on reporting;
  - 509 on data management;
  - 111 on other activities;
  - 585 on travel;

Total: 1919 man-hours

Advice & Lessons

- Triaging/pre-sampling visits of facilities and sites to be sampled.
- Develop a rigorous data management plan.
  - Ensure good communication with lab service provider to avoid issues.
- Establish follow-up plan after initial sampling finds exceedances.
- Develop communications and action protocol for exceedances.

Advice & Lessons

- Remain engaged with stakeholders, including:
  - ISC, Regional Operations throughout the sampling project, especially regarding facilities or communities of concern.
  - Regional communications.
  - Regional Medical Health Officer on messaging.
- Follow-up directly with facilities and contacts where exceedances identified.
- Practice effective communication to manage perceptions of risk.

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Thank you!

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