**To:**  Mayor and Members  
Committee of the Whole  
Outstanding Business Item No. G and Issue: Lead in Water Supply  
BOH07049

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**Date:**  September 27, 2007  

**Re:**  Update on Lead in Tap Water in Hamilton (City Wide) BOH07049

**Council Direction:**  
At the June 11, 2007 COW, a motion was made that the Medical Officer of Health be directed to clearly outline to Council the health risks to residents as they relate to measured levels of lead in drinking water.

**Information:**  
This report will review;  
1. Sources of and health effects of lead.  
2. Lead water service line sample results in Hamilton.  
3. Information regarding schools and daycare facilities.  
4. PHS next steps

**1. Sources & Health Effects of Lead**  
**Lead Sources**  
Lead is a metal found throughout the environment in combination with other minerals. It is known to be harmful to human health if inhaled or ingested. Lead exposure typically comes from food, air, soil, dust, industrial emissions and drinking water. Food can be contaminated by naturally occurring lead in soil as well as by lead from sources such as atmospheric fallout, water used for cooking, or the use of lead-soldered cans. In young children, it can come from eating dirt and dust from the environment.  

In the last sixty years, the largest sources of lead exposures, particularly for children, were lead-based paint and leaded gasoline, resulting in their removal from the marketplace. Efforts to further reduce exposures continued with regulations to limit the lead content of solder used in plumbing and that of brass plumbing fixtures.
Table 1 shows the contribution of lead from all sources for both children and adults in urban areas, as outlined in the Guidelines for Canadian Drinking Water Quality. Young children are particularly vulnerable to exposure to lead in dirt and dust. Lead dust tends to accumulate at floor level where young children spend a lot of their time crawling and playing.

**Table 1. Sources of lead for urban Canadian children & adults**

<table>
<thead>
<tr>
<th>Medium</th>
<th>Concentration</th>
<th>Child (two yrs old, 13.6 kg)</th>
<th>Adult (70kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Uptake (%)</td>
<td>Uptake (%)</td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>0.06 µg/m³</td>
<td>0.14 (1.1)</td>
<td>0.48 (7.1)</td>
</tr>
<tr>
<td>Water</td>
<td>4.8 µg/L</td>
<td>1.45 (11.6)</td>
<td>0.72 (10.7)</td>
</tr>
<tr>
<td>Food</td>
<td>Various</td>
<td>7.5 (60.2)</td>
<td>5.25 (78.0)</td>
</tr>
<tr>
<td>Dust, Dirt</td>
<td>140 µg/g</td>
<td>3.36 (27.0)</td>
<td>0.28 (4.2)</td>
</tr>
<tr>
<td>Total</td>
<td>12.5 ug/d</td>
<td>6.7 ug/d</td>
<td></td>
</tr>
</tbody>
</table>

**Effects of Lead Exposure**

The main target for lead toxicity is the nervous system in both adults and children. While rarely seen in Ontario, short-term, acute exposure to very high levels of lead can cause vomiting, diarrhea, convulsions, coma or even death.

Long-term, chronic exposure of adults to lead at work has resulted in decreased performance in some tests that measure functions of the nervous system. Lead can also interfere with the blood system and disturb processes essential to vitamin D and calcium metabolism. Chronic lead exposure may cause small increases in blood pressure and mild effects on the kidney, particularly in middle-age and older people. Additional health impairments associated with chronic high lead exposure in the workplace involve reproductive, musculoskeletal, endocrine, other cardiovascular, gastrointestinal, and immunologic outcomes.

In young children, research to date has shown that subtle effects can occur even at low blood lead levels, resulting in the statement that there is no safe level of exposure. Young children are still developing, are more sensitive to the health effects of lead, and have higher rates of exposure, uptake, and absorption of lead than adults. Even in very small amounts, lead can harm the developing brain and nervous system of fetuses and young children, and in the long-term may increase the risk of subtle effects on cognitive development, behaviour, growth, and sexual maturation of children.

Because of these risks, there is no safe level of lead exposure for pregnant women, and therefore pregnant women also need to reduce their exposure to lead. Lead has the ability to cross the placenta and harm a developing fetus. Fetuses exposed to lead in the womb may be born prematurely and have lower weights at birth. Lead can also be released into breast milk, however studies have demonstrated that even among populations of women with relatively high lifetime exposure to lead, levels of lead in
breast milk are low\(^1\) and there is no evidence that high maternal breast milk lead concentrations are a major public health concern\(^2\).

While it is generally agreed that it is best to reduce all lead exposures as much as possible, the risk of suffering adverse health effects from lead exposure does decline as exposure declines. The WHO has published a tolerable daily intake (TDI) for lead of 3.5 ug/kg body weight per day. Similarly the Maximum Allowable Concentration of lead in drinking water in Ontario has been established as a threshold level, rather than a toxic level.

**Lead & Drinking Water**

Any lead which may be present at the tap can come from three sources: lead pipes or connections (including service connections to buildings and homes); lead-containing solder; or brass materials such as valves, fittings and fixtures.

Lead pipe service connections were used to deliver water to buildings and homes from the distribution pipes from the late 1800s until 1950\(^3\). Buildings and homes built between the mid-1950s and 1989 may contain lead in some fixtures or solder used to connect pipes. Buildings and homes built after 1989 are unlikely to have any lead in pipes, service lines, solder or joints. The amount of lead dissolved into the water from any of these sources depends upon several factors, including the acidity (pH), water softness, and standing time of the water, with soft, acidic water dissolving the most lead.

The current Maximum Allowable Concentration for lead in drinking water in Ontario is 0.010 mg/L. This is established to assist in minimizing exposures to lead, particularly for high risk groups: children under the age of 6 years and pregnant women. The literature does show that consumption by the non-high risk population of average amounts of drinking water having a lead concentration less than 0.030 mg/L are unlikely to cause an exceedance of the Tolerable Daily Intake for lead from all sources. Even among young children, drinking water with lead concentrations in this range will not exceed the TDI (see Appendix 2).

The Public Health advice to occupants of buildings that are connected to the municipal water distribution system via lead water service lines remains the same, including the following key points:

- Run the water from the drinking water tap if it has been sitting in the pipes for 6 hours or more.

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• Use cold, flushed water for drinking and preparing food.
• Boiling the tap water will not remove lead.
• Children under the age of six years or pregnant women should consider alternate sources of drinking water or use an approved filter attached to the tap.

More detailed advice has been provided directly to those who have been found on Public Works' testing to have high lead levels, and can be found on the Public Health Services website.

2. Hamilton’s lead water service line sample results
Table 2 provides a summary of lab results for water samples collected between May 1st and August 24, 2007 by Public Works staff from private plumbing connected via a lead water service line to the Woodward Water Treatment Plant water distribution system. These results are broken down by ward in Table 3 and a map is included in Appendix 1.

<table>
<thead>
<tr>
<th>Lead Concentration (ug/L)</th>
<th># Homes</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.001 - 0.010</td>
<td>198</td>
<td>68.3</td>
</tr>
<tr>
<td>0.011 – 0.030</td>
<td>81</td>
<td>27.9</td>
</tr>
<tr>
<td>&gt;0.30</td>
<td>11</td>
<td>3.8</td>
</tr>
<tr>
<td>TOTAL</td>
<td>290</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Ward</th>
<th># Samples</th>
<th>&gt; MAC</th>
<th>% &gt;MAC</th>
<th>&gt;30 ug/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>74</td>
<td>31</td>
<td>42</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>31</td>
<td>12</td>
<td>39</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>65</td>
<td>21</td>
<td>32</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>49</td>
<td>19</td>
<td>39</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>1</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>14</td>
<td>2</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>37</td>
<td>6</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTALS</td>
<td>290</td>
<td>92</td>
<td>32%</td>
<td>11</td>
</tr>
</tbody>
</table>

Further details regarding the above results were distributed to the Board of Health and Council on August 30, 2007.

3. Testing in schools and daycare facilities
In June 2007, Regulation 243/07 under the Safe Drinking Water Act came into effect, requiring all schools and day nurseries to flush the tap water daily or weekly, and to test the tap water for lead annually. There are specific testing timelines in this regulation. Schools are to test the tap water for lead between June 15 and August 15 each year, and day nurseries are to test the tap water for lead between May 1 and October 31 each year. Directions on flushing procedures are limited to requiring a daily flush of a minimum of five minutes for all schools and daycare centres constructed before 1990. Day care centres constructed after 1990 are required to flush weekly.

The role of the Medical Officer of Health under Regulation 243/07 is described in Section 7, which states “If a [adverse] report is made under section 6, the operator of the school, private school or day nursery shall take such steps as are directed by the medical officer of health.” A protocol has been developed by PHS for any Hamilton school or day nursery with lead above the MAC. This protocol is based on guidance from the MOHLTC, the MOE, and local experience. If a post-flush water sample has a lead concentration above 0.010 mg/L, the school or daycare facility will be directed to provide an alternate drinking water supply and/or install tap/faucet mounted, or plumbed in filters that meet NSF Standards.

As of September 13, 2007 all schools under the Hamilton public, catholic, french public and french catholic school boards have been tested for lead. Eight schools had lead concentrations above the MAC detected in initial post-flush samples. After further flushing and resampling, all of these schools had lead concentrations <MAC. One school was directed by PHS to provide an alternate supply of drinking water for one day (the first day of school) as lab results for follow up samples were not available until after classes had resumed. PHS has directed these schools to resample and test the tap water once more in accordance with our new corrective action protocol.

As of September 18, 2007 the tap water at twenty-two of twenty-four Hamilton area private schools had either not been tested or the results have not been provided to PHS. Two private schools have tested for lead and are reported to be below the MAC. PHS has phoned and written each of these schools to inform them of the new testing and flushing regulations and to provide a copy of the regulation and corrective action protocol. PHS has also reported the lack of sampling at these twenty-two schools to the MOE for any enforcement action they deem necessary.

Presently PHS has not received any adverse lead results from any Hamilton daycare facilities. PHS staff have mailed information packages about the new regulation to all daycare centres, along with copies of our corrective action protocol.

4. Next Steps
The issue of lead exposures will require ongoing follow-up. PHS is currently taking the following actions:

1. Monitoring and providing advice regarding adverse lead concentrations in water samples from schools and daycare facilities.
2. Confirming the post flush lead concentration in tap water at all private locations connected to the municipal water supply with a lead service line and where lead was previously found to be above 0.010 mg/L.

3. Working with Public Works to educate occupants of buildings with lead service lines about what they need to do to ensure that the lead concentration in their tap water is reduced as much as possible.

4. Working with other public health agencies at the local, provincial and federal levels and with academic institutions to determine whether further study of lead exposure in Hamilton is warranted. A report with further advice will be brought to the Board of Health in the coming months.

Elizabeth Richardson, MD, MHSc, FRCP<br>Medical Officer of Health<br>Public Health Services
Lead Service Lab Results (May 1 - August 24, 2007)

Out of 293 total properties, seven properties (with concentrations <= 0.010 mg/L) are not shown on the adjacent map. Three of these could not be mapped due to insufficient address information, and four properties, whose addresses were located, lie outside the maps' boundaries. Of those four, one is in Mount Hope and the other three are in Waterdown.

Disclaimer: All information provided is believed to be accurate and reliable. We will make changes, updates and deletions as required and make every effort to ensure the accuracy and quality of the information provided. However, the City of Hamilton assumes no responsibility for any errors and are not liable for any damages of any kind resulting from the use of, or reliance on, the information contained herein.

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This is not a Plan of Survey.
Methodology to Define the Tiers (Level of Concern)

The expert panel recommends that the tier for which there should be continued access to water while undertaking a public health review should be 10 – 30 ug/L. The following calculations show that there is a reasonable margin of comfort with this level.

Approach 1

The World Health Organization provisional tolerable weekly intake for lead for children is 25 ug/kg body weight (bw), which is equivalent to an acceptable daily intake (ADI) of approximately 3.5 ug/kg bw per day. For a 13.6 kg child, the provisional daily intake allowed for a 2-year old is therefore 3.5 ug/kg bw x 13.6 kg= 47.6 ug/day. ¹

The Guidelines on Canadian Drinking Water Quality identify the lead intake from all sources (air, water, food, dust and dirt) by a two year old child as 29.5 ug/day. ²

The Guideline allocated the contribution of water to this daily intake as 2.9 ug based on the consumption of 0.6 litres. The difference between the WHO ADI and the Health Canada daily intake is 47.6 – 29.5 = 18.1 ug/day. If this difference is assigned to drinking water this allows a total of 21.0 ug/day (18.1 + 2.9 = 21.0) which is equivalent to drinking 0.6 L of water with 35 ug/L of lead.

Approach 2

The Guidelines on Canadian Drinking Water Quality allocates the contribution to food as 15 ug/day, which is 50.9% of intake. Lead in food has decreased significantly. Health Canada has recently posted average dietary lead intake of 0.492 ug/kg bw/day for 1 to 4 year olds which gives a daily contribution of lead from food of 6.7 ug/day (0.492 ug/kg bw/day x 13.6 kg).

This difference in lead intake through food (15.0 – 6.7= 8.3 ug/day) provides an additional level of comfort. If this is added to the calculation taken in Approach 1, then this would be equivalent to drinking 0.6L of water with 48.9 ug/L. (18.1 + 2.9 + 8.3 = 29.34 and 29.34/0.6=48.9)

Further support:

A recent re-evaluation by the WHO of the relationship between the provisional tolerable weekly intake (PTWI) of 25 ug/kg/week for lead and the associated blood lead level has been reduced from 5.7 ug/dL (WHO, 1993) ³ to the range 1.8 -3.6 ug/dL (WHO, 2000) ⁴. This is consistent with the blood lead concentration range currently observed (e.g., in Port Colborne in 2001).

http://www.who.int/water_sanitation_health/dwq/chemicals/lead.pdf

² Guidelines on Canadian Drinking Water Quality, 2003


