MAKING THE GRADE ON REDUCING LEAD IN NY’S PUBLIC SCHOOL DRINKING WATER

Strategic Guidance for The New York League of Conservation Voters Education Fund

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EXECUTIVE SUMMARY

The toxicity of lead and its health impacts are well documented. Lead can quickly build up in young bones, leading to cognition loss, reduced attention span, behavior alteration, dyslexia, attention deficit, hypertension, renal insufficiency, immunotoxicity and toxicity to the reproductive organs. As a result, the health-based standard for lead in drinking water is zero parts per billion (ppb). For most contaminants, the Environmental Protection Agency (EPA) sets an enforceable regulation called a maximum contaminant level (MCL). However, because lead contamination of drinking water often results from corrosion of the plumbing materials, the EPA established an action level to trigger treatment techniques to control corrosion rather than an MCL for lead. The EPA limit of 15 ppb, as set in the 1991 Lead and Copper Rule, is the action level to undertake said treatment techniques.

New York City, which is served by the Catskill, Delaware, and Croton watersheds, is known for having the highest quality drinking water source in the world. However, according to the EPA, lead can enter drinking water through lead pipes, faucets, fixtures or plumbing with lead solder. Acknowledging the risk of lead exposure that was experienced in Flint, Michigan and Newark, New Jersey, the New York State Legislature enacted a law in 2016 requiring all public schools to test their drinking water and remediate any outlets that had “elevated” levels of lead. Governor Andrew Cuomo signed this bill into law on September 6, 2016 and at the same time, the state Department of Health issued emergency regulations pursuant to the new legislation, requiring that school districts test their water for lead contamination by Oct. 31, 2016.

The statute did not specify the level of lead that would trigger remediation, leaving that decision to the New York State Department of Health (NYSDOH). NYSDOH chose to adopt the EPA’s action level of 15 ppb. In 2016, 400,000 outlets were tested in New York State’s 4,660 public school buildings and 12% of those outlets fell above the action level of 15 ppb. In New York City, 132,244 outlets were tested in the city’s 1,543 public school buildings, with 8% falling above the acceptable level. The next round of mandated testing of drinking water in New York’s public schools will take place in 2020.

The client, The New York League of Conservation Voters Education Fund (NYLCVEF), contends that the EPA action level of 15 ppb adopted by NYSDOH is outdated and needs to be lowered to a more protective limit. They assert that other countries and states follow a lower limit of 10 ppb or are moving to 5 ppb. NYLCVEF maintains that this more protective level is particularly important for drinking water in schools because those outlets expose young children to lead at ages when their bodies are still developing.

NYLCVEF’s mission is to educate New Yorkers, develop policy agendas, and advocate on various environmental issues — from transportation to public health. They were the driving force behind the 2016 New York law that mandated testing for lead in school drinking water.

1 Outlets include the following: bubblers, faucets, hose bibbs, ice makers, slop sinks, steamers and water bottle fillers.
Since then, NYLCVEF has compiled the results of NYSDOH’s testing of the 132,244 water outlets in New York City and is continuing to gather data from the rest of the state. The capstone team analyzed the New York City data as a case study, creating maps and graphs to support lowering the action level to 5 ppb. The client also asked the team for effective and informative forms of communication to support their educational campaign.

This report was written by a team of Columbia University students in the University’s Master of Science in Sustainability Management program. It details the capstone team’s methodology, findings, and recommendations, featuring policy research, data analysis, GIS maps, communications materials, and an outreach strategy for NYLCVEF to utilize to motivate stakeholders and encourage the state to lower the allowable level of lead in New York’s public school drinking water, by statute or by regulation.

Based on the raw data provided by the client, the team found that if the standard is lowered to 5 ppb from its current 15 ppb level, an estimated 11,239 additional outlets will need to be remediated at a cost of approximately $17,800,000. Through data visualization, the team created an interactive map that NYLCVEF can use to inform and motivate various stakeholders. The project also identified potential lead “hotspots” throughout the five boroughs – areas that will require a significant amount of remediation if the action level is lowered to 5 ppb.
BACKGROUND

I. Public Health Impacts of Lead

The impact of lead on children’s health is well documented. Children are especially susceptible to lead poisoning due to their small body size and still developing brains. They absorb 4 – 5 times more lead than adults from any given source. According to the World Health Organization (WHO), even low levels of lead exposure can have harmful impacts, including loss of cognition, shortening of the attention span, behavior alteration, dyslexia, attention deficit, hypertension, renal insufficiency, immunotoxicity and toxicity to the reproductive organs. High blood-lead levels can cause coma, seizures and even death.

Lead in public school drinking water is both a sustainability management and a public health issue. It relates directly to three Sustainable Development Goals (SDG): SDG 3, which focuses on promoting good health and wellbeing, SDG 6, which focuses on ensuring availability of clean water, and SDG 11, which focuses on making cities inclusive, safe, resilient and sustainable. Lead exposure via school drinking water threatens the health of children – thus, school facilities must manage and mitigate potential health risks to create and maintain environments that are conducive to learning and thriving.

II. How Lead Enters School Drinking Water

Children are exposed to lead from a variety of sources including paint, gasoline, consumer products and water. Despite substantial declines in levels of lead in children’s blood nationwide over the last 30 years, over 17,000 children in New York under the age of six (3% of those tested) had elevated blood-lead levels in 2016. Lead in school drinking water is of particular concern because children spend much of their time in school facilities, receiving most of their daily water intake from school fountains and sinks. Many elementary school children spend their entire day in a single classroom, drinking repeatedly from the same water outlet. New York’s water leaves the reservoirs uncontaminated but lead can enter school drinking water through corroding lead solder, pipes, and fixtures in drinking water outlets.

III. Background of Testing New York’s Public School Drinking Water

In 2016, Governor Andrew Cuomo enacted a law requiring public schools throughout New York State to test their drinking water outlets and replace any fixtures with elevated levels of lead. The Governor put aside funds to accomplish this goal. However, the statute did not specify the level of lead which would be considered elevated, leaving this decision to NYSDOH. NYSDOH set the action level at 15 ppb, following the EPA’s 1991 standard for public drinking water systems, detailed in the Lead and Copper Rule (LCR). While New York’s statute was a positive step towards combating lead poisoning through drinking water, the action level utilized by NYSDOH is still too high. The EPA and the Centers for Disease Control and Prevention (CDC) acknowledge that there is no safe level of lead exposure, especially for children. The medical community has asserted that the only safe level of lead in drinking water is 0 ppb.
more than 400,000 water outlets tested in New York State’s 4,660 public school buildings in 2016, 12% reported lead levels above the action level of 15 ppb. In New York City, 132,244 outlets were tested in the city’s 1,543 public school buildings, with 8% falling above the acceptable level. The majority of these outlets have since been remediated and the next round of mandated testing will take place in 2020.

IV. The Client

The New York League of Conservation Voters Education Fund (NYLCVEF) advocates on behalf of a range of environmental issues including transportation, public health, water, parks, climate change, and environmental justice. The organization uses various tactics to educate the public, candidates, and elected officials on sustainability issues and develops policy agendas that will guide New York State towards a more sustainable future. NYLCVEF was a driving force behind the Governor’s 2016 statute requiring testing of public school drinking water statewide.

V. Purpose

Despite NYLCVEF’s victory in pressuring New York State’s officials to mandate testing of public school drinking water in 2016, the organization asserts that the 15 ppb action level set by NYSDOH is based on an outdated standard set by the EPA in 1991. Recognizing that any level of lead in the blood is toxic, various countries (Figure 1) and a few states in the U.S (Figure 2) have already moved toward lower action levels. NYLCVEF tasked the capstone team to help make the case that New York’s regulation needs to be more protective of children’s health and communicate the impacts of lowering the action level to 5 ppb. The team was asked to research lead-in-water standards around the world, analyze and visualize data from the 132,444 water outlets in NYC’s public schools, organize the data in an effective and compelling way for various audiences, and produce a cost estimate of lowering the action level. NYLCVEF is acting now to educate officials and inform parents and the public about the issue before the next round of mandated testing takes place in 2020. The team began the task by asking the following questions: “What does the data say?” and “How can NYLCVEF effectively communicate this data to different audiences?”
CASE STUDIES FOR LOWERING THE LEAD ACTION LEVEL

New York State relies on an outdated EPA guideline from 1991, which set the action level for lead in drinking water at 15 ppb. Yet, many national and international organizations have set more protective levels. For example, the World Health Organization recommends no more than 10 ppb in drinking water while the American Academy of Pediatrics suggests one ppb. Although bottled water doesn’t pass through lead pipes, the Federal Food and Drug Administration (FDA) has set an allowable level of lead in bottled water at 5 ppb, indicating FDA’s stance on the safety of lead in water.

Many countries updated their lead standards after WHO suggested the level of 10 ppb in 1998. Table 1 depicts the countries that have adopted lead action levels lower than 15 ppb and the year these regulations were adopted.

Table 1. Countries and Jurisdictions with Action Level of 10 ppb or Lower and Year Adopted

<table>
<thead>
<tr>
<th>Country</th>
<th>Action Level (ppb)</th>
<th>Year Adopted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>5</td>
<td>2019</td>
</tr>
<tr>
<td>South Korea</td>
<td>10</td>
<td>2017</td>
</tr>
<tr>
<td>Nigeria</td>
<td>10</td>
<td>2015</td>
</tr>
<tr>
<td>European Union</td>
<td>10</td>
<td>2013</td>
</tr>
<tr>
<td>Israel</td>
<td>10</td>
<td>2013</td>
</tr>
<tr>
<td>India</td>
<td>10</td>
<td>2012</td>
</tr>
<tr>
<td>Australia</td>
<td>10</td>
<td>2011</td>
</tr>
<tr>
<td>Singapore</td>
<td>10</td>
<td>2008</td>
</tr>
<tr>
<td>China</td>
<td>10</td>
<td>2006</td>
</tr>
<tr>
<td>Japan</td>
<td>10</td>
<td>2003</td>
</tr>
<tr>
<td>Brazil</td>
<td>10</td>
<td>2002</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>10</td>
<td>2000</td>
</tr>
</tbody>
</table>
Within the U.S., two states and Washington D.C. have adopted action levels for lead in drinking water below 15 ppb:

- In 2018, Michigan set the statewide acceptable level of allowable lead in water at 12 ppb; this new action level will take effect in 2025.\(^{51}\)
- In 2017, Illinois adopted a maximum level of 5 ppb for schools and required schools to notify parents and guardians if any outlets test above this level.\(^{52}\)
- As of 2016, Washington D.C. requires remediation of any outlets testing above 1 ppb in the district’s public schools and parks and recreation centers.\(^{53}\)

Several states also have proposed legislation that would create stricter regulations for lead in school drinking water. For example:

- Massachusetts proposed a policy that would establish a 1 ppb standard for lead in school water outlets and requires that all outlets that exceed this level be immediately remediated.\(^{54}\) The Governor of Massachusetts has proposed up to $30 million in the FY20 budget to help schools with testing and remediation.\(^{55}\)
- Washington State has proposed a bill that would require schools to proactively install filters on all outlets and take any outlets over 5 ppb out of service.\(^{56}\)
- A bill introduced in Pennsylvania would require annual testing and remediation for any outlets over 5 ppb.\(^{57}\)
- In February 2019, the state senate of Vermont, which had originally sought to follow the American Academy of Pediatrics’ recommendation of 1 ppb, passed legislation to lower the acceptable level of lead in the state’s school and childcare
facility drinking water to 3 ppb; the bill requires replacement of any water fountains or sink outlets testing above this level.58

The team’s analysis shows that all of these states and Washington D.C. lowered their lead action levels after 2015 when high levels of lead in Flint, Michigan’s drinking water created national headlines and raised widespread awareness of the dangers of lead in drinking water. Vermont was likely incentivized to lower its action level after 2017 when a public-health crisis hit the national airwaves reporting that 480 children under the age of 6 were poisoned due to lead in Vermont’s public school drinking water.59 Almost all these situations share two commonalities. First, lowering the standard occurred through a top-down approach led by elected officials, a state senate or Department of Health (such as in Illinois).60 Second, the main motivator has been social pressure applied by parents and local organizations; this was particularly effective in Michigan. Similarly, in Washington D.C., the ordinance largely came from parents and lead-in-water activists, who spearheaded the push for this stricter regulation.61

Figure 2 illustrates the states that have lowered their acceptable level of lead in drinking water to below 15 ppb and states that have proposed legislation to lower the level.

Figure 2. States with Action Level Below 15 ppb
LEAD IN NEW YORK CITY’S PUBLIC SCHOOL DRINKING WATER

In response to the passage of New York State’s 2016 drinking water law, all schools were responsible for collecting samples and submitting them to laboratories approved by NYSDOH. Subsequently, all of the 132,244 outlets in New York City’s 1,543 schools were tested. NYLCVEF reviewed the publicly-available lab results and compiled the lead level data into a spreadsheet. The results revealed that 10,633 outlets tested above the threshold of 15 ppb.

New York City’s public schools have done great work to address the lead contamination. In fact, most outlets contaminated above 15 ppb have been repaired or removed from service.\(^6\) For our impact assessment the team assumed that 100 percent of those violations were repaired or removed from service. This new analysis for NYLCVEF is aimed at examining the extent, location and impact of contamination above the proposed threshold of 5 ppb and below 15 ppb.

I. A Citywide View

The team investigated the number of outlets in NYC that would need to be remediated if New York State adopted the more protective level of 5 ppb. This high-level review of the current action level and the proposed level demonstrated that lowering the action level of lead in school drinking water to 5 ppb would result in an additional 11,239 lead violations. Table 2 compares the number of outlets above the current 15 ppb action level and the proposed 5 ppb level. The team found that overall, an additional 8.4% of outlets would need to be remediated if the action level was lowered to 5 ppb.

<table>
<thead>
<tr>
<th>Table 2. New York City Public School Water Lead Contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lead Concentration above 15 ppb (current action level)</strong></td>
</tr>
<tr>
<td>Number of Outlets</td>
</tr>
<tr>
<td>Citywide Percentage</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

II. The View by Borough

In order to develop a targeted campaign that allows NYLCVEF to prepare stakeholders for the impact of the proposed regulation, the team also analyzed the data on a more granular level. The team examined how the 11,239 new outlets were distributed by borough (Table 3).
Table 3. Lead Contamination in NYC Public School Drinking Water Broken Down by Borough

<table>
<thead>
<tr>
<th>Borough</th>
<th>Number of School Buildings</th>
<th>Number of Outlets Tested</th>
<th>Number of Outlets Above Current Action Level (15 ppb)</th>
<th>Number of Outlets between 5 – 15 ppb</th>
<th>Percent of Outlets between 5 – 15 ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manhattan</td>
<td>234</td>
<td>22,878</td>
<td>1,510</td>
<td>1,740</td>
<td>7.6%</td>
</tr>
<tr>
<td>Bronx</td>
<td>333</td>
<td>25,035</td>
<td>1,759</td>
<td>1,812</td>
<td>7.2%</td>
</tr>
<tr>
<td>Brooklyn</td>
<td>470</td>
<td>40,817</td>
<td>4,151</td>
<td>3,877</td>
<td>9.4%</td>
</tr>
<tr>
<td>Queens</td>
<td>408</td>
<td>35,194</td>
<td>2,486</td>
<td>2,911</td>
<td>8.2%</td>
</tr>
<tr>
<td>Staten Island</td>
<td>98</td>
<td>8,320</td>
<td>727</td>
<td>899</td>
<td>10.8%</td>
</tr>
</tbody>
</table>

Table 3 shows that on a percentage basis, the distribution of outlets needing replacement if the action level for lead in school drinking water was lowered to 5 ppb is fairly even, ranging from 7.2% in the Bronx to 10.8% in Staten Island. On a whole number basis, however, Brooklyn will have to replace the most outlets (40,817) while Staten Island will have to replace the fewest (8,320). Manhattan, the Bronx, Queens and Staten Island would be responsible for fixing more contaminated outlets than they fixed after the 2016 round of testing. NYLCVEF can use these borough-wide statistics to target parties that manage policy at the borough level.

III. The View by School District

Each school in NYC belongs to one of 32 school districts. In order to visualize the data, look for patterns, and present results in an understandable way at a district level, the team imported NYSDOH testing data into ArcMap GIS software and grouped it by school district. Figure 3 presents the data as a district-by-district map ranging from District 1 in Manhattan to District 32 in Brooklyn. The darker shades of green indicate a higher number of outlets that would need to be remediated in each district if the acceptable level of lead was lowered to 5 ppb. This map allows important players in each district to quickly visualize and understand the level of remediation that will be required under the new proposal. This map can be used to inform and motivate the city council members that represent the various school districts, the superintendents that oversee these districts, as well as other community level groups such as District Leadership Teams (DLTs) whose members may control the operations and/or financials for the project.
Figure 3. Number of Outlets that Would Require Remediation Under a 5 ppb Action Level: School-District Level

Figure 3 reveals that District 2 in Manhattan would need to remediate between 501 and 899 outlets, a significant amount, while District 7 would only have to remediate between 110 and 200. This map also suggests that District 31 has a large number of outlets to replace. However, this district also represents the entire borough of Staten Island. There are 98 school buildings on Staten Island on 58 square miles of land. In contrast, there are 87 school buildings in District 2 and this district is about a third of the size of District 31.

Looking at whole numbers does not tell the entire story. To better understand the financial burden of lowering the proposed threshold of lead in drinking water for each school district, we then visualized the outlets that would fall above the 5 ppb action level as a percentage of the total number of outlets tested. In Figure 4, the darker shades of purple denote a higher percentage of outlets that would need to be remediated under the threshold of 5 ppb. Under this analysis, District 2 in Manhattan would only have to replace 8% to 9% of its outlets while Staten Island would have to replace 10% to 12%. Some takeaways from this map are that all throughout the city there is contamination that should be addressed. The range of percentages is in line with the citywide percentage (Table 2) but it does expose areas that are significantly higher and should be looked at closely. The percentage data is most useful when paired with the number of schools in a district. The relative impact is a function of the percentage and number of schools in the district.
IV. The View at a School Building Level

New York City’s school districts vary widely in size and number of school buildings. For example, District 31 covers all of Staten Island and has 98 schools, while District 7 has only 35 schools. To account for this variability, the team took the total number of outlets that would need to be remediated in each district and divided it by the number of school buildings in each district to find the average number of outlets in each building that would require fixing.

Figure 5 illustrates the average number of outlets per building that would need fixing in the borough of Manhattan, broken down by school district. The average building in District 1 will need to remediate just 5.2 outlets under the proposed action level while District 4 will have to remediate 10 outlets. This chart also allows districts to compare their exposure: Manhattan, at 6.9 fixtures per building, is doing better than the average citywide at 7.3 fixtures per building.
First, we aggregated the number of outlets between 5 – 15 ppb per each school district and calculated the average number of outlets that would need to be remediated in each school district. **Figure 6** shows a map of school districts citywide: the darker the shade of blue, the higher the average number of outlets to be remediated per school district.
Figure 6. Average Number of Outlets between 5 – 15 ppb per School District
Table 4, below, collects the districts with a high average number of outlets that would need remediation into a chart for easy viewing.

<table>
<thead>
<tr>
<th>Borough and District</th>
<th>Number of Schools</th>
<th>Number of Outlets 5–15 ppb</th>
<th>Average Number of Outlets per School 5–15 ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brooklyn D18</td>
<td>28</td>
<td>329</td>
<td>11.8</td>
</tr>
<tr>
<td>Brooklyn D14</td>
<td>32</td>
<td>353</td>
<td>11.0</td>
</tr>
<tr>
<td>Brooklyn D21</td>
<td>48</td>
<td>500</td>
<td>10.4</td>
</tr>
<tr>
<td>Brooklyn D17</td>
<td>43</td>
<td>430</td>
<td>10</td>
</tr>
<tr>
<td>Manhattan D4</td>
<td>22</td>
<td>222</td>
<td>10</td>
</tr>
<tr>
<td>Staten Island D31</td>
<td>98</td>
<td>899</td>
<td>9.1</td>
</tr>
<tr>
<td>Queens D26</td>
<td>46</td>
<td>419</td>
<td>9.1</td>
</tr>
</tbody>
</table>

The data have been presented in the following views: citywide, by borough, by school district, and by average number of affected outlets per building in a district. Next, the team visualized the data on the most granular level: by each specific school. At this level, the impact of a few highly contaminated schools on district averages is eliminated. This visualization also exposes clusters of schools with relatively low and relatively high contamination rates. The team utilized geographical coordinates to place each data point on a base map of New York City and produce maps of school location in each borough (Figure 7 & Appendix A). Each dot represents a school that was tested. The larger the size and the darker the color of each dot, the higher the number of contaminated outlets in that particular school. This visualization is the most direct tool for targeting parents, principals, and immediate community stakeholders near a school of interest.
Figure 7 reveals locations with clusters of outlets between 5 – 15 ppb. There are dense clusters in the south Bronx, northeastern Manhattan (Harlem), southeastern Manhattan (Lower East Side) and central Brooklyn. Mapping the individual schools narrows the “hotspots” in each district down to a few buildings. For example, figure 8 shows the contamination issues in district 31 (the borough of Staten Island). Just three highly contaminated schools, P.S.4, Jerome Parker Campus, and Tottenville High School, account for 15% of the contaminated outlets in the borough.
The top ten schools with the highest number of outlets that will need to be remediated if the threshold is reduced to 5 ppb are listed in Table 5, below.

Table 5. Top Ten Schools with Highest Number of Outlets That Will Need to Be Remediated Under a 5 ppb Action Level

<table>
<thead>
<tr>
<th>School Name</th>
<th>Address</th>
<th>Borough</th>
<th>Outlets Tested</th>
<th>Number of Outlets 5 – 15 ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDWARD R. MURROW HS</td>
<td>1600 Avenue L</td>
<td>Brooklyn</td>
<td>351</td>
<td>70</td>
</tr>
<tr>
<td>WILLIAM E. GRADY VOC HS</td>
<td>25 Brighton 4th Rd</td>
<td>Brooklyn</td>
<td>359</td>
<td>54</td>
</tr>
<tr>
<td>AUTOMOTIVE TRADES HS</td>
<td>50 Bedford Ave</td>
<td>Brooklyn</td>
<td>144</td>
<td>51</td>
</tr>
<tr>
<td>PROSPECT HEIGHTS HS</td>
<td>883 Classon Ave</td>
<td>Brooklyn</td>
<td>242</td>
<td>50</td>
</tr>
<tr>
<td>PARK WEST HS</td>
<td>525 West 50th St.</td>
<td>Manhattan</td>
<td>266</td>
<td>46</td>
</tr>
<tr>
<td>JEROME PARKER CAMPUS</td>
<td>100 Essex Drive</td>
<td>Staten Island</td>
<td>274</td>
<td>45</td>
</tr>
<tr>
<td>TOTTENVILLE HS</td>
<td>100 Luten Avenue</td>
<td>Staten Island</td>
<td>219</td>
<td>43</td>
</tr>
<tr>
<td>CLARA BARTON HS</td>
<td>901 Classon Ave</td>
<td>Brooklyn</td>
<td>202</td>
<td>40</td>
</tr>
<tr>
<td>FASHION INDUSTRIES HS</td>
<td>225 West 24 St.</td>
<td>Manhattan</td>
<td>266</td>
<td>40</td>
</tr>
<tr>
<td>P.S. 4 - STATEN ISLAND</td>
<td>200 Nedra Lane</td>
<td>Staten Island</td>
<td>167</td>
<td>40</td>
</tr>
</tbody>
</table>
Figure 9, below, is a heat map that emphasizes these clusters in an understandable way. Heat maps highlight areas of increased activity by location using color. Groups of schools with a high number of outlets between 5 – 15 ppb create red clusters. Areas with the highest concentration of schools with a high number of outlets to be remediated are shown in yellow. The heat map confirms that there are certain hotspots within districts and sheds light on specific locations that will require high levels of remediation under the proposed threshold.

Figure 9. Locations with Clusters of Schools with Outlets between 5 – 15 ppb

Examining lead levels at the individual school levels allows NYLCVEF to make compelling cases for lowering the lead in school drinking water to school board members, parents, teachers and children.

V. External Data and Overlays

External demographic data for New York City public schools were obtained from the NYC Open Data database. These data match the levels of analysis the team examined for the lead testing data: citywide, borough wide, districtwide, and by individual school. The
demographic data include breakdowns of enrollment by gender, race, students with disabilities, poverty and economic need index. Since the demographic data from NYC Open Data share the same common school district code attribute, it can be matched with the lead testing data and visualized simultaneously. For example, the NYLCVEF school district results can be overlaid with demographic variables. This option allows NYCLVEF to further target messages to specific communities. While the data do not prove causation between high lead levels in the drinking water at school and public health issues, they can be packaged together to express nuanced views. For example, a key demographic for lead-related issues is the age of the students. Children under six-years-old are most vulnerable to lead poisoning. In Figure 10, the blood-lead-levels of children six-years-old and younger are mapped alongside individual school lead-testing results. The darker the shade of blue on the base map, the higher the blood lead levels in children living in that community. The larger and darker the circles, the higher the number of contaminated outlets in a specific school.

Figure 10. School Drinking Water Lead-Testing Results and Blood-Lead-Levels of Children Six Years Old and Under

In order to effectively communicate all of this data, the team created an interactive online tool for the public to utilize. The geocoded lead test results, demographic variables, and boundary shapefiles were uploaded into an ArcGIS Online mapping tool to allow for an easy and comprehensive way for the public to visualize what is happening in their borough, their district
and their school. An ArcGIS story map was created which combines maps, narrative text, graphs, and multimedia content to visualize a compelling story for NYLCVEF to make a case for lowering the acceptable level of lead in New York City’s public school drinking water to 5 ppb. A story map allows users to click on the map which depicts individual schools and see more detail about lead level test results there. The story map also depicts interactive maps by school district. It can be accessed here: https://arcg.is/WHDGe
I. Methodology

In order to determine the financial cost of lowering the action level to 5 ppb, the team extracted the number of faucets and bubblers with lead levels between 5 – 15 ppb in New York City’s public schools and multiplied both amounts by the average remediation cost for each type of fixture, based on cost information for the years 2015, 2016 and 2017 provided by NYLCVEF. This data was initially gathered from the New York State Department of Education.

- **Number of Outlets.** There are 8,906 faucets and 1,848 bubblers with lead levels between 5 – 15 ppb. Faucets and bubblers together accounted for about 95% of outlets with lead levels between 5 – 15 ppb. The remaining 5% of outlets are left out of this calculation due to a lack of cost information.
- **Average Costs.** The average remediation cost is $1,688 for faucets and $1,505 for bubblers.
- **Calculation.** 8,906 faucets at an average cost of $1,688 and 1,848 bubblers at an average cost of $1,505 yields a total cost of USD 17.8 million.
- **Result.** Lowering the action level to 5 ppb will result in an estimated remediation cost of USD 17.8 million for New York City’s public schools.

<table>
<thead>
<tr>
<th>Outlet Type</th>
<th>Number of Outlets between 5 – 15 ppb</th>
<th>Average Cost</th>
<th>Estimated Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faucets</td>
<td>8,906</td>
<td>$1,688</td>
<td>$15,035,763</td>
</tr>
<tr>
<td>Bubblers</td>
<td>1,848</td>
<td>$1,505</td>
<td>$2,781,364</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
<td><strong>$17,817,127</strong></td>
</tr>
</tbody>
</table>

- **Disclaimer.** Faucets and bubblers together accounted for 95% of outlets with lead levels between 5 – 15 ppb. There was no cost data for other outlet types (5%). Therefore, the estimated costs represent 95% of outlets that will need to be remediated. This estimation is not meant to be a formal or official budgetary value. Further calculations will be required.
- **Note:** Please see the Economic Impact Analysis Appendix that includes the specific details of the calculations that were used to develop this estimation.
COMMUNICATIONS RESEARCH & FINDINGS

NYLCVEF tasked the team with developing a communications strategy and action plan directed at three distinct audiences:

- Technical (i.e. health department, facilities managers)
- Non-technical (i.e. school leadership, parent-teacher organizations, elected officials)
- Media (i.e. print and social media)

I. Outreach Case Study Review

In order to determine best practices and approaches to these goals, the team examined five successful environmental and/or public health campaigns (plastic straws, plastic bags, clean heat, tobacco control, electric buses) and six successful lead abatement campaigns (Wipe Out Lead, Nationwide Lead Poisoning Prevention Campaign, “Test and Treat” in Minnesota schools, NYC Lead Outreach Campaign, LeadFreeNYC, and Lead-safe Milwaukee). Based on this research, the team identified five key outreach strategies, which can be seen in Table 7 below.

Table 7. Communications Best Practices Matrix

<table>
<thead>
<tr>
<th>KEY STRATEGY</th>
<th>Improves Awareness</th>
<th>Builds Your Coalition</th>
<th>Creates Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Knowledge</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Go Local</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Target Primary Stakeholders</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Simple Communications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategic Partnerships</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A. Increase Public Knowledge and Awareness

All previous successful case studies offered significant opportunity for public outreach. These included printed media (flyers, fact sheets), TV/radio spots, digital ads, public forums, and meetings. NYLCVEF relies heavily on public and partner forums to educate key stakeholders and influence change. For example, their Clean Buses for Healthy Niños campaign kicked off with a town hall which included a diverse panel of speakers. Recently, social media has become an additional tool for creating awareness among target populations. The Wildlife Conservation Society’s “Give a Sip” campaign created digital cards for concerned citizens to send to the New York City Council and pre-fabricated social postings for them to share on Facebook and Twitter saying that they support banning plastic straws.

B. Go Local (and Don’t Rule Out Traditional Forms of Media)

Several initiatives targeted the intended audiences through local placement of media. For example, the “Wipe Out Lead” campaign in Buffalo, NY placed billboards in neighborhoods...
where high lead levels were found in homes. The NYC Lead Outreach Campaign “targeted individuals in their communities where childhood lead poison prevention is most crucial.” Members showed up at health fairs, schools, and meetings for community organizations and tenant/landlord groups. LeadFreeNYC placed its communications on bus shelters, in salons, and convenience stores in neighborhoods where rates of testing needed to be increased.

C. Target Your Primary Stakeholders

Parents are the primary audience for these types of campaigns because of their inherent concern for the well-being of their children. Once they become aware of the dangers of lead on childhood development, they act.

D. Keep Communications Simple

Regardless of the intended audience, successful campaigns kept messaging and visuals simple and clear. The Lead-safe Milwaukee initiative utilized a cheerful infographic to show that there are three easy ways to keep children safe from lead poisoning. Visual materials should contain eye-catching, emotionally-charged images and grabby headlines. For example, the “Wipe Out Lead” campaign featured billboards with the phrase “Is your baby sucking on poisonous lead?” Almost all campaigns included websites to visit or phone numbers to call in order to find deeper information or get involved.

E. Form Effective Strategic Partnerships

The most successful campaigns partner with a wide variety of organizations from government to not-for-profits and private industry. The National Ad council partnered with the Coalition to End Childhood Lead Poisoning, the EPA, and HUD to create its public service announcement for the Nationwide Lead Poisoning Prevention Campaign. The “Test and Treat” lead campaign in Minnesota schools partnered with a technology company, Great Water Tech that provided a breakthrough product for inhibiting corrosion in pipe systems.

II. Implementation Strategy

A. Strategic Partnerships for Broad Outreach

Based on the findings listed above, the team researched the potential for creating strategic partnerships with groups, organizations, and government agencies that could help NYLCVEF educate stakeholders, apply political leverage, or amplify its messaging. Since NYLCVEF already works with New York’s “leading environmental, public health, conservation, energy, environmental justice and transportation organizations,” the team began by identifying the primary stakeholders for this project.

B. Primary Stakeholders

- Children who attend the schools with elevated outlets
• Parents of those children
• Teachers who must deal with the learning and attention issues caused by lead poisoning
• School staff, especially pregnant women
• New York State (and/or City) Department of Education

C. Secondary Stakeholders
• New York State Parent Teacher Association. “A strong advocate for the education and well-being of every child,” the PTA provides conferences, workshops, publications and resource materials on many issues.⁸⁹
• New York City School Construction Authority. Its mission is “to design and construct safe, attractive and environmentally sound public schools...throughout the many communities of New York City.”⁹⁰ NYCSCA also “modernize[s] schools in a responsible, cost-effective manner while achieving the highest standards of excellence in safety, quality and integrity.”⁹¹ NYCSCA handles environmental remediation and “potable water quality testing and remediation.”⁹²
• Real estate agents who understand that healthy schools keep local housing prices up.

D. Suggested Partners
The team also researched not-for-profit organizations and groups with experience in the areas of clean water and/or environmental impact on children’s health. It quickly became clear that, in this particular case, the health implications of lead in school drinking water is a more compelling story than simply advocating for clean water. The team identified four partners with expertise on lead’s impact on children’s health who can help drive that story through public engagement and motivate government officials.
• The Children’s Environmental Health Network (CEHN), based in Washington DC, “protect[s] the developing child from environmental health hazards and promote[s] a healthier environment.”⁹³ CEHN focuses research and advocacy on removing lead from drinking fountains and outlets in childcare centers and offers a downloadable PDF on “Lead in Tap Water.”⁹⁴
• The Children’s Environmental Literacy Foundation (CELF), which is part of Green Schools National Network, uses workshops, summer institutes, and a student Ambassador Program to teach children, educators, and citizens how to advocate for themselves using “a methodology that develops [the] critical thinking skills necessary to understand and take action on complex, interconnected issues...preparing students...to become agents of change.”⁹⁵
• National Resources Defense Council (NRDC) “works to safeguard the earth—its people, its plants and animals, and the natural systems on which all life depends.”⁹⁶ NRDC is a well-known advocacy group working on large issues and a powerful partner for influencing change.
Healthy Schools Network is a national organization that works to promote healthy school environments and is especially well-suited for a strategic partnership because of its New York Program. Recent campaigns include “Healthy and High Performance School Design” and “Green Cleaning and Healthy Products.”

E. Suggested Actions
Using these partnerships and NYLCVEF’s advocacy history, the team suggests the following actions:

- Host a forum or town hall with representatives from the partners mentioned above plus a knowledgeable pediatrician to talk about the dangers of lead exposure in children and how school water contributes. Discussion will also make clear that while initial remediation was done well by all involved, the state needs to go further, and lower the levels to more modern and more protective standards. Audience members could include everyone from parents and teachers to city council members, health department officials, and school board members. The forum could be headed by Mayor Bill de Blasio who, post recent lead-inspection scandal, just came out with a plan to “eliminate childhood lead exposure” by 2029.

- Create a signature NYLCVEF “Citizen Toolkit” with “Green tips” about the dangers of lead in water and what you need to do to protect your child and yourself. Design an educational pre-made social media posting about how the EPA’s level of lead in water is outdated and why it needs to be lowered (Appendix C). Create “Tap into Your Kid’s Health” (Appendix C) – a signature campaign card that concerned citizens can send to their council people to pressure them to act.

- Ask a concerned councilperson to write an op-ed in a local paper.

F. Talking Points
For each of the three audiences (Technical, Non-technical, and Media), the team developed talking points for best communicating the issues and desired actions.

1. Technical (i.e. health department, facilities managers)
   i. Emphasize the known impacts of lead poisoning
   ii. Reference scientific and health practitioner consensus that there is no safe level of lead, especially for children
   iii. Communicate countries and states that have lowered action levels – clearly, these countries and states see a need for a lower action level to protect public health
   iv. Convey the fact that children absorb 4 – 5 times as much ingested lead as adults from any given source, and therefore we must work to reduce potential lead exposure for children
   v. Show that data links even low lead levels with long-term loss of learning in children (See Figure 10 below)
2. Non-technical (i.e. school leadership, parent-teacher organizations, elected officials)
   a. Elected Officials
      i. Speak in terms of school districts/community districts
      ii. Focus on the need for more protective legislation, but always speak positively about current actions that have been done
      iii. Emphasize that healthy schools help develop healthy children, and therefore healthier and more sustainable communities
      iv. Mention that children affected by lead poisoning can exhibit increased anxiety and stress and run up healthcare costs
      v. Speak about economic costs
      vi. Maps to show: number of outlets to be remediated by borough or district, specific school buildings affected
   b. Parents/School leadership
      i. Emphasize the impacts of lead on young children’s development
      ii. Highlight the need for action in schools because of the amount of time children spend there
      iii. Focus on the need to reduce allowable lead levels since no amount of lead exposure is safe
      iv. Discuss the current number of outlets that are at a concerning level
      v. Educate about who will be able to make this change happen and how to influence them
3. Media (i.e. print and social media)
   i. Highlight past actions in a positive light and call for more protective actions
ii. Speak about the health impact on children
iii. Connect lead in water to the issue of lead in homes and other news about lead and health
iv. Connect this issue to sustainability and healthy living
v. Mention the states and countries that have adopted more protective action levels
vii. Maps to show: National/International maps, maps with outlets by school district
CONCLUSION

The toxicity of lead and its health impacts are of great concern. School drinking water is of particular concern because children spend much of the day drinking from school water fountains and sinks and are especially susceptible to the impacts of lead poisoning. The client, The New York League of Conservation Voters Education Fund (NYLCVEF), contends that while New York made a positive step by requiring testing of public school drinking outlets and remediation of outlets with lead levels above 15 ppb, the 15 ppb level is outdated and needs to be lowered to 5 ppb in order to be more protective of children’s health. The capstone team researched lead-in-water regulations throughout the US and around the world, analyzed the New York City data as a case study for the state, created maps and graphs to help visualize the impacts of lowering the level, and developed a communications strategy to support the client’s campaign. Based on the raw data provided by the client, the team found that if the standard is lowered to 5 ppb from its current 15 ppb level, an estimated 11,239 additional outlets will need to be remediated at a cost of approximately $17.8 million. Through data visualization, the team created an interactive story map that NYLCVEF can use to inform and motivate various stakeholders. Lead in school drinking water is an important issue that needs the attention of parents, elected officials, activists and the media. Through the results, outputs and recommendations of this analysis, NYLCVEF will be able to move forward with a campaign for better protecting children’s health.
APPENDICES

APPENDIX A: Additional Maps

Number of Outlets between 5 – 15 ppb in New York City Public School Buildings, Broken Down by borough

Manhattan
Bronx
APPENDIX B: Economic Impact Analysis

Estimated Cost of Lowering the Action Level to 5 ppb for NYC’s Public Schools

I. General Methodology
   The capstone team calculated the following data:
   A. **Number** of faucets and bubblers with lead levels between 5 – 15 ppb in NYC’s public schools.
   B. **Average remediation costs** of faucets and bubblers in NYC’s public schools.
   C. Multiplied the number of faucets and bubblers by the respective average remediation cost, thus yielding an estimated cost of lowering the action level from 15 ppb to 5 ppb.

II. Detailed Calculations

A. NYC Public Schools – Outlet Types

   Table 8. Outlets between 5 – 15 ppb

<table>
<thead>
<tr>
<th>Outlet Type</th>
<th>Total #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faucet</td>
<td>8,906</td>
</tr>
<tr>
<td>Bubbler</td>
<td>1,848</td>
</tr>
<tr>
<td>Hose Bibb</td>
<td>207</td>
</tr>
<tr>
<td>Slop Sink</td>
<td>142</td>
</tr>
<tr>
<td>Steamer</td>
<td>63</td>
</tr>
<tr>
<td>Ice Maker</td>
<td>7</td>
</tr>
<tr>
<td>Water Bottle Filler</td>
<td>7</td>
</tr>
<tr>
<td>N.S.</td>
<td>59</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11,239</strong></td>
</tr>
</tbody>
</table>
Outlet Type Distribution
- Faucets = 8,906 (80%)
- Bubblers = 1,848 (15%)
- Hose bibs = 207 (2%)
- Ice makers, slop sinks, steamers, and water bottle fillers, accounted for the remaining 3%.

B. Costs
NYLCVEF provided the capstone team with the remediation costs (purchase and installation) data for faucets and bubblers for the years 2015, 2016, and 2017, in NYC’s public schools. There was no cost data for other outlet types.

Table 9. NYC Average Remediation Costs

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th># of Faucets Replaced</th>
<th>Total Cost</th>
<th>Cost per Faucet</th>
<th>Fiscal Year</th>
<th># of Fountain s / Bubblers Replaced</th>
<th>Total Cost</th>
<th>Cost per Fountain / Bubbl er</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y15-16</td>
<td>4,495</td>
<td>$8,653,106</td>
<td></td>
<td>Y15-16</td>
<td>3,532</td>
<td>$5,827,602</td>
<td></td>
</tr>
<tr>
<td>Y16-17</td>
<td>2,520</td>
<td>$3,276,000</td>
<td></td>
<td>Y16-17</td>
<td>1,980</td>
<td>$2,178,000</td>
<td></td>
</tr>
<tr>
<td>Y17-18</td>
<td>621</td>
<td>$962,550</td>
<td></td>
<td>Y17-18</td>
<td>488</td>
<td>$1,024,800</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>7,636</td>
<td>$12,891,656</td>
<td>$1,688</td>
<td>Total</td>
<td>6,000</td>
<td>$9,030,402</td>
<td>$1,505</td>
</tr>
</tbody>
</table>

The following calculation was done to yield the average remediation costs for faucets and bubblers:
- 7,636 faucets replaced at a total cost of $12,891,656 yields an average cost of $1,688 per remediated faucet.
- 6,000 Bubblers replaced at a total cost of $9,030,402, yields an average cost of $1,505 per remediated bubbler.
C. Calculations

8,906 Faucets (with lead levels between 5 and 15 ppb) at an average cost of $1,688, and 1,848 Bubblers (with lead levels between 5 and 15 ppb) at an average cost of $1,505 yields a total cost of USD 17,817,127.

<table>
<thead>
<tr>
<th>Outlet Type</th>
<th># Between 5 – 15 ppb</th>
<th>Average Cost</th>
<th>Estimated Total Cost</th>
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<tr>
<td>Faucets</td>
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<td>$1,688</td>
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<td>$1,505</td>
<td>$ 2,781,364</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$ 17,817,127</td>
</tr>
</tbody>
</table>

III. Results

If the action level is lowered to 5 ppb, the estimated remediation cost for NYC public schools is USD 17.8 million.

IV. Disclaimer

Faucets and bubblers together accounted for 95% of outlets between 5 and 15 ppb. There was no cost data for other outlet types (5%). Therefore, the estimated costs represent 95% of outlets that will need to be remediated. This estimation is not meant to be a formal or official budgetary value. Further calculations will be required.

V. Sources

Files provided by NYLCVEF:

- “NYC Schools Lead Results Database”
- “Schedule W - Water Testing and Remediation Aid (WTR)”. Original source: New York State Department of Education.
APPENDIX C: Outreach and Social Media Templates

WATER YOU WAITING FOR?!

Tell New York State that 15 parts per billion is too high for our children to drink.

High 5

Tell New York State that 15 parts per billion in water is too high for our children to drink.

TAP INTO YOUR KIDS HEALTH
ENDNOTES


31 Files provided by NYLCVEF: “Schedule W - Water Testing and Remediation Aid (WTR)”. Original source: New York State Department of Education.


55 Ibid.
56 Ibid.
57 Ibid.
62 Files provided by NYLCVEF: “Schedule W - Water Testing and Remediation Aid (WTR)”. Original source: New York State Department of Education
65 Environmental and Health Data Portal. “Children under 6 years with elevated blood lead levels (BLL) - Rate BLL>=5 µg/dL (per 1,000 tested), 2017, UHF42.” Date accessed: April 1, 2019. http://a816-dohbесп.nyc.gov/IndicatorPublic/VisualizationData.aspx?id=2184,4466a0,14,Map,Rate%20%BLL%3E5%20%20%C2%B5g/dL,2017


82 Ibid.


91 Ibid.

92 Ibid.


94 Ibid.


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Natural Resource Defense Council. “About Us.” n.d. Date accessed: February 5, 2019. [Link](https://www.nrdc.org/about?gclid=Cj0KCQjwwODlBRDuARIsAMY_28UdSUs3x8HTy8HISuPwgR1ITq0eRTeCue_UOBSPcGXdvO3GXyl-WMaAol5EALw_wcB)


https://www.nysenate.gov/legislation/bills/2015/S8158


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