The Role of Water in Buffalo's Lead Exposure Crisis

Daniel Cadzow

Introduction

While the lead exposure crisis in Flint, Michigan garnered national attention, several cities in Western New York far exceed Flint's lead exposure rates. According to the NYS Department of Health, 5.83% of children in Buffalo, NY tested for blood lead level (BLL) between 2000 and 2014 suffered from lead exposure.[1] That's three times the rate in Flint. It is argued here that our water supply and infrastructure play a significant role in excess cases of lead exposure. Following the presentation of how these factors are involved, with supporting data, examples of affordable and immediate steps we can take to protect our city's children are offered.

Blood Lead Levels

The BLLs discussed here exceeded 10 micrograms per deciliter (µg/dL) – the BLL of concern established in 1991. However, more recent research has shown that even small levels of lead exposure are unsafe and can cause irreversible damage. In 2012, the Centers for Disease Control (CDC) revised its guidelines with the goal of reducing every child's BLL to the lowest possible level. Using the 97.5th percentile of the BLL for all US children aged 1–5 years, the new "level of concern" was lowered to 5 µg/dL.[2,3] The CDC eliminated the most extreme cases of lead exposure and used an average of the rest to determine what might be considered a normal level of lead exposure. Because of these changes, the data used to determine lead exposure rates in this paper applies the older 10 µg/dL level of concern. As a result, the rates discussed here are under representative of blood lead exposure severity and rates in Buffalo.

There are many documented symptoms of blood lead exposure, which can cause significant quality of life issues. These include developmental delay, learning difficulties, lowered ability to manage emotions, seizures, loss of appetite, fatigue, abdominal pain, vomiting, constipation, hearing loss, and pica (i.e., eating non-food items).[4]

This policy brief was drafted by Daniel Cadzow, Policy Fellow at PPG and an advocate for environmental justice and equitable transportation infrastructure.

The brief finds that Buffalo's lead in water levels are more troubling than many residents realize stemming from our manufacturing history and combined sewage overflow system. The author details his home's own susceptibility to lead contamination and demonstrates that lead may appear in dangerous, unpredictable bursts. Lower income households are at even greater risk of exposure due to having older water service lines or faucets.

Recommendations are provided for both residents and government officials to curb the instances of lead in water through filtration and infrastructure improvements.

PARTNERSHIP FOR THE PUBLIC GOOD

It's enough to derail a child's life from one that would have been productive and socially and emotionally secure to one that is uncertain and insecure. The personal, social, and economic fallout from this crisis is incalculable.

For the first half of the twentieth century it was known that lead was toxic. But it was believed to be so only at very high levels, e.g., exceeding 60 µg/dL. As such, pediatricians were not regularly checking blood lead levels in children, as they do now. In the early 1970s, pediatrician Herbert Needleman came up with a way to precisely measure children's lead levels by analyzing lead levels in discarded baby teeth. He compared lead levels to a host of cognitive tests, including IQ tests. Aware of the role racism plays in public policy, he focused on lead levels in relativity affluent white children. He found that for every increase of 10 µg/dL blood lead levels, there was a decrease in IQ of 4.6 points. That means that even low lead levels dramatically affected the kids' lives. As a result, lead was regulated in gas and banned in toys and paints. Blood lead levels began to gradually decrease.

During his presidency, Ronald Reagan wanted to ease regulations to boost the economy. In 1985, he ordered the Environmental Protection Agency to determine how much money regulating lead was costing the lead industry. This task was assigned to the EPA's Joel Schultz, who was aware of the harms caused by lead to children and society in general. So, as ordered, he conducted the economic analysis and determined the lead regulations were costing the lead industries about $100 million annually.

But Schultz's analyses did not end there. He was aware of Herbert Needleman's research. In the first ever economic analysis of public health risks, Schultz related children's lower IQs to lost education, lost wages, and higher health care costs. He found that failing to regulate lead costs society nearly $1 billion annually. Based on this study, legislation was passed in 1986 that banned lead in pipe solder and flux and phased lead out of gas, with it being banned outright in 1996. In the subsequent years the blood lead levels in the general population dropped by 90%.[5, 6, 7]

It is well established that the cause of most lead poisoning is older, pre-1978 housing stock with lead paint, compounded by poverty and lack of access to loans to make repairs. It is argued here that, in some cases, the water supply and water infrastructure also play a significant role in elevated BLLs. The two principal factors in determining water's role in lead poisoning appear to be the water source and infrastructure (pipes) that have been 1) subjected to waste

Blood lead poisoning symptoms include developmental delay, learning difficulties, lowe ed ability to manage emotions, seizures, loss of appetite, fatigue, abdominal pain, vomiting, constipation, hearing loss, and pica (i.e., eating non-food items).

from manufacturing and commerce and 2) Combined Sewer Overflows (CSOs) (described below) or road runoff. This is supported by a comparison of lead poisoning rates from several cities with different types of water supplies.

Background

Policy briefs don't usually include personal narratives, but research on this topic began when one of our kids was diagnosed with an elevated BLL. In addition, some of the research, experiments, and mitigative methods we used in our family's battle with lead can inform public policy as well as personal practices for local residents.

The usual culprits for lead exposure are dust and paint chips from walls, woodwork, and windows painted before lead was banned from paints in 1978.[8] It is common to simply seal the leaded paint in with a fresh coat of non-leaded paint. However when the painted surfaces are movable, as with doors and windows, the fresh paint can wear through, releasing lead-tainted dust. The best way to fix that problem is to either 1) remove the paint with specialized paint strippers that immobilize lead or 2) remove the entire painted surfaces (gut the place), while wearing the recommended personal protective equipment. If unable to do either of those, it's a good idea to wipe areas around the affected windows and doors frequently with wet rags.

Our windows, however, are not painted. Using DIY test kits from our local hardware store, we tested all painted surfaces. We found lead only on some shelving in the basement and in the garage. Our children do not play in either of these places. To be safe, we removed or painted over those surfaces to seal the lead in. As a further precaution, we took care of that work while the kids were visiting grandparents and gave the house a thorough cleaning when finished.

We also tested the soil in the backyard where the children play, but the results were erratic. We tested the paint on the exterior on our house and garage but found no lead there. However, we live near Scajaquada Expressway and were concerned that lead from the exhaust of cars burning leaded gas until it was banned in 1996 may have settled into the soil. So, we spread five cubic yards of topsoil over the backyard to give the kids a safe yard surface to play in – except for the air pollution still coming from the urban expressway.[9]

When all was said and done, we compared our kids' situation to that of most kids and found it strange that one of ours would suffer from lead poisoning while so many others did not. That includes friends

with lead water service lines that were only recently informed (by us) that they should flush the water lines for about two minutes before consuming water. You should also flush your water lines if you have copper plumbing that was installed before 1986, because that was the year lead was outlawed from solder (used for joining pipes).

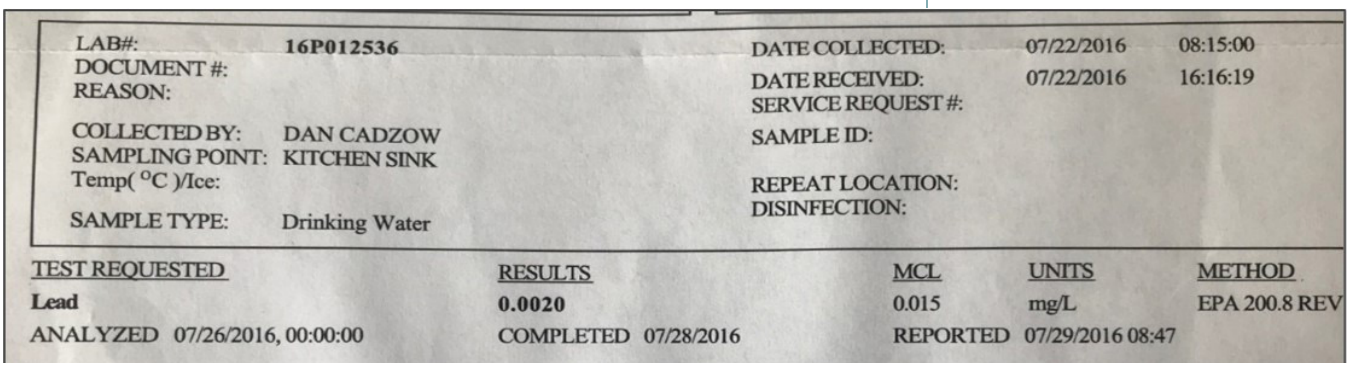
It also seemed strange that only one of our kids would have elevated BLL, while the other three were untouched. We homeschool our kids, so they are all are getting the same exposure to environmental toxins. In all, our situation suggested a contaminant that occurs in unpredictable episodes, like rainstorms or water main breaks.

The Water

Around this time, we learned many cities had been using "cheats" when testing water for lead. The three "cheats" are 1) not testing high-risk homes, 2) removing aerators from faucets they are testing, and 3) flushing the house's pipes before taking the samples to test for lead. Ironically, using these "cheats" at home are steps we can take to protect our families from lead. Buffalo is no longer using these three "cheats" when testing our city's water for lead, but they were when we were testing our home.[10] Upon learning this, we installed a whole-house water filter.

Soon after, we learned our whole house water filter didn't actual filter soluble lead, which is lead dissolved in water. We also learned that we could test our own water though the Erie County Public Health Lab for $20.[11] With the best interests of our kids and the "cheats" in mind, we tested our water under the worst-case scenario: 1) early in the morning (after the water had sat stagnant in the pipes all night), 2) with the aerator in, and 3) at the kitchen sink (where most of the water is consumed and the probability of lead-tainted scale in the aerator is highest). Knowing there are no safe levels of lead in our kids' bodies, we weren't thrilled with the results, but the amounts were within regulations--under the NYSDOH Drinking Water Part 5 Maximum Contaminant Level of 0.015 mg/L (Figure 1).

Figure 1: Water test results at home on Humboldt Parkway, July 2016.



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COLLECTED BY:	DAN CADZOW	SAMPLE ID:	
SAMPLING POINT:	KITCHEN SINK		
Temp(°C)/Ice:		REPEAT LOCATION:	
SAMPLE TYPE:	Drinking Water	DISINFECTION:	

TEST REQUESTED	RESULTS	MCL	UNITS	METHOD
Lead	0.0020	0.015	mg/L	EPA 200.8 REV
ANALYZED 07/26/2016, 00:00:00	COMPLETED 07/28/2016	REPORTED 07/29/2016 08:47		

Getting to the Source

While Flint's blood lead exposure epidemic has garnered national attention, we were shocked to find out Buffalo has three times as many lead-exposed kids. Some of our hardest hit neighborhoods have eight times as many exposed kids. The City and Erie County Health Department blame the crisis on old housing stock and poverty. However, anyone that has traveled outside of Buffalo knows we do not have a monopoly on old housing stock or poverty. When the discussion turns to the water supply, they say the problem is old lead service lines. Some of the lines that tap into the water mains and bring the water into our homes, schools, and businesses are made of lead.[12,13] But again, we are not the only city with lead service lines.

One thing that makes Buffalo's water infrastructure unique is its source: Lake Erie. Our corner of Lake Erie has been the dumping ground for waste generated over two centuries of intensive and diverse manufacturing and commerce. For example, Lackawanna Steel, later Bethlehem Steel, (1902-1982) was located on the waterfront and bulldozed tons of their primary waste product, slag, into Lake Erie over 82 years. It was enough to create entire landforms projecting into the lake. Slag has traditionally been considered ugly, but relatively harmless. However, research conducted at Stanford University has shown that slag contains numerous toxins, including lead.[14]

And notably, in October 1951, a barge containing 3,500,000 gallons of leaded gasoline broke loose from its moorings in Buffalo River. It drifted down river and crashed into the steamer Penobscot just inside of the break wall, bursting into fire.[15] Three and a half million gallons of leaded gas and burnt wreckage were cast into our water supply from this event alone.

These are just two examples from a city with two centuries of intensive manufacturing and commerce. The total amount of toxins dumped, leaked, or spilled into our water supply can never be known.

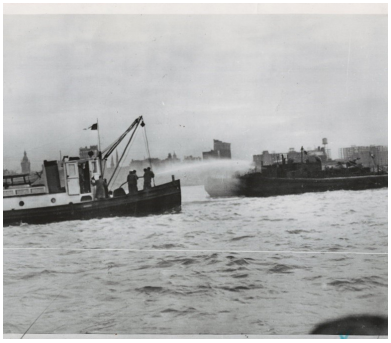

Figure 2: October 30, 1951 burning barge containing 3,500,000 gallons of leaded gasoline in the Buffalo River.

Combined Sewage Overflows

Thanks to the creation of agencies like the Environmental Protection Agency (EPA) in 1970, events like those are now less common and usually less severe.[16] However, our water supply has another big problem: we have a combined sewer system. That means the sanitary sewage that comes from our sink, tubs, and toilets ends up in the same pipes as our road's storm sewers on the

way to the water treatment plant. As Buffalo's sewage system is currently designed, every time we get more than about a half inch of rain in a 24 hour period, hundreds of thousands of gallons of untreated sewage spill out directly into our water supply. These events are referred to as Combined Sewage Overflows (CSOs).

Between May 1 and July 31 of 2017, for example, the city of Buffalo had 13 CSO events. These events resulted in 64.7 million gallons of untreated/raw sewage spilling into our water supply in this three month period.[17] Besides being simply disgusting, these CSOs have the potential for introducing untold toxins into our water supply. In addition to the raw sanitary sewage, storm sewer runoff includes traffic pollution dust/sediment contaminated with exhaust, tire wear, asbestos-containing brake dust, road paints, and dust contaminated by oil (which may contain toxic substances like lead, benzene, zinc or magnesium) gas, brake fluid, power steering fluid, transmission fluid, and battery acid that leak from the vehicles, insecticides, plastic debris, cigarette butts, solvents, and other hazardous waste.[18,19]

It's generally believed that any toxins from the industrial era that weren't washed downstream are now "safely" buried in the sediment. The problem is every time a new pipeline is laid across the lake, every time a boat's anchor is dropped, and every time a storm rages against our beaches, those sediments are stirred up and those buried toxins can be released. Like those sediments, the scale in our pipes has built up over time (see Figure 4). It's likely that most of those same toxins buried in the sediment are also buried in the scale in these old pipes. If so, any events that disturb that scale can release toxins like lead that are buried in it.

Another problem is that we use salt to de-ice our roads. Salt is corrosive to metal. Not only does it make our cars rust, it corrodes the pipes that deliver water to our homes, schools, and businesses. This also releases lead contained in the scale of our pipes. A 2018 federal study found monitoring stations in urban and snowy areas had higher chloride levels that corresponded with higher lead levels in nearby drinking water systems.[20]

A Modest Experiment

Due to low water flow, we contacted the city for information about our water main and service. We were told the water main in front of our home has been in service since 1890. They also said we had a half-inch lead service line that was about 12 inches long before switching to galvanized. Learning about that lead service line played a big role in our decision to spend $5,000 on upgrading our water

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Figure 3: Note the oily sheen in the curbside puddle at the intersection of Humboldt Pkwy and Woodward Ave from the December 30, 2019 rainfall.

Figure 4: Note the scale in this section of pipe that was removed from our 1892 home in the Parkside neighborhood of North Buffalo when the water service line was replaced in July, 2016.

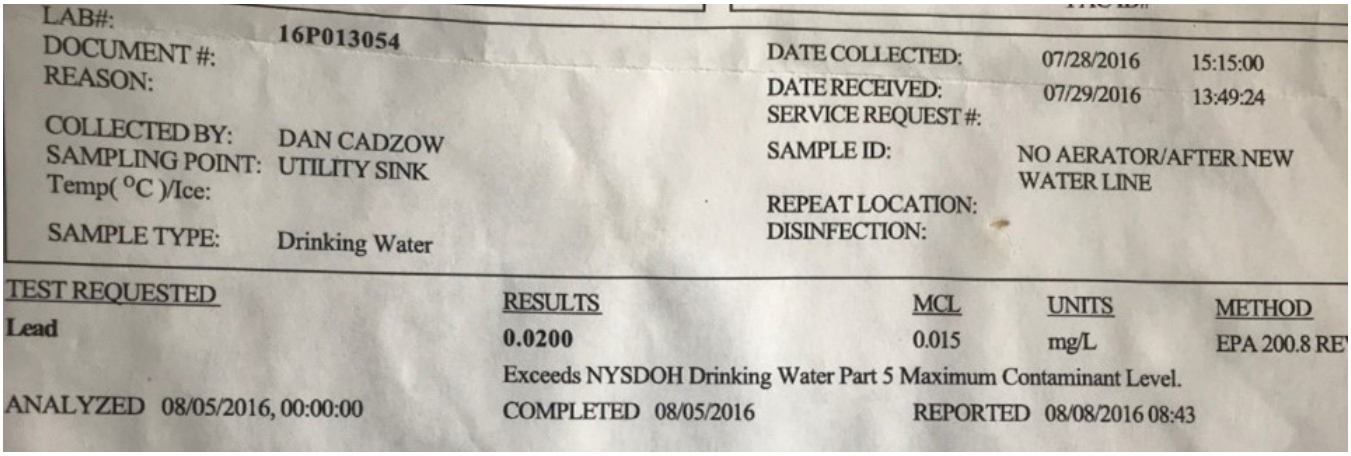
Figure 5: Circa 1890 Humboldt Parkway water main. Note the ¾" copper service on the bottom right and the older ½" disconnected lead service at the top right.

line. When replacing the service line, however, we discovered the tap was ¾ inch and copper. The copper line converted to the 1-inch galvanized pipe that entered our basement about 10 feet from the water main. It appears the city's records are not entirely accurate or complete.

However, knowing 1) a bit about the city's history of manufacturing and commerce and its effects on water quality, 2) about Lake Erie being our water supply, and 3) about the scale in old pipes, we hypothesized that lead and other pre-EPA contaminants could be trapped in that scale. If that were the case, any activities that disturb that scale would, just like with sediments under Lake Erie, cause a burst of contaminated water for everyone downstream. This could include large events like the water main breaks that have become all too frequent headlines in Buffalo[21] as well as small events like flushing or replacing fire hydrants or having a new tap installed in a water main for new water service lines like ours.

We tested the hypothesis by having another water sample tested for lead following the installation of the new water service line in our home. To take the sample, I employed all three cheats Buffalo had been using. First, I tested a "low-risk" home, ours. Second, I engaged the whole house water filter bypass and used the nearest water faucet at the utility sink after removing the faucet's aerator. And third, I flushed sediment out of t he pipe until the water ran clear (about a minute) before taking the sample.

This time, the results were 10 times (1,000%) higher than the first test and exceeded the New York State Department of Health's regulations (Figure 6). As we feared, drilling the new tap into the water main appears to have disrupted the scale on the pipe's interior and released lead into the water. But, sadly, it wasn't just for us; this burst of lead tainted water had the potential to reach those drinking water downstream from us.



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Temp(°C)/Ice:
SAMPLE TYPE: Drinking Water
DATE COLLECTED: 07/28/2016 15:15:00
DATE RECEIVED: 07/29/2016 13:49:24
SERVICE REQUEST #:
SAMPLE ID: NO AERATOR/AFTER NEW WATER LINE
REPEAT LOCATION:
DISINFECTION:

TEST REQUESTED	RESULTS	MCL	UNITS	METHOD
Lead	0.0200	0.015	mg/L	EPA 200.8 RE

Exceeds NYSDOH Drinking Water Part 5 Maximum Contaminant Level.

ANALYZED 08/05/2016, 00:00:00 COMPLETED 08/05/2016 REPORTED 08/08/2016 08:43

Figure 6: Water test results at home on Humboldt Parkway, July 2016 immediately after the replacement of water service line. Compare to Figure 1.

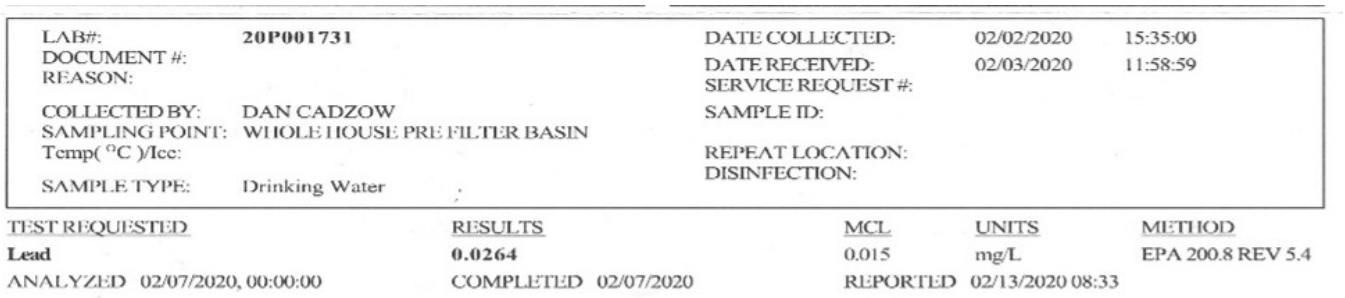
On January 24, 2020, the water main at Main Street and Delevan Avenue burst. We took steps to monitor whether this affected the water in our home. The pre-filter in our whole house water filter immediately became discolored and a centimeter of sediment settled out in the basin (Figure 7). We tested the water in the pre-filter's basin and this time it was even higher than when our new water line was taped through the old pipe scale (Figure 8).

Figure 7: Discoloration in water filter following the January 24, 2020 water main break at Main St and Delevan Ave.

A fourth water sample was analyzed for lead on August 8, 2021 (Figure 9). This sample was also collected from the pre-filter basin, which has some sediment that had settled in the bottom. The water passing through the line was solely used by a garden spigot, which was very infrequent. This time the results were 0.039 mg/L, the highest readings yet and again exceeding NYSDOH Drinking Water Part 5 Maximum Contaminant Level of 0.015 mg/L. This is another example illustrating the randomness of lead contamination. It was a fluke that this burst of sediment settled out in the basin leading to the garden hose, rather than the main house.

Of the four samples we analyzed, three exceeded NYSDOH Drinking Water Part 5 Maximum Contaminant Level of 0.015 mg/L. Each of these three samples was taken after our water service line

was replaced and because of disturbances (known and unknown) that resulted in the dislocation of scale or sediments in the water mains leading to our home. This clearly demonstrates the inadequacy of the current lead water testing regime.



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COLLECTED BY:	DAN CADZOW	SAMPLE ID:	
SAMPLING POINT:	WHOLE HOUSE PRE FILTER BASIN		
Temp(°C)/Ice:		REPEAT LOCATION:	
SAMPLE TYPE:	Drinking Water	DISINFECTION:	

TEST REQUESTED	RESULTS	MCL	UNITS	METHOD
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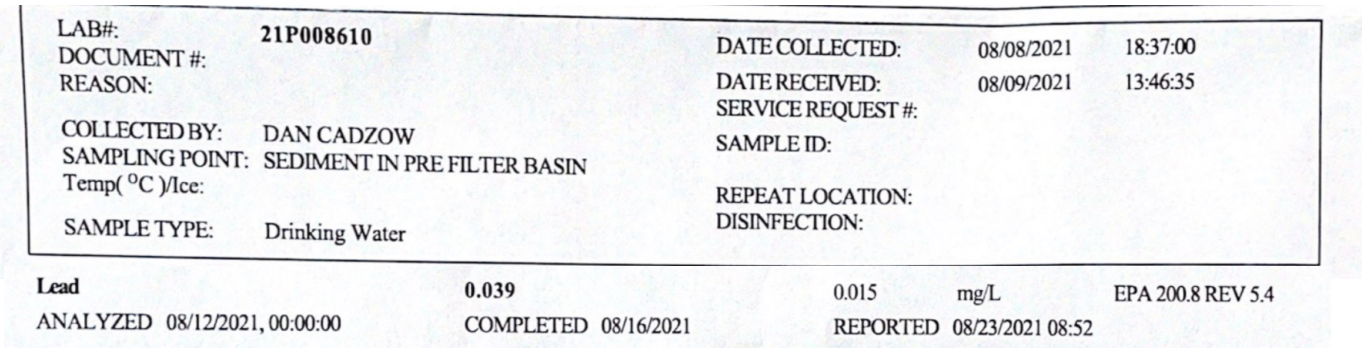
ANALYZED 02/07/2020, 00:00:00	COMPLETED 02/07/2020	REPORTED 02/13/2020 08:33		

Figure 8: Lead water levels following the January 24, 2020 water main break at Main St and Delevan Ave.



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COLLECTED BY:	DAN CADZOW	SAMPLE ID:	
SAMPLING POINT:	SEDIMENT IN PRE FILTER BASIN		
Temp(°C)/Ice:		REPEAT LOCATION:	
SAMPLE TYPE:	Drinking Water	DISINFECTION:	

Lead	0.039	0.015	mg/L	EPA 200.8 REV 5.4
ANALYZED 08/12/2021, 00:00:00	COMPLETED 08/16/2021	REPORTED 08/23/2021 08:52		

Figure 9. Water test results from the pre-filter basin at home on Humboldt Parkway, August 8, 2021.

Scale Treatment

Evidence that the Buffalo Water Authority is aware of lead in the scale can be found in the annual water quality report: "Prior to potable water being pumped into the distribution system, a phosphate-based corrosion inhibitor is added, which provides a protective layer inside service connections and plumbing systems, minimizing the potential for contaminants such as lead to leach into drinking water."[22]

This acknowledges the problem, lead in the pipes and scale, and it treats it by covering the scale with a phosphate-based corrosion inhibitor. It is much like the above-described practice of painting over leaded paint. However, it also has the same flaw: when the scale and phosphate-based corrosion inhibitor are disturbed, bursts of lead can be released. It also parallels lead paint exposure in that it's more likely to affect low-income households because they are less likely to have new water service lines and water filtration systems and more

likely to have older water faucets whose aerators are clogged with lead tainted scale. And again, when things like putting food on the table and paying for rent are daily battles, any water that appears clean is thought to be a blessing. Lead exposure just isn't on the radar.

Unlike windows and doors contaminated with lead paint, there are no warning signs that bursts of lead-tainted water are coming your way. The disturbances that release the scale could literally be miles upstream from our homes. Likewise, the rainfall that leads to CSOs is erratic. Further, nobody knows how long it would take for water contaminated with salt, oil and brake dust to spill into Lake Erie and move through our water supply system to our homes. And then it's just up to chance that contaminated water ends up in our toilet, shower, washing machine, or cup of soup.

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Another potential problem is that the phosphate-based corrosion inhibitor may be at odds with a more reliable solution: point-of-use filtration. Our whole house water filtration system came with a 10-year/1,000,000-gallon warranty (Figure 10). However, we replaced the main filter under warranty after only three years and 27,981 gallons of water because it was clogged. We suspect the filter was clogged by the phosphate-based corrosion inhibitor. The photo in Figure 10 illustrates the reduction of water flow through the filter. A new filter has virtually no restriction--the water shoots out of the other side as if it were coming straight out of the hose. Sending a video of the flow under these conditions is how the manufacturer determined the warranty replacement was appropriate. And now, just two years after getting the replacement filter, our water flow is again beginning to diminish.

Rather than rely on the phosphate-based corrosion inhibitor, a better solution is replacing water mains, beginning with the oldest. However, when cost is an issue, water mains can be cleaned and even relined.

Figure 10: Whole house water filtration system with reduced water flow, possibly due to phosphate-based corrosion inhibitor.

Figure 11: Comparison of two pre-filters installed at the same time. One filters water in the carriage house apartment, and one filters water to the house. Note the scale on the one to the left. This demonstrates that the contamination of water happens randomly. Annual testing of only a few homes may miss events like this.

The Problem with Status Quo Water Testing

Buffalo no longer uses the above-described "cheats," but the testing regime is still inadequate. As our experiment suggests, lead in scale can be released in short-lived and unpredictable bursts. Likewise, CSOs happen at irregular intervals and we have no idea how long CSO contaminated water takes to get from storm to faucet. Testing water once a year is extremely unlikely to catch those. And if it did, I suspect a follow-up test would "prove" that the problem is resolved.

As our experiment suggests, lead in scale can be released in short-lived and unpredictable bursts.

We now have two water filters - one for our home and one for our carriage house apartment. Both are fed by the same new copper waterline and both were installed at the same time. Not long after, I noticed one of the pre-filters had numerous bits of scale on the surface, while the other did not (Figure 11). That scale potentially contains lead. Sampling a few homes at annual intervals isn't likely to catch random events like that.

A better way to test the water would be to dissect and analyze the contents of used water filters like ours. Their contents are a much better proxy for our kids' bodies, who drink water much more than once a year, from numerous taps, and retain the mineral contents of the water.

Comparison with Nearby Cities

Rochester, NY gets its water from Hemlock Lake, one of the Finger Lakes. Because of this, NYS gradually acquired land around it and now the lake is surrounded by the 6,849-acre Hemlock-Canadice State Forest.[23] There are no towns, businesses, or homes with septic systems on its shores. It's about as ideal as a water supply can get. The one shortcoming is that while they prohibit swimming in the lake to protect the water supply, they do allow motorized fishing boats, provided the engines are less than 10 HP. The photo in Figure 12 was taken on our October 2017 canoe trip and shows the folly of that distinction -the smoke and exhaust from that motor's two-stroke engine are blowing oil and gas exhaust right into the water. And remember, oil can contain lead.

Figure 12: Motor boat spewing exhaust on Hemlock Lake in 2017; this is the water supply for Rochester, NY.

Like Buffalo, Rochester has old housing stock, poverty, a history of manufacturing, and higher rates of lead poisoning than Flint. According to NYS Department of Health, from 2004 to 2014, 2.31% of children tested for lead exceeded 10 µg/dL in Rochester. However, during that same period, 5.83% of children in the city of Buffalo exceeded 10 µg/dL.[24,25] That suggests our tainted water source and old, scaly pipes could be the cause of a 252% higher rate of lead poisoning compared to Rochester.

We can tease out a little more detail about the role water sources play in lead poisoning rates by comparing Buffalo and Rochester to nearby Syracuse, NY. Syracuse's primary water supply is Skaneateles Lake. The town of Skaneateles, at the north end of the lake, is relatively small with a population of about 7,000. It has no history of manufacturing, especially compared to Buffalo. But it does have the same Combined Sewage Overflow (CSO) problem.[26] During the same time period, 4.24% of children tested for BLLs in Syracuse exceeded 10 µg/dL.[27]

This may indicate that the CSOs contribute to Syracuse's rate of blood lead poisoning, which is 198% higher than Rochester's. That suggests the additional 74% increase in lead poisoning experienced in Buffalo could be attributed to the release of contaminated scale from its history of manufacturing and commerce. However, when you consider relative population sizes, an even larger proportion of causality would appear to fall in the CSO category. Other factors would need to be considered, including the locations of the CSOs, the location of the drinking water intake, and the relative sizes of the lakes. Regardless of the exact numbers, it is obvious that dealing with our CSOs is a paramount issue in treating the blood lead exposure crisis.

According to NYS Department of Health, from 2004 to 2014, 2.31% of children tested for lead exceeded 10 µg/dL in Rochester. However, during that same period, 5.83% of children in the city of Buffalo exceeded 10 µg/dL. During the same time period, 4.24% of children tested in Syracuse exceeded 10 µg/dL.

The village of Dansville, NY was founded in 1795, so it has old housing stock and is certainly not without poverty. Its water source is a reservoir that is 580 feet from the nearest road. People can fish in the reservoir, but no motorized boating is permitted. While there is an access road that skirts the southern shore, it is for official vehicles only and therefore sees very little traffic. While 201 kids did test positive for blood lead between 2004 and 2014, there were exactly zero cases of BLLs in excess of 10 µg/dL.[28] This might suggest Hemlock Lake's large drainage basin makes it susceptible to agricultural and road salt runoff.

Table 1 summarizes the rates of high blood lead levels alongside the risk for water contamination.

COMPARISON OF BLOOD LEAD LEVELS AND WATER CONTAMINATION RISK IN FOUR CENTRAL AND WESTERN NY MUNICIPALITIES

Municipality	Water Source Contaminated by Manufacturing	Water Source Contaminated by Combine Sewage Overflow	Number of Children with Blood Lead Levels Above 10 µg/dL out of Number of Children Tested	Percentage of Children with Blood Lead Levels Above 10 µg/dL
Buffalo	X	X	2,418/41,486	5.83%
Syracuse		X	1,401/33,009	4.24%
Rochester			808/34,958	2.14%
Dansville			0/538	0%

Table 1: Source: New York State Department of Health

A Way Forward for the City of Buffalo

First, residents should not be told that the water is always safe to drink without filtration. The problems that contribute to high blood levels in children are not limited only to old housing stock and poverty. The sooner Buffalo recognizes this, the sooner we will reduce the number of children with high lead exposure, and the better the City will fare if lawsuits are eventually filed.

Second, the City, Erie County, and community-based organizations can start telling residents about what they can do right now to keep them safe from lead tainted water. Here are some suggestions:

First and foremost, we need to provide free point-of-use water filtration systems to all who will take them. Purchasing water filtration is not on the radar for people who struggle to pay rent or buy groceries. This is a step that can happen immediately - no

research is necessary. Children who drink filtered water will not be drinking lead. These don't need to be whole house filters; the smaller ones that attach to the kitchen sink can remove lead. We should investigate strategies like tax-credit and health insurance incentives for landlords, tenants, and homeowners to use and maintain these filters. Regardless of who pays for these filters, the cost will be much less than the cost of long-term treatment of a lead-poisoned population. These steps alone, might help bring the rates of lead exposure in Buffalo closer to those in Rochester. While still far from a vision-zero approach, it would be a *significant* improvement.

Provide free point-of-use water filtration systems.

The City should also update its Complete Streets policy to include utilities, which also impact our health, safety, and wellbeing. Street maintenance projects should include a review for the possibility of including features like the "smart sewer" recently installed below Hertel Ave, west of Military Ave. This is a large underground chamber with computerized control gates that can take in sewage during heavy rainfall and release it to the water treatment plant when the sun is shining to reduce CSO events.[29]

Update the Complete Streets policy to include utilities, which also impact our health, safety, and wellbeing.

Building separate street and sanitary sewers might seem like a good solution, but remember: the roadside dust component of traffic pollution includes particles from exhaust, tire wear, asbestos-containing brake dust, road paints, and dust contaminated by oil (which may contain toxic substances like lead, benzene, zinc or magnesium) gas, brake fluid, power steering fluid, transmission fluid, and battery acid that leak from the vehicles, insecticides, plastic debris, cigarette butts, solvents, and other hazardous waste.[30] Those are exactly the kind of toxins we do not want dumped, untreated into our water supplies.

Incorporate rain gardens into the street scape to address CSOs.

A better design would be to incorporate rain gardens into the street scape. These rain gardens could be used to as the protective barrier for bike lanes and sidewalks. They could also act as corridors that contain all buried utilities. This would make repairs and maintenance possible without disturbing pavement and possibly without disrupting traffic.

Money and planning to replace aging waterlines should be included for all road maintenance efforts to reduce the likelihood of lead poisoning via the erratic release of lead-contaminated scale. In 2015, for example, Fordham Ave in Buffalo and numerous surrounding streets were repaved. About a year later, that new pavement was damaged as the water lines were replaced. In 2017, the same streets were repaved again. By coordinated these activities and agencies, a lot of money can be saved for upgrades in more

Include money and plans to replace aging waterlines in all road maintenance efforts.

neighborhoods as well as for providing free water filtration systems. We do not need to create a new agency to do this: we just need to make sure each agency involved in maintaining our streets and utilities are talking to each other and have shared goals.

We need to collect data to figure out how to do things better in the future. We don't need to wait for top-down federal policy and funds to start collecting data and generating solutions for ourselves.

Working with the Erie County Public Health Lab, the City and Buffalo Water can test sediments that build up along the roadsides near sewer drains for lead and other toxins. They can also sample the discharge at different CSO sites, focusing on those closest to or upstream from the city's primary source of water, the Emerald Channel Intake.

Water samples could also be tested for Ph on an hourly basis following large rain events to see if they are altering corrosivity, potentially leading to spikes in water lead levels. I received training on these sample collecting procedures from a job I had at a local environmental planning company. It's not rocket-science--any city employee can learn these skills and the Erie County Public Health Lab can help with training for free. The employees should be kept in the loop regarding sampling strategies and results. Being a part of the bigger picture improves performance and may lead to new insights.

Test sediments near sewer drains for lead and other toxins; sample discharge at CSO sites, especially close to or upstream from the city's primary water source.

THE CHALLENGE OF REPLACING LEAD SERVICE LINES: THE SCALE OF THE PROBLEM AND THE SCALE IN THE PIPES

In 2019, Buffalo accepted $822,000 in state grant initiatives to begin the Replace Old Lead Lines (ROLL) Program. With these funds, Buffalo can replace lead service lines in about 480 homes. In addition to that, Buffalo's American Rescue Plan spending plan includes $10 million for the ROLL program, allowing for the replacement of lead water service lines to an additional 1,000 homes over the next two years. While this is a laudable effort, it leaves an estimated 39,000 homes served with as much as 150 miles of lead water service pipes still to be replaced.

More concerning, however, is the apparent lack of research on how much lead contamination is coming from the lead service lives versus disturbances in lead-tainted pipe scale and sediment. Assuming the lead in our water is coming solely from the lead service lines might overlook the impacts of scale, sediment, and corrosion. Lead was used for pipes because it is malleable and resistant to corrosion; the same is certainly not true for pipe scale.

If additional research bears out this paper's assertion that pipe scale is more problematic than lead pipes, replacing these lead service lines may cause more harm than it mitigates, by releasing plumes of lead-tainted water every time another water service line is tapped into our ancient water mains. That's 1,480 plumes based on current funding. For that reason, the city needs to create an alert system for residents downstream from all identifiable disturbances in pipe scale, be they service line replacement, hydrant flushing, or water main breaks. Such an alert system may also encourage residents to use point-of-use filtration.

We should also test the contents of used water filters to see exactly what they are filtering out of the water. With more data, we may be able to pinpoint key sources and sinks of contamination and start the mitigative work on the worst offenders. Using existing employees and our affordable Public Health Lab, we can do this testing without spending a lot of money. It may also be possible to use reservoirs to store water that can be used instead of lake water when CSO events are occurring. And again, the long-term savings of these efforts are beyond calculation.

We also need to talk with people and organizations that have faced similar problems. For example, the city of Brick, New Jersey's water pipes were corroding and releasing lead due to road-salt-contaminated water. After consulting with people investigating the crisis in Flint, they were able to make corrections in their water treatment procedures to mitigate the problem.[31]

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A Way Forward for Residents

Bottled water is not the solution. Many people think bottled water is safer. However, bottled water is less regulated than tap water and much of it comes from taps anyway.[32] In addition, plastic bottles are made with harmful chemicals including plasticizers (phthalates) and BPA. "Hundreds of studies show that high doses of BPA disrupt reproductive development and function in laboratory animals. Levels in humans were thought to be too low to be of concern, but more recent research has challenged that perception. Like BPA, phthalates disrupt hormones -- in this case, testosterone. Phthalates are thought to block the action of testosterone in the body, with significant effects on the male reproductive tract and other organs in high-dose animal studies..."[33] There are many other health and environmental concerns with plastic food and beverage containers.

Simple steps we can take to protect our families from water-borne lead include:

1. Let the faucet run for 2 minutes before drinking water that has stagnated overnight or during work/school.

2. Clean the faucet aerators regularly - it is common to find bits of pipe scale in them.

3. Use whatever filtration you can afford. Most pitcher filters don't remove soluble lead, but any pitcher filter will remove chunks of lead-tainted scale.

Finally, the most important thing we can all do is make noise. We need to tell our Common Council members, our mayor, our NYS senate and assembly members, as well as our congressional representatives that we will not stand for contaminated water that makes our children sick and ruins the qualities of their lives. We pay too much in taxes, not to mention the additional water and sewer bills, to be supplied unsafe water.

Conclusion

Lead exposure can be personally debilitating and cause extreme and long-term social problems and economic costs. Poverty and old housing stock are not adequate explications for many cities with extreme cases of blood lead poisoning. Water sources and infrastructure can bridge that gap. Lead, and possible other toxins, trapped in the scale inside old pipes can be released during mechanical disturbances as well as through corrosion resulting changes in alkalinity that can result from events such as combined sewage overflows. There are immediate and affordable mitigations for families and cities with these problems. However, with the current federal prioritization of infrastructure, more encompassing and long-term solutions, including cleaning, relining, and replacing water mains, need to be prioritized to ensure all citizens are protected.

We will not stand for contaminated water that makes our children sick and ruins the qualities of their lives.

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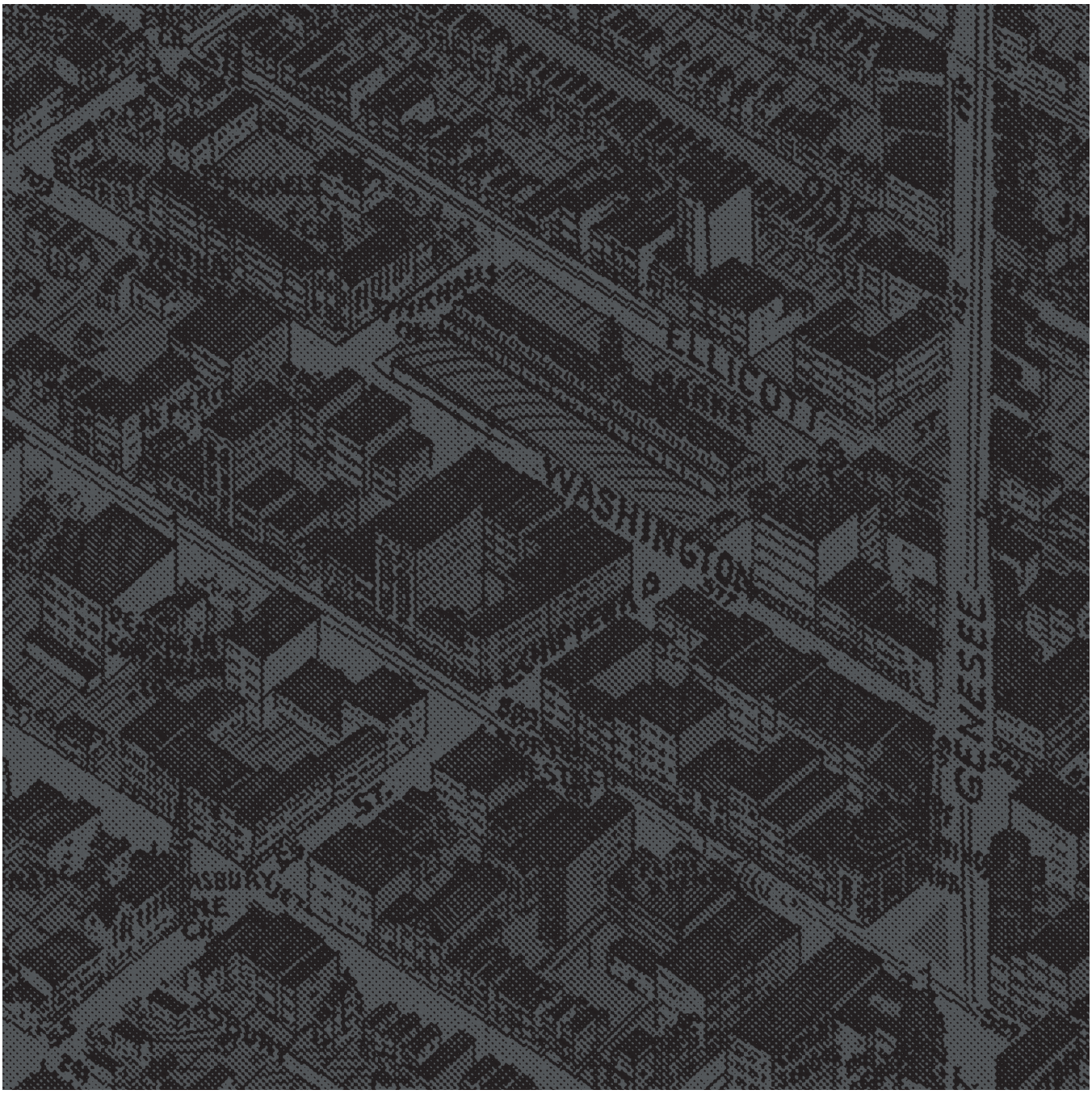

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