An Insider's Look at the Flint, MI Lead Disaster

EFFORTS OF THE

FLINT WATER INFRASTRUCTURE INTEGRITY SUBCOMMITTEE

CONCERNING THE FLINT, MI WATER CRISIS

OTCO CLASS III AND IV WORKSHOP
AUGUST 3RD, 2016

NICK PIZZI
AQUA SERV

Acknowledging the Committee Members

- Chair – Keith Creagh, Director, Michigan DEQ
- Jim Koski, Genesee County Representative
- Dr. Laura Sullivan, Professor, Kettering University
- Dr. Marc Edwards, Professor, Virginia Tech
- Nick Pizzi, Aqua Serv, AWWA Appointment
- Mike McDaniel, Retired National Guard Brigadier General
- Bob Kaplan, Acting Regional Administrator for EPA Region 5
- Bill Maier, Lansing Board of Water & Light (Retired)
- Jamie Curtis, Commissioner, Genesee County
- Dr. Shawn P. McElmurry, Associate Professor, Wayne State University

Flint crisis in a nutshell

- Around April of 2014, Flint MI changes its source of drinking water
  - quits taking water from Detroit - which it has been getting since the mid-60's and which has orthophosphate in it since the 1990's - and starts treating Flint River water and distributing it to customers
- Water from the Flint River WTP is not treated with a corrosion inhibitor
  - Water quality deterioration takes place rapidly
  - Local and state health authorities are eventually quoted as saying:
    - As many as 12,000 children are exposed to excessive levels of Lead, and the water may have caused a Legionnaire's outbreak that kills 10 people

Flint crisis in a nutshell

- Because State testing of children had previously taken place in 12 urban areas of Michigan – we have a baseline
  - Children in Flint who were tested for blood Lead levels in 2013 were retested in 2015
  - The amount of children with excessive blood Lead levels doubles
- In April 2016, criminal charges are brought against three officials, and 6 more are indicted on 7/29/2016
- The City is still trying to recover, and excessive Lead is still found in the water of homes

Eric P. Rothstein is a principal at Galardi Rothstein Group, 3300 N. Lake Shore Dr., Unit 6C, Chicago, IL, and is a member of the Flint Water Advisory Task Force

"While the cascade of poor decisions, failures, and indifference in Flint was startling and ultimately heartbreaking, we cast it as an anomaly at our peril, and the peril of those whose health we serve to protect."

"THE ISSUES IN FLINT WILL BE LONG-LASTING LOCALLY, BUT THE SITUATION ALSO HAS FAR-REACHING IMPLICATIONS FOR THE WATER UTILITY INDUSTRY AS A WHOLE."

ROTHSTEIN| 108:7 • JOURNAL AWWA | JULY 2016, page 41

Current Thought on Flint Lead Crisis and Lead in General

VARIOUS POLICY STATEMENTS AND EXPERT POSITIONS ON HEALTH ISSUES REGARDING LEAD

RELATIVE IMPORTANCE OF LEAD THAT IS CONTRIBUTED BY DRINKING WATER

Center for Disease Control (CDC)

Current Policy

- Blood Lead Levels in Children
  - Protecting children from exposure to Lead is important to lifelong good health.
  - No safe blood Lead level in children has been identified.
  - Even low levels of Lead in blood have been shown to affect IQ, ability to pay attention, and academic achievement. And effects of Lead exposure cannot be corrected.
  - The most important step parents, doctors, and others can take is to **prevent Lead exposure before it occurs**.
- On a related note …….
  - In 2012, Congress decreases the budgetary allotment to the "Childhood Lead Poisoning Prevention Program" from $30 M down to $2 M dollars

Statements from Dr. Joan Rose*

- "Environmental health assessments need to look at Lead exposure pathways" .....
  - They've ignored water more than they like to admit as a source of elevated blood Lead levels in children
  - We have been told not to worry about our water because "your Lead problem is in your paint"
  - We don't understand cumulative exposures unless we sample bone, which we don't do
  - Taking blood samples for Lead only provides a "snapshot" of intermittent exposures

*Journal AWWA roundtable discussion, July 2016

Note: Dr. Rose runs the Water Quality and Microbiology Laboratory, and is a professor at MSU

Creation and Findings of the Flint Water Advisory Task Force

- In Fall 2015, the governor of MI creates the Task Force to investigate what happened - and why - and to make recommendations
- In March 2016, the report is offered by the Task Force to:
  - "Fulfill our charge of determining the causes of the Flint water crisis",
  - "Identify remedial measures for the Flint community",
  - "Safeguard Michigan residents"
- From the Executive Summary of that report:
  - "The Flint water crisis is a story of government failure, intransigence, unpreparedness, delay, inaction, and environmental injustice"

Flint Water Advisory Task Force
FWATF Report on Flint Lead Catastrophe

- Lead is a potent neurotoxin. For any given exposure, Lead has more profound health effects in children because the exposure is distributed throughout the body's volume.
- Children's smaller body volumes convey larger risks from Lead exposure; these effects are concentrated in brain cells.
- One of the most concerning aspects of Lead exposure is that once it has been deposited in the nervous system, Lead cannot be removed.
  - Therefore, the impact of Lead poisoning on neurological development is permanent.
- Recent research has indicated that, with each 1 microgram per deciliter increase in blood Lead level, children demonstrate decreasing performance on intelligence tests.

FWATF report findings

- “The Michigan Department of Health and Human Services (MDHHS) failed to adequately and promptly act to protect public health.”
- “Both agencies, but principally the MDEQ, stubbornly worked to discredit and dismiss others’ attempts to bring the issues of unsafe water, Lead contamination, and increased cases of Legionellosis (Legionnaires’ disease) to light.”

FWATF Report Findings Continued …

- "Flint water customers were needlessly and tragically exposed to toxic levels of Lead and other hazards through the mismanagement of their drinking water supply. The specific events that led to the water quality debacle, Lead exposure, heightened *Legionella* susceptibility, infrastructure damage are a litany of questionable governmental decisions …"
  - Contains 36 findings
  - Contains 44 recommendations

History and Timelines

FLINT, MI CONTAMINATION EVENT

ORIGIN OF THE **CULTURES** THAT EXISTED AND THE EVENTS THAT FOLLOWED

History Lesson: “Karegnondi”

- WHAT’S IN A NAME?
  - The native Huron-Petun (later known as Wyandot) people referred to Lake Huron as **Karegnondi**, translated as “big lake.”
  - Cartographer Nicolas Sanson’s 1656 map of the territory bears that name for the “fresh water sea” encountered by French explorers.

Then and Now

Yesterday and today. Left: Map from 1656 drawn by noted French cartographer Nicolas Sanson showing Karegnondi (Lake Huron) as it was then conceived. Right: Water drawn from Lake Huron will be used within the Great Lakes basin.

Timelines of the Flint Lead Issue

Sources:

Articles from New York Times,

National Public Radio,

and the Detroit Free Press

Flint, MI city ordinance - 1897

In 1897, an ordinance is adopted that requires the use of Lead pipe for the construction of service lines for city homes and businesses

Flint, MI Timelines

- From 1930's to 1960's
  - Flint is a major vehicle manufacturing center - General Motors (GM) Headquartered there – UAW strike sets a standard
  - There are 196,000 people living in Flint in 1950-1960
  - In 1963, Flint wants to stop treating Flint River Water, and so moved to build a pipeline from Lake Huron to Flint, but a profiteering scandal derailed that pipeline. This led the city to sign a contract to purchase water for 30 years from the Detroit Water and Sewerage Department on June 6, 1964
  - "White flight" commences – population shrinks to 159,000 by 1980, and to 102,000 by 2010
- Early 2002
  - **Flint is $30,000,000 in debt**
- November 29th, 2011
  - Flint becomes the fourth Michigan City brought under the control of an **Emergency Manager**
    - Under MI law, Emergency Managers take the power away from local authorities
    - **Detroit is one of those four cities under Emergency Manager control**

Flint, MI Timelines

- March 25th, 2013
  - The Flint City Council voted 7-1 to get 16 mgd of raw source water from an entity called the “Karegnondi Water Authority”.
  - Flint Emergency Manager – with approval from the State Treasurer - begins to take steps to disconnect the Flint Water System from Detroit Water and develop its own source from Karegnondi Water Authority (KWA)
    - Distance between Flint and Lake Huron – 70 miles
    - Karegnondi raw water line has not been built as yet
    - No transition or contingency plan was put in to place for providing safe and reliable drinking water while the raw water line is going to be built

What is Karegnondi Water Authority?

- KWA consists of Genesee County Drain Commissioner, Lapeer County Drain Commissioner, Lapeer City, Sanilac County Drain Commissioner and the City of Flint. KWA was incorporated in 2010. The purpose of the Authority is to provide and distribute raw water to the region.
  - From the KWA Website: "The pipeline will supply untreated water to the municipalities of the region."
  - Supplying raw water from Lake Huron to Flint is approx. the same distance covered by supplying raw water from Cleveland to Ohio towns like New Philadelphia or perhaps Conneaut, or Mansfield, or Port Clinton.
  - Or perhaps as long as the already-paid-for-pipe from Detroit that brings FINISHED DRINKING WATER to Flint with phosphate in it.
- The project will require the installation of a water intake structure, 72" and 66" pipelines, and pumping stations over the next few years. The project began construction in June of 2013, with an expected completion date of Spring of 2017.

What is a Drain Commissioner? What is the culture?

- A Drain Commissioner is an elected official in county government of the U.S. State of Michigan who is responsible for planning, developing and maintaining surface water drainage systems under Public Act 40 of 1956.
- Drain Commissioners are elected on the partisan ballot in presidential election years for a term of four years.
- In counties with a population under 12,000, the office of Drain Commissioner may be abolished with its statutory duties and responsibilities performed by the county's board of road commissioners.

Drain Commissioner Culture

- Duties and powers
  - It is the only elected office in Michigan that can directly levy taxes and borrow money without a vote of the people.
    - This led one Drain Commissioner to declare he is more powerful than the governor.
    - While the powers of the Drain Commissioner are immense, the office has become sinecure in some counties
  - Nevertheless, Drain Commissioners are responsible for overseeing the county's drains.
    - In Michigan, a **drain** may be a natural or artificial creek or ditch, or a massive pipe for carrying water. The territory served by a particular drain, its watershed, is typically organized as a **drainage district** and the Drain Commissioner levies tax assessments and directs construction or maintenance of drains and culverts on behalf of each district.

Back to Timelines

- Between March 2013 and April 2014

Important date!

  - Flint, still relying on its master metered account from Detroit, is notified that they will have to pay a premium for water due to agreement with Detroit (the contract had expired in 2000)
  - Detroit is angry that they are losing this customer, and asserts its right to charge extra per the contract
  - Remember - KWA is not scheduled to complete the Lake Huron supply line to Flint until 2017

Flint, MI Timelines

- April 25, 2014
  - The Flint City Emergency Manager weighs the choice of staying on Detroit's higher rate vs. firing up the existing Flint WTP
    - He is in negotiations with the Detroit Emergency Manager
      - Neither of the two men is a drinking water professional
  - On orders from the Emergency Manager, the city switches its water supply from Detroit's system to the Flint River WTP.
  - Soon after, residents begin to complain about the water's color, taste and odor, and to report rashes and concerns about bacteria.

Flint Timelines – Flint WTP Manager Mike Glasgow

- In an email sent April 17, 2014 -- eight days before Flint switched its water source -- Mike Glasgow mentions problems with the monitoring schedule and his staffing ahead of the switch.
  - "I do not anticipate giving the OK to begin sending water out anytime soon. If water is distributed from this plant in the next couple weeks, it will be against my direction," Glasgow wrote to state officials, including Busch and Prysby. "I need time to adequately train additional staff and to update our monitoring plans before I will feel we are ready. I will reiterate this to management above me, but they seem to have their own agenda."
- In an interview with CNN, Glasgow alleges that DEQ employees Busch and Prysby told him to alter water quality reports and remove the highest lead levels.*
  - *CNN - Updated 11:45 PM ET, Wed April 20, 2016

Flint WTP

- Is a turbidity removal / lime softening plant
  - Ferric chloride and plate settlers for turbidity
  - Lime softening and recarbonation for hardness removal
  - Over the last 50 years, it had been operated only 4-5 days at a time about three times a year
    - It did not put finished water into the system during those times
    - Staff was not prepared for 24/7 OPS

Flint Timelines

- April 25th, 2014 - when speaking to the residents of Flint, Mayor Dan Walling states:
  - "Even with a proven track record of providing perfectly good water for Flint, there still remains lingering uncertainty about the quality of the water. In an effort to dispel myths and promote the truth about the Flint River and its viability as a residential water resource, there have been numerous studies and tests conducted on its water by several independent organizations. Michael Prysby of the Michigan DEQ Office of Drinking Water verified that the quality of the water being put out meets all of our drinking water standards and Flint water is safe to drink."
  - " It's regular, good, pure drinking water, and it's right in our backyard", said Mayor Walling – "this is the first step in the right direction for Flint, and we take this monumental step forward in controlling the future of our community's most precious resource. "

Flint Timelines

- August and September 2014
  - City officials issue boil-water advisories after coliform bacteria are detected in tap water.
- October 2014
  - The Michigan Department of Environmental Quality blames aging pipes and a population decline for pockets of bad WQ
- October 2014
  - A General Motors plant in Flint stops using municipal water, saying it corrodes car parts.

Flint Timelines

- January 2015
  - Detroit's water system offers to reconnect to Flint, waiving a $4 million connection fee. Three weeks later, Flint's state-appointed Emergency Manager, Jerry Ambrose, declines the offer.
- February 2015
  - In a memo for the governor, officials play down problems and say that the water is not an imminent "threat to public health."

Ms. LeeAnne Walters

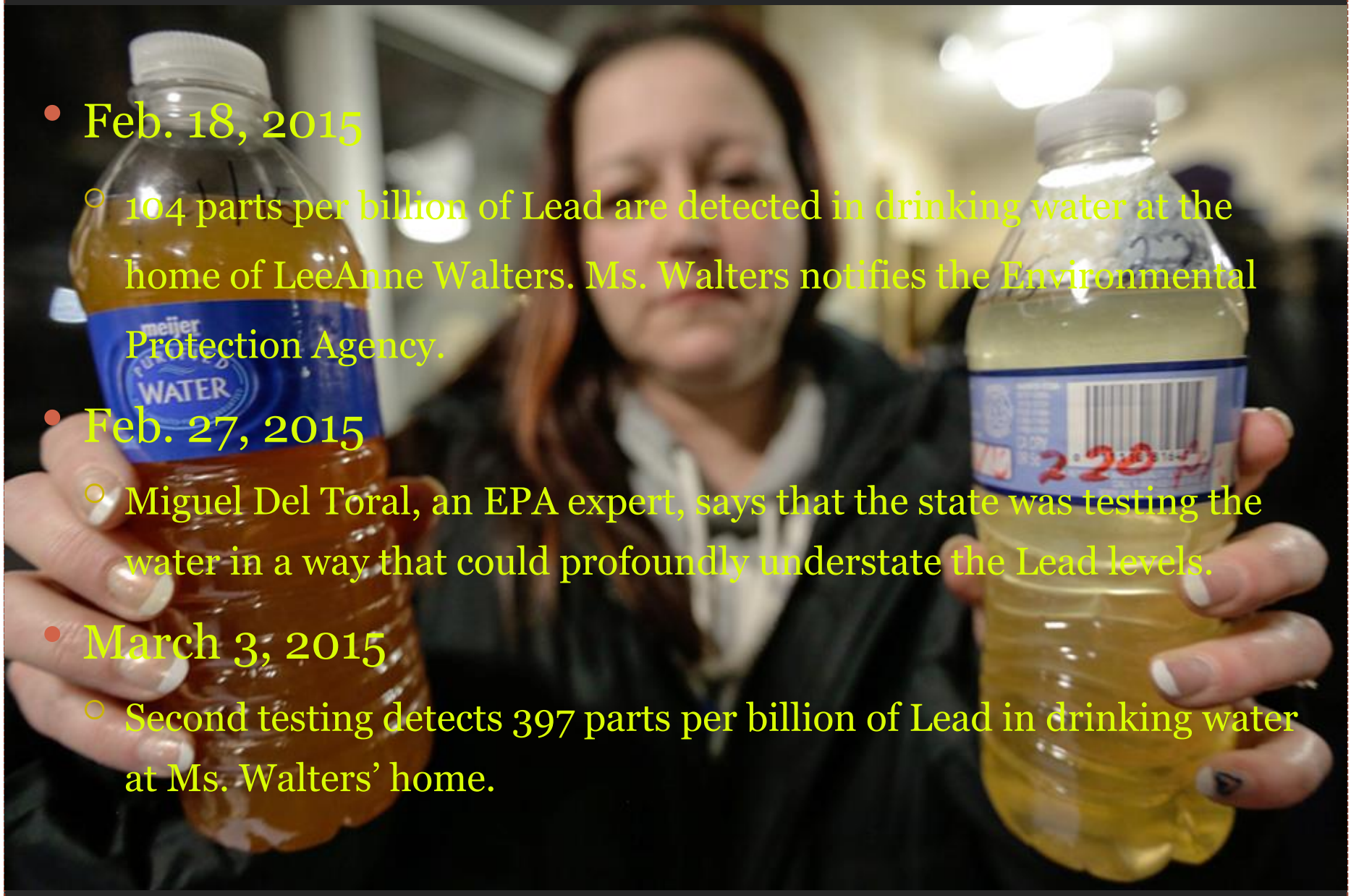
Shown here with two of her children – the twins.

She is the mother of four kids – an 18 year old daughter, a 14 year old son, and the twins Gavin and Garrett.

Gavin has stopped growing, and the daughter's hair fell out while taking a shower.

Ms. Walters lost her eye lashes at one point.

Flint Timelines



- Feb. 18, 2015
  - 104 parts per billion of Lead are detected in drinking water at the home of LeeAnne Walters. Ms. Walters notifies the Environmental Protection Agency.
- Feb. 27, 2015
  - Miguel Del Toral, an EPA expert, says that the state was testing the water in a way that could profoundly understate the Lead levels.
- March 3, 2015
  - Second testing detects 397 parts per billion of Lead in drinking water at Ms. Walters' home.

Flint Timelines

- March 12, 2015
  - Veolia, a consultant group hired by Flint, reports that the city's water meets state and federal standards; it does not report specifically on Lead levels.
    - "The review of the water quality records during the time of Veolia's study shows the water to be in compliance with State and Federal regulations, and, based on those standards, the water is considered to meet drinking water requirements." ---- Flint MI Water Quality Report, Veolia, 3/12/2015
  - The Mayor of Flint uses this report to state publicly that the water is safe

Flint Timelines

- July 2, 2015
  - An EPA administrator tells Flint's mayor that "it would be premature to draw any conclusions" - (based on a leaked internal EPA memo regarding Lead).
- July 22, 2015
  - Dennis Muchmore, Governor Rick Snyder's Chief of Staff, expresses concern about the Lead issue in an email, and asks about Flint test results, blood testing and the State's response.

Flint Timelines

- Aug. 17, 2015
  - Based on results showing Lead levels at 11 parts per billion from January to June 2015, the Department of Environmental Quality tells Flint to optimize corrosion control.
- Sept. 2, 2015
  - Marc Edwards, an expert on municipal water quality and professor at Virginia Tech, reports that corrosiveness of water is causing Lead to leach into the supply. Soon after, the Department of Environmental Quality disputes those conclusions.

Flint Timelines

- Sept. 24-25, 2015
  - A group of doctors led by Dr. Mona Hanna-Attisha of Hurley Medical Center in Flint urges the city to stop using the Flint River for water after finding high levels of Lead in the blood of children. State regulators insist the water is safe.
- Sept. 28, 2015
  - The governor is briefed on Lead problems in a phone call with the state environment department and federal officials.

Flint Timelines

- Oct. 1, 2015
  - Flint city officials urge residents to stop drinking water after government epidemiologists validate Dr. Hanna-Attisha's finding of high Lead levels. Governor Snyder orders the distribution of filters, the testing of water in schools, and the expansion of water and blood testing.
- Oct. 16, 2015
  - Flint reconnects to Detroit's water. Residents are advised not to use unfiltered tap water for drinking, cooking or bathing.

Flint Timelines

- Oct. 19, 2015
  - The Department of Environmental Quality director, Dan Wyant, reports that his staff used inappropriate federal protocol for corrosion control.
- Oct. 21, 2015
  - Governor Snyder announces that an independent Water Advisory Task Force will review water use and testing in Flint.
- Dec. 9, 2015
  - Flint adds additional corrosion control chemicals.
- Dec. 14, 2015
  - Flint declares an emergency.

Flint Timelines

- Jan., 2016
  - MDEQ is testing (Sentinel) the water at more than 600 homes. Some results top 600 ppb Lead
  - USEPA Region 5 Administrator Susan Hedman resigns her position due to this crisis
- Jan. 16, 2016
  - President Obama declares a state of emergency in the city and surrounding county, allowing the Federal Emergency Management Agency to provide up to $5 million in aid
- Jan. 21, 2016 – Veolia report resurfaces – Detroit Free Press headline:
  - March 2015 Veolia report urged corrosion control but made no mention of Lead leaching into the water and did not cite health concerns, only aesthetic ones. Its recommendation to add phosphates to treat the water would have cost a tiny fraction of today's mounting costs to address the Flint drinking water crisis, but it went unheeded by the city's state-appointed Emergency Manager

State of Michigan Audit of DEQ

- In March of 2016, MI issues an audit report:
  - "MDEQ does not verify that water samples for Lead come from the right homes"
  - "MDEQ doesn't have a procedure for determining the population served by a water system"
  - "MDEQ didn't follow its own policy for water system visits and detailed surveys"
  - "MDEQ fees do not cover the costs of oversight"
  - "Audit also faults federal Lead and Copper Rule"
- Water Infrastructure Committee begins its work

Flint Timelines

- April 2016
  - Flint Water Advisory Task Force issues its final report
    - As mentioned, it blames the crisis on governmental failure at many levels
    - Assigns tasks to the Committees
  - Three people – a Flint utility employee and two MDEQ employees are indicted
    - Another Flint employee is found dead

First 3 Flint Indictments

- Michigan Attorney General Bill Shuette indicts government employees:*
  - A district water supervisor for the Michigan Department of Environmental Quality, and a district water engineer, each face six charges.
    - Accusations include misleading federal regulatory officials, manipulating water sampling and tampering with reports.
  - A former laboratory and water quality supervisor who served as the city's utilities administrator, is accused of tampering with a lead report.
    - He is charged with tampering with evidence, a felony, and willful neglect of duty, a misdemeanor.

*Detroit Free Press, April 2016

Flint timelines

- June 2016 – two engineering firms are sued by the State of Michigan
  - Veolia
  - Lockwood, Andrews & Newnam (LAN)
- According to Michigan Attorney General:
  - The companies, Veolia North America and Lockwood, Andrews & Newnam, or LAN, were awarded contracts to advise the city about using the Flint River as its drinking water source. But, Mr. Schuette said, each failed to sound alarms about lead contamination, overlooked obvious problems and were complicit in the series of events that caused lead to leach from pipes and poison children.*

*DETROIT FREE PRESS, JUNE 22, 2016

Flint Timelines

- July 29th, 2016
  - Six more DEQ and State employees are criminally charged by the Michigan
- As of this presentation – 8/3/2016 – the charges are ongoing, and nine persons have been indicted
- When indicting these six State employees, Shuette is quoted as saying:
  - "They had knowledge and ability to stop the problem, but they failed"

    - The following press release was taken from the Detroit Free Press on 7.29.2016

July Indictment 1

- Former chief of the Michigan Department of Environmental Quality's Office of Drinking Water and Municipal Assistance
- Charges: One felony count of misconduct in office, which carries a penalty of five years in prison and/or $10,000 and one misdemeanor count of willful neglect of duty, according to a news release from Attorney General Bill Schuette's office.
- Allegations: It's alleged that despite notice from citizens about water quality and being aware of an outbreak of Legionnaires' disease, the chief "not only allegedly failed to take corrective action or notify public health officials but, in fact took steps to mislead and conceal evidence from health officials in phone calls revealed by the investigation," the release says.
- **Work status: Fired**

July Indictment 2

- MDEQ water quality analyst
- Charges: Three felony charges -- one count of misconduct in office, which carries a penalty of five years in prison and/or $10,000; one count of tampering with evidence, which carries a penalty of four years and/or $5,000; and tampering with evidence, which carries a penalty of four years and/or $10,000. He is also facing a misdemeanor charge of willful neglect of duty.
- Allegations: It's alleged that the analyst "was warned by Flint Water Treatment Plant officials that they were not ready for operations and was later warned by the EPA that high levels of lead us usually due to particulate lead, signaling a corrosion problem," the news release from the Attorney General's Office says. He is accused of participating in the manipulation of lead testing results.
- **Work status: Suspended without pay**

July Indictment 3

- MDEQ specialist for the Community Drinking Water Unit
- Charges: One felony count each of misconduct in office and conspiracy, both of which carry penalties of five years in prison and/or $10,000; and one misdemeanor count of willful neglect of duty.
- Allegations: It's alleged that the specialist was aware of water problems in Flint, "but allegedly took no corrective action in his duty to ensure the provision of clean, safe drinking water in Flint" and also is accused of misleading the Environmental Protection Agency about the necessity of using corrosion control treatments, the release from the Attorney General's Office says.
- **Work status: Suspended without pay**

July Indictment 4

- Director of the Michigan Department Health and Human Services program for maternal, infant and early childhood home visiting
- Charges: One felony count each of misconduct in office and conspiracy, both of which carry penalties of five years in prison and/or $10,000; and one misdemeanor count of willful neglect of duty.
- Allegations: It's alleged that the director requested a report on blood lead level data on Flint children, but the report -- created in July 2015 and showing a spike in blood lead tests for Flint children -- was "buried," the news release from the Attorney General's Office says. It's alleged that he and another health department employee created another report that "falsely indicated no statistically significant rise in blood lead levels of children in the summer of 2014," according to the release.
- **Work status: Suspended without pay**

July Indictment 5

- Data manager for the MDHHS Health Homes and Lead Prevention program
- Charges: One felony count each of misconduct in office and conspiracy, both of which carry penalties of five years in prison and/or $10,000; and one misdemeanor count of willful neglect of duty.
- Allegations: It's alleged that the manager, along with a director, created a report that "falsely indicated no statistically significant rise in blood lead levels of children in the summer of 2014," the Attorney General's Office news release says.
- **Work status: Suspended without pay**

July Indictment 6

- Former director of the Bureau of Epidemiology and State Epidemiologist
- Charges: One felony count each of misconduct in office and conspiracy, both of which carry penalties of five years in prison and/or $10,000; and one misdemeanor count of willful neglect of duty.
- Allegations: It's alleged that the director received a first report regarding blood lead levels in Flint children, "but instructed others not to take action, rebuffing other employees who asked about next steps of action," the news release says. "The charges allege that the director later instructed another MDHHS employee to delete emails concerning the original blood lead data report from July 28, 2015.“
- **Work status: Suspended without pay**

Task Force and Committee Work

"FLINT WATER CUSTOMERS WERE NEEDLESSLY AND TRAGICALLY EXPOSED TO TOXIC LEVELS OF LEAD AND OTHER HAZARDS THROUGH THE MISMANAGEMENT OF THEIR DRINKING WATER SUPPLY"

Creation of Committee

- The State of Michigan – Executive Office
  - January 11th, 2016 - EXECUTIVE ORDER No. 2016-1 - CREATION OF FLINT WATER INTERAGENCY COORDINATING COMMITTEE (FWICC)
- The Coordinating Committee became a function of the Michigan State Police and the Michigan Department of Environmental Quality
- Duties of the Coordinating Committee:
  - (paraphrasing) shall advise the governor ..and propose statutory, regulatory, or contractual actions necessary …for making recommendations for:
    - acceptable standards for potable water
    - the health impacts for the affected population
    - the assessment of the status of infrastructure
    - the determination of feasible actions to upgrade the water system.

The FWICC creates 5 sub-committees

- One of which is the Water Infrastructure Integrity Committee
  - Tasks:
    - Assess the condition and functionality of the overall distribution system
    - Determine the right-sizing of the water infrastructure system to support the needs of the City
    - Create a plan for addressing the needs as defined in the overall assessment
    - Determine a viable-backup emergency water source
    - Develop a comprehensive Lead line replacement program that takes all needs into consideration such as at-risk populations
  - Meanwhile …….

Findings of the Flint Water Advisory Task Force

- F-1. MDEQ bears primary responsibility for the water contamination in Flint.
- F-2. MDEQ, specifically its Office of Drinking Water and Municipal Assistance (ODWMA), suffers from cultural shortcomings that prevent it from adequately serving and protecting the public health of Michigan residents.
- F-3. MDEQ misinterpreted the LCR and misapplied its requirements. As a result, Lead-in-water levels were under-reported and many residents' exposure to high Lead levels was prolonged for months.
- F-4. MDEQ waited months before accepting EPA's offer to engage its Lead (Lead) experts to help address the Flint water situation and, at times, MDEQ staff were dismissive and unresponsive.
- F-5. MDEQ failed to move swiftly to investigate, either on its own or in tandem with MDHHS, the possibility that Flint River water was contributing to an unusually high number of Legionellosis cases in Flint.

http://www.michigan.gov/documents/snyder/FWATF_FINAL_REPORT_21March2016_517805_7.pdf

MDEQ's Failures and Intransigence

When considering Flint's conversion from DWSD to the Flint River water, MDEQ had multiple communications and meetings with Flint Utilities Department staff and their consultants.

- When asked by Flint water plant personnel about adding phosphate in the treatment process, as DWSD does for corrosion control, MDEQ said that a corrosion control treatment decision would be made after two 6-month monitoring periods were conducted to see if corrosion control treatment was needed.
- ODWMA anticipated that use of Flint River water would be problematic but deferred to state Emergency Manager decisions to proceed.
- Subsequently: MDEQ advised Flint WTP staff, in contradiction to longstanding federal policy under the LCR, that corrosion control treatment was not required.
- MDEQ insisted, even after compelling evidence of Lead poisoning of children was presented, that Flint water quality met applicable SDWA standards.

FWATF Findings and Recommendations

FOCUSING ON THE ONES THAT ARE AIMED AT THE MDEQ, AND THEREFORE PERTAIN TO THE FWICC COMMITTEES - INFRASTRUCTURE INTEGRITY COMMITTEE, WATER QUALITY COMMITTEE, ETC.

(SOME FINDINGS AND RECOMMENDATIONS ARE AIMED AT, FOR EXAMPLE, THE GOVERNOR'S OFFICE, OR THE HEALTH DEPARTMENT)

THE GOVERNOR IS REQUIRING THAT THE MDEQ RESPOND TO THE RECOMMENDATIONS QUICKLY

Lead service line replacement

- Flint took the recommendation to perform total Lead service line replacement as opposed to partial
  - How do you advise Flint which lines to replace first?
    - It can't be done in a day or a week or a month
    - Who gets to go first – who goes last?
  - A tiered approach is being used
    - Results of water samples, locations of children
      - For those on the waiting list, temporary remedial action is given

Service lines in Flint

- The city records show that flint water customers are served through ≈ 30,000 service lines
- The records indicate that over 15,000 of them are Lead
  - There is some conjecture that a number of those are simply services with a Lead gooseneck

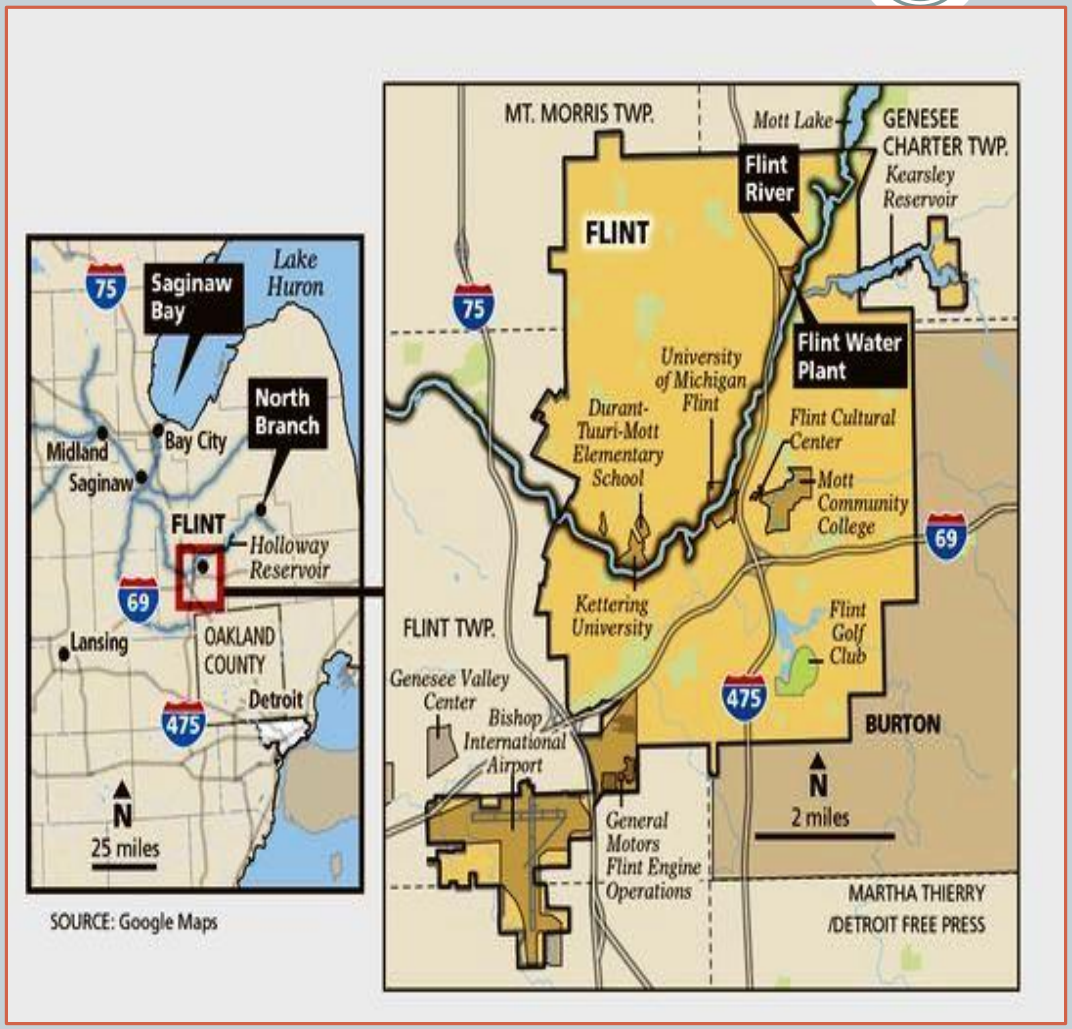
Madison, WI Lead study and replacement

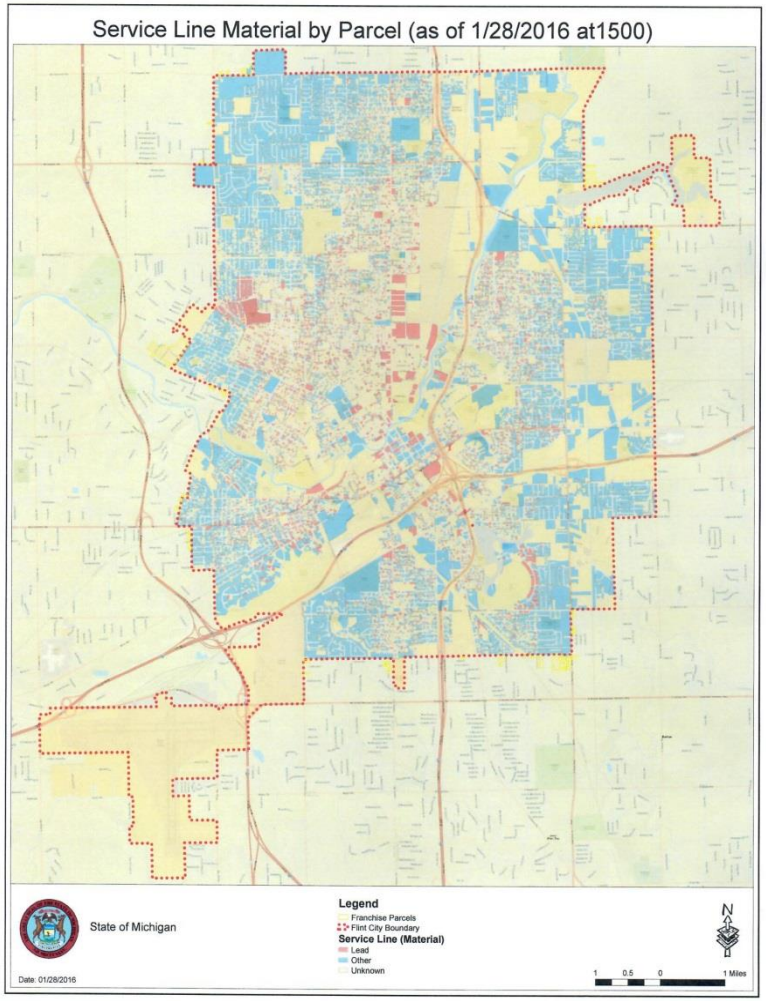
- Madison began to fully replace Lead service lines in 2001
  - About 8,000 lines were found
  - Cost estimated at $15.5 Million
    - The City faced problems because the service lines are private property and the public balked at using public funds for the replacements
  - The study revealed:
    - After replacement, it took 4 years before major spikes of Lead were no longer seen
    - Where service lines were Lead coupled to galvanized
      - Removal of the Lead portion caused the iron oxide to absorb Lead, then release it slowly – it took 8 years for lines to get below 5 ug/L

Flint Began Replacement in March

- 30 were scheduled in first month – we needed to establish a unit cost
  - 20 got done
    - Weather - Multiple connections off one line – bad records
  - Another 13 were completed in April
- A unit cost of approximately $4,500 was determined
- Committee recommended, and the City started on the next 500 lines
  - RFP for this work was let out in June 2016 - $20,000,000 was allotted
  - Homes picked using GIS, Census data, Density of population and children
    - Choosing Lead – to – Galvanized service lines
  - Bids came in at unit cost of $9,000 per line

Where are the Lead service lines?





Lead service lines in this Country

- According to a recent national estimate, a total of 6.1 million LSLs—either full or partial—are in place today in US community water systems (CWSs)
  - Providing water to an estimated 15 million to 22 million people (Cornwell et al. 2016)*.
- Lead is present in private plumbing systems, primarily in housing stock developed before 1986 when the use of Lead pipe was banned.

*Cornwell, D.A.; Brown, R.A.; & Via, S.H., 2016. National Survey of Lead Service Line Occurrence. Journal AWWA, 108:4:E182. http://dx.doi.org/10.5942/jawwa.2016

FWATF Finding F-1 and Recommendation R-1

- F-1.
  - MDEQ bears primary responsibility for the water contamination in Flint.
- R-1
  - Implement a proactive, comprehensive cultural change program within MDEQ, specifically its Office of Drinking Water and Municipal Assistance (ODWMA), to refocus the department on its primary mission to protect human health and the environment.

FWATF Finding F-2 and Recommendation R-2

- F-2.
  - MDEQ, specifically its Office of Drinking Water and Municipal Assistance (ODWMA), suffers from cultural shortcomings that prevent it from adequately serving and protecting the public health of Michigan residents.
    - MDEQ isn't training operators – nor being trained by operators
    - MDEQ answered "this was an important part of MDEQ staff training and it provided opportunities for contact with operators. However, due to increased workloads, staff are not as engaged as they once were"

FWATF Finding F-2 and Recommendation R-2

- R-2
  - Establish an apprenticeship/certification program for MDEQ ODWMA employees that requires direct, hands-on experience with public water system operations. MDEQ ODWMA employees responsible for water system regulation and SDWA enforcement should be, or have access to, certified operators and subject matter experts
  - After my response to the MDEQ outlining the cultural issue, I was assigned to work with MDEQ staff to develop training

FWATF Finding F-3 and Recommendation R-3

- F-3.
  - MDEQ misinterpreted the LCR and misapplied its requirements. As a result, Lead-in-water levels were under-reported and many residents' exposure to high Lead levels was prolonged for months.
    - "MDEQ discounted evidence of dangerous water quality problems, even manipulating sampling procedures mandated by the LCR. The US Environmental Protection Agency (USEPA), on learning of these transgressions, waited months to act."*

*July 2016 Journal AWWA

FWATF Finding F-4

- F-4
  - MDEQ waited months before accepting EPA's offer to engage its Lead (Lead) experts to help address the Flint water situation and, at times, MDEQ staff were dismissive and unresponsive.

FWATF Recommendation R-19

- R-19 (not tied to a specific finding)
  - Review budget requests for MDEQ to ensure adequate funding is provided to the ODWMA. EPA audit and interviews indicate that Michigan's drinking water program might have one of the lowest levels of financial support within EPA Region V while having one of the largest, if not the largest, number of community water systems (CWS) to regulate.
    - From 2010 to 2016, MDEQ lost 12 field engineering positions due to budget decreases and attrition
      - The number of Full Time Equivalents (FTE's) has decreased

R-19 PWS to FTE comparisons in USEPA Region V Based in part on 2011 ASDWA Report

- Michigan
  - Population 9.9 million
  - 1,425 PWS
    - 85 Full time equivalents
    - Ratio of PWS to FTE = 16.8
- Ohio
  - Population 11.5 million
  - >4,800 PWS
    - 147.5 Full time equivalents
    - Ratio of PWS to FTE = 32.5
- Minnesota (best in region)
  - Population 5.3 million
  - ≈ 1,000 PWS
    - 112 Full time equivalents
    - Ratio of PWS to FTE = 8.9
- Indiana (worst in region)
  - Population 6.6 million
  - 4,105 PWS
    - 51.5 Full time equivalents
    - Ratio of PWS to FTE = 79.7

Sampling Programs and Results

INCLUDING STATE AND CITY EFFORTS,
ALONG WITH EFFORTS OF OUTSIDE EXPERTS

Data From Ongoing Sampling Programs

- Children's Blood Levels
  - Report is generated by MDHHS to track Blood Lead Level test results in Flint, Michigan
  - Between 10/1/2015 and 5/27/2016, an additional 24,999 people were tested in Flint
  - A child on Medicaid is required to be screened for blood Lead levels
- Sentinel Sampling Results
  - Conducted by Michigan DEQ – 600 locations
- Residential Testing Results
  - Virginia Tech – Marc Edwards – 174 locations
- School Drinking Fountain Testing Results
  - Conducted by Michigan DEQ – all City Schools
- City of Flint WTP Orthophosphate – and the pH / chlorine issue – ordered by USEPA
  - Conducted by plant staff

Blood Lead Levels

- Continued testing efforts by Genesee County Health Department, MDHHS, and local medical personnel have identified 160 children under age 18 in Flint with blood Lead levels greater than or equal to 5 mcg/dL (micrograms Lead per deciliter of blood) since 10/1/2015.
- Of children younger than 6 years old tested between 10/1/2015 and 5/27/2016, 2.2% had blood Lead levels greater than or equal to 5 mcg/dL.
- Nineteen of the 46 children (41.3%) younger than 6 years old with an elevated blood Lead level (tested between 4/1/2016 and 5/20/2016) had a previous test result greater than or equal to 5 mcg/dL.

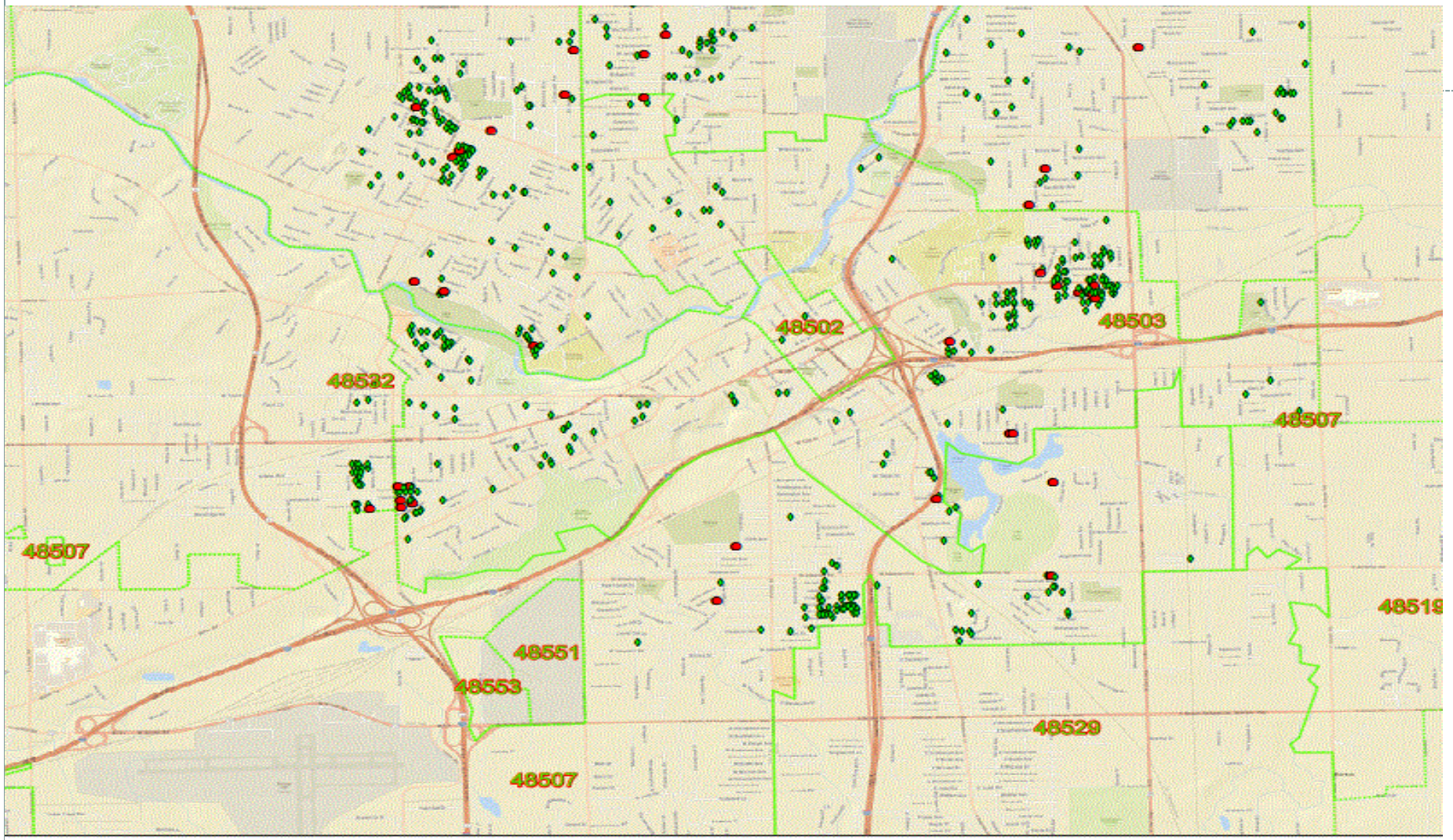
Incidence of elevated blood lead ≥ 5 mcg/dL among children < 6 years of age by quarter, Michigan, 2010-2016

*Data for Quarter 1 of 2016 is subject to change.
**Data for Quarter 2 will be graphed once the quarter is complete.

Lead Sampling – Sentinel Program

- Approximately 600 homes were being sampled for Lead contamination in the water supply
  - The worst case scenario sites were chosen for sampling
- The database is a public record and can be viewed at:
  - http://www.michigan.gov/flintwater/
- As of May, 2016, there were some sites showing in excess of 20,000 ug/L
  - Sites that are just Lead service lines are improving – sites with Lead solder and brass fittings are slower to improve

Sentinel Sites Map



Legend

Lead_PPB

- 586 Results less than or equal to 15 parts per billion of Lead
- 40 Results greater than or equal to 16 parts per billion of Lead
- Flint Area Zip Codes

State of Michigan

Date: 5/10/2016

N

1 0.5 0 1 Miles

Residential Testing Results

- Marc Edwards and his team from Virginia Tech
  - In March 2016, 174 Flint residents (out of 269 who participated in the original August 2015 sampling of Flint water) re-sampled their homes for Lead in drinking water.
  - The goal was to track possible improvements since the switch back to Detroit water in October 2015 and implementation of improved corrosion control (i.e., extra phosphate added beyond that present in Detroit water) starting December 2015.
  - This work was coordinated by Virginia Tech and was funded by the United States Environmental Protection Agency (US EPA).
  - The following conclusions are based on a preliminary evaluation of this sampling event.

Comparing water quality in August 2015 vs. March 2016

To assess improvements since switch back to Detroit water and implementation of improved corrosion control

Courtesy Marc Edwards, Va. Tech.

Sampling protocol

Collected water samples from a cold water tap that is **used for drinking water**

6+ hour stagnation → 

1 L
First draw (FD)

Flush for 45 seconds → 

500 mL
~1 min flush

Flush for 2 minutes → 

250 mL
~3 min flush

Courtesy Marc Edwards, Va. Tech.

Homeowner sampling in Flint

August 2015: 269 homes sampled

- Participation rate: 90%

March 2016: 187 homes sampled

- Participation rate: 70%

174 homes participating in both 2015 and 2016 used for analysis

Courtesy Marc Edwards, Va. Tech.

Two years later - 20 Highest Results for Households (Virginia Tech data)

Sample Number	Date Submitted	Analysis (Lead)	Lead (ppb)
LG37030	4/18/2016	Lead	22,905
LG42004	5/3/2016	Lead	13,295
LG20441	3/4/2016	Lead	11,846
LG31194	4/2/2016	Lead	11,070
LG11253	2/9/2016	Lead	10,467
LG37991	4/21/2016	Lead	10,450
LG39875	4/27/2016	Lead	10,306
LG21835	3/9/2016	Lead	9,416
LG48019	5/26/2016	Lead	9,032
LG17956	2/24/2016	Lead	7,391
LG06432	1/30/2016	Lead	6,290
LG02507	1/22/2016	Lead	5,447
LG18457	2/26/2016	Lead	5,254
LG01574	1/21/2016	Lead	5,013
LG30993	4/1/2016	Lead	4,931
LG01371	1/21/2016	Lead	4,247
LG29472	3/29/2016	Lead	3,343
LG17488	2/24/2016	Lead	3,207
LG43586	5/10/2016	Lead	3,008
LG28235	3/25/2016	Lead	2,562

1,500 times the AL of 15 ug/L

600 times the AL of 15 ug/L

200 times the AL of 15 ug/L

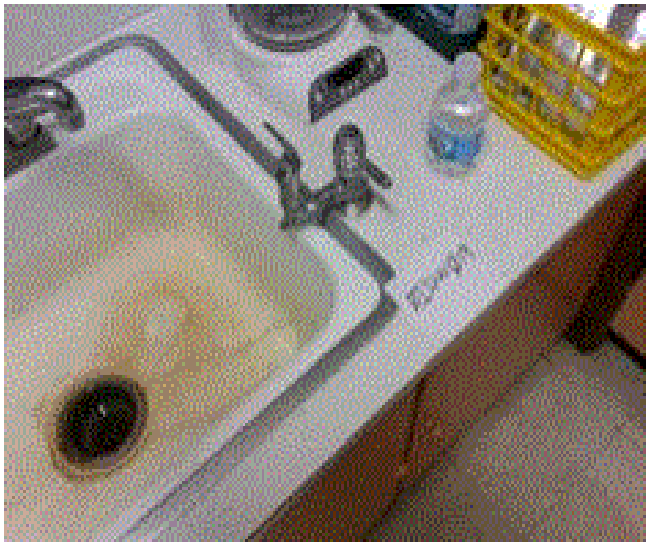
School drinking fountain tests

- The City schools are being tested, each with many drinking fountains and sinks
  - Samples are drawn for the first 125 mLs, and then the next 125 mLs
  - The fountain is then flushed for 30 seconds and sampled, then flushed for two minutes and sampled
  - Ten 1 Liter samples are also obtained from the service lines of the schools
- As an example, one of the schools – Pierce Elementary School – has 34 faucets/fountains that are tested

Example Faucet Results for Pierce Elementary School

Outlet: Bubbler Fountain (01DW019)

Location: Classroom 302, southwest wall
Results: P1=220 parts per billion, P2=23 parts per billion
F01=3 parts per billion, F02=2 parts per billion



These results suggest the highest contribution of lead may be from the bubbler and its connecting plumbing. This bubbler fixture is made of chrome-plated brass, with a brass operating valve, and a brass connector on the underside of the sink. Connecting plumbing in the cabinet under the sink should be checked for brass components and copper piping with lead solder.

Replacement of this bubbler tap and its connecting plumbing with lead-free materials will significantly reduce lead exposure at this location. If replacement is not currently feasible, sample results indicate that flushing this tap for three minutes following periods of stagnation is likely to reduce lead concentrations and lead exposure.

City of Flint WTP OPS

- Was ordered by USEPA to augment City of Detroit Water with an extra orthophosphate
  - Levels to be kept at 3.0 mg/L
- Was then ordered by USEPA to add additional chlorine and caustic soda
  - Extra 0.3 mg/L chlorine and keep pH at range of 7.5 to 7.8
    - Water comes in from Detroit at 7.2 or so pH

Flint WTP

current USEPA mandated chemicals

Phos Acid

Caustic

Hypo

Enhanced orthophosphate

- USEPA has mandated 3.0 mg/L PO4
- The WTP takes in Detroit finished water which has ≈ 1.0 mg/L PO4, and is supposed to bring that up to the 3.0 goal
- To the right are two 9-day periods – Jun and Jul

1.22
3.60
3.68
3.70
3.68
3.55
3.39
3.68
3.86

Ortho phosphate (mg/L PO4)
1.11
4.10
3.15
3.09
3.06
3.09
2.86
3.12
3.12

FLINT WATER PLANT & FACILITIES

WEEKLY ENHANCED QUALITY PARAMETER MONITORING

SAMPLE POINT IDENTIFICATION		PARAMETERS AND RESULTS									
Distribution System Location #	Sample Week	Temperature (°C)	Conductivity (mS)	pH (su)	Total Alkalinity (mg/L $CaCO_3$)	Calcium (mg/L Ca^{2+})	Hardness (mg/L $CaCO_3$)	Turbidity (NTU)	Iron (mg/L)	Chloride (mg/L Cl^-)	Ortho phosphate (mg/L PO_4)
#1	Jan. 17	14.0	0.18	7.74	72	36.1	100	0.167	0.1	11	2.76
#2	Jan. 17	11.9	0.20	7.47	70	36.1	100	0.118	0.03	11	3.77
#3	Jan. 17	9.4	0.20	7.48	70	34.5	102	0.17	0.06	11	3.96
#4	Jan. 17	9.8	0.21	7.46	72	35.3	98	0.143	0.06	12	3.69
#5	Jan. 17	9.3	0.21	7.49	70	36.9	102	0.182	0.07	12	3.29
#6	Jan. 17	15.4	0.22	7.67	74	35.3	102	0.163	0.05	11	2.67
#7	Jan. 17	13.1	0.20	7.51	72	35.3	98	0.203	0.03	11	3.50
#8	Jan. 17	13.3	0.21	7.41	70	37.7	98	0.169	0.02	11	3.75
#9	Jan. 17	6.2	0.21	7.43	72	34.5	102	0.125	0.02	11	1.16
CS	Jan. 17	10.2	0.21	7.61	74	34.5	104	0.231	0.05	19	3.09
WS	Jan. 17	9.5	0.24	7.59	72	37.7	100	0.289	0.05	10	3.43

July 2016 Journal AWWA Roundtable

- Moderator Mike McGuire:
  - How in the world did this happen?
- Participants:
  - Joan Rose – "Complacency, lack of communication, lack of diagnostic testing. Failure to listen, and political pressures"
  - Janice Beecher – "At its core, the Flint Water Crisis constitutes serial regulatory failure leading to operational failure"
  - Mona Hanna-Atisha – "There are people and agencies at the county, city, state, and federal levels whose main job is to make sure the water that comes out of your tap is good and that the populations are protected and Lead levels are tracked. Everyone failed the people of Flint."

Final Thoughts

- Back in time to the early 1990's
  - American Water Works Association argued against Lead service line replacement by Utilities
    - It lobbied the political establishment, stating:
      - The cost would be prohibitive to customers
      - Service line ownership is a confused jumble of rules that differ from one Utility to another
      - The technology existed (orthophosphates) to passivate the Lead in service lines rendering them harmless
  - We now know differently, and AWWA has changed its policy

Final thoughts

- Nationwide, there are aggressive efforts
  - there are law firms looking at the practices of utilities to see if there is the potential to bring a lawsuit
    - They look for clues: population concentration of low-income families, old neighborhoods likely to have Lead plumbing, Lead and Copper reports that show a pattern for several years
  - There are companies that manufacture Lead testing kits, and they are talking directly to your customers to try to get them to take samples and mail them in
    - They look for clues: CCR, source water, Lead and Copper reports that show a pattern for several years
- Commonality? – use the fears of the public to divide and conquer