Preventing Lead Contamination of Water

Presented to

City of Richmond Council

Land Use Committee

2/16/16

Safe Drinking Water

- History/Background
- Lead and Water
- DPU's Efforts
- Property Owner's Responsibility
- Public Education
- Moving Forward

History/ Background

- What is Lead?
- Why is it harmful?
- Where is it found?
- Who is at risk?
- What are the health effects?

- Naturally occurring element
- Found in earth's crust
- Chemical symbol (Pb) comes from Latin word for waterworks (or plumbing), plumbum

History/ Background

- What is Lead?
- Why is it harmful?
- Where is it found?
- Who is at risk?
- What are the health effects?

- Highly toxic metal
- Cannot be seen, smelled, or tasted
- Can be damaging at low levels
- Does not break down naturally and can remain until it is removed

History/ Background

- What is Lead?
- Why is it harmful?
- Where is it found?
- Who is at risk?
- What are the health effects?

- Lead has widespread use including:
  - Mining
  - Smelting
  - Manufacturing
  - Recycling
- More than 3/4 of global lead consumption is for lead-acid motor vehicle batteries

History/ Background

- What is Lead?
- Why is it harmful?
- Where is it found?
- Who is at risk?
- What are the health effects?

- Used for many years in products found in and around homes including:
  - Paint
  - Ceramics
  - Pipes/plumbing material
  - Gasoline
  - Batteries
  - Cosmetics
  - Toys
  - Dust

History/ Background

- What is Lead?
- Why is it harmful?
- Where is it found?
- Who is at risk?
- What are the health effects?

- Can affect all, but particularly dangerous to children
  - Growing bodies absorb more lead and more sensitive to damaging effects
- Pregnant women also impacted due to potential exposure to developing baby

History/ Background

- What is Lead?
- Why is it harmful?
- Where is it found?
- Who is at risk?
- What are the health effects?

- While it has some beneficial uses, can be highly toxic to humans and animals
- Can cause a range of health effects
  - Behavioral problems
  - Learning disabilities
  - Slowed growth
  - Hearing problems
  - Anemia

History/ Background

- What is Lead?
- Why is it harmful?
- Where is it found?
- Who is at risk?
- What are the health effects?

- Other health effects
  - Reduced growth of fetus in pregnant women
  - Premature birth
  - Cardiovascular effects, increased blood pressure and incidence of hypertension
  - Decreased kidney function
  - Reproductive problems

History/ Background

- What is Lead?
- Why is it harmful?
- Where is it found?
- Who is at risk?
- What are the health effects?

- Health effects same whether lead is:
  - Breathed in
  - Swallowed
  - Absorbed
- Lead is absorbed and stored in bones, blood, tissues acting as continuous source of internal exposure

Lead and Water

- Sources
- Corrosion

- Most sources of drinking water have no or very low levels of lead
- Most lead gets into drinking water after water leaves treatment plant and comes into contact with plumbing materials containing lead

Lead and Water

- Sources
- Corrosion

- Plumbing components include:
  - Lead pipes and lead solder (commonly used until 1986)
  - Faucets, valves, and other components made of brass

Lead and Water

- Sources
- Corrosion

- Potential for lead to leach into drinking water increases in proportion to length of contact with lead plumbing

Lead pipe, corroded pipe, pipe treated with protective orthophosphate

Lead and Water

- Sources
- Corrosion

- Corrosion contributes to amount of lead released from plumbing components into drinking water
- Tends to occur more frequently in:
  - "Soft" water (water that lathers soap easily)
  - Acidic (low pH) water

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Safe Drinking Water Act
  - Enacted in 1974 by Congress; Amended and reauthorized in1986 and 1996
  - Requires EPA to determine level of contaminants in drinking water at which no adverse health effects are likely to occur with adequate margin of safety

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Safe Drinking Water Act
  - Non-enforceable health goals, based solely on possible health risks are called maximum contaminant level goals (MCLG)
  - MCLG for lead is zero based on best available science which shows there is no safe level of exposure to lead

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Safe Drinking Water Act
  - Amended in 2011 to include "Reduction of Lead in Drinking Water Act"
  - Amendment made it illegal in the US as of Jan. 4, 2014, to use pipes, pipe fittings, plumbing fittings or fixtures that come into contact with drinking water that do not meet the new definition of lead free. This legislation changes the definition of "lead-free" to <0.25% lead, and any new meters, pipe saddles, etc., that are installed have to meet this new definition as well as any parts that are used in repairs.

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Lead and Copper Rule
  - Maximum contaminant level (MCL) is set as an enforceable regulation by EPA and is based on MCLG
  - MCLs set as close as possible to MCLGs based on costs/benefits and ability of public utilities to detect and remove contaminants using suitable treatment technologies

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Lead and Copper Rule
  - EPA established treatment technique for lead rather than an MCL for lead due to it's link to infrastructure
  - Requires water systems to control corrosivity of water
  - Requires collection of tap samples from sites served by system

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Lead and Copper Rule
  - If more than 10% of tap water samples exceed lead action level of 15 parts per billion, additional actions are necessary including:
    - Further steps to optimize corrosion control treatment
    - Public education
    - Replace portions of lead service lines under system's control

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Richmond and LCR
  - "Loop Study" was started in 1992 which collected and analyzed water data
  - Those results fed into LCR-required Lead and Copper Corrosion Control Study completed in 1994
  - Recommendations included optimal chemical, chemical dose, and pH to best keep lead from leaching into drinking water

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Liquid Zinc Orthophosphate (ZOP)
  - Recommended chemical to best accomplish goal
  - Forms cathodic film inside of distribution piping
  - Acts as barrier between pipe wall and water to prevent compounds from leaching into water

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- pH Levels
  - Water with low pH (<7.0) is corrosive; Water with high pH (>8.3) is scale forming
  - Plant's finished water (post-filtration, post clear well) enters basin with average pH of 6.8
  - Adjustments have to be made to reduce corrosion

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- pH Levels
  - Calcium Carbonate (lime) and Sodium Hydroxide (caustic soda) are added to increase pH and alkalinity of water to make it less corrosive
  - ZOP most effective at minimizing lead solubility when pH range is 7.4 to 7.8
  - Yearly average pH of water leaving water plant is 7.7
  - Critical to maintain stable pH throughout distribution system


1490


GLI
International
MODEL 33
pH: 7.10pH
TEMP: 76.4°F
A B
MENU
ESC
ENTER

2014 Consumer Confidence Report

Microbial Contaminants

Substance	Likely Source	Richmond's Samples Indicating Bacteria Presence	Richmond's Highest Monthly % of Positive Samples	MCL	MCLG	Sample Date	Meets EPA Standards
Total Coliform	Naturally present in the environment	2	1.6%[1]	5% of all samples positive per month	0	June 2014	☑
Fecal coliform & Escherichia coliform	Human and animal fecal waste	0[2]	0%	A routine sample and repeat sample are total coliform positive; one is fecal or E. coli positive	0	2014	☑

[1]Total Coliforrm – Highest monthly percentage of positive total coliform samples for 2014

[2] Fecal Coliform – Highest total number of positive samples per month in 2014

The EPA has implemented the Stage 2 Disinfectants and Disinfection Byproduct Rule (Stage 2 DBPR) and the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The Stage 2 DBP Rule provides increased protection against health effects associated with disinfection byproducts (DBPs). The LT2ESWTR further protects public health against Cryptosporidium and other microbial pathogens that may be present in drinking water.

2014 Consumer Confidence Report

Regulated Substances

Substance	Likely Source	Richmond's Results	Richmond's Range	MCL	MCLG	Sample Date	Meets EPA Standards
Fluoride (ppm)	Added to promote dental health	0.7		4	4	Aug. 2014	☑
Nitrate + Nitrate (ppm)	Fertilizer runoff, septic tank leakage, sewage, erosion of natural deposits	<0.05		10		Aug. 2014	☑
Total organic carbon removal ratio[3]	Naturally present in source water	1.3	-2.5 to 2.8	TT, removal ratio≥1.0		2014	☑
Alpha Emitters (pCi/L)	Erosion of natural deposits	<0.7		15	0	Feb. 12	☑
Combined Radium (pCi/L)	Erosion of natural deposits	<0.6		5	0	Feb. 12	☑
TTHMs (ppb) Total trihalomethanes[5]	Byproduct of drinking water chlorination	28	14-40	80		2014	☑
HAA5 (ppb) Haloacetic Acids[5]	Byproduct of drinking water chlorination	23	11 –24	60		2014	☑
Barium (ppm)	Discharge of drilling wastes; Discharge from metal refineries; Erosion of natural deposits	0.036 mg/L		2 mg/L		Aug. 14	☑

[3]TOC Removal Ratio – Amount detected is the lowest of the annual rolling average of the four quarterly calculations made in 2014; range is the minimum and maximum of all samples used to calculate average

[4] Radioactive Contaminants – Analyzed in 2012

[5] TTHMs and HAA5s – Richmond's Results are the maximum of the rolling annual average. The range is the minimum and maximum of all 2014 samples used to calculate those averages.

2014 Consumer Confidence Report

Disinfectant

Substance	Likely Source	Richmond's Results	Richmond's Range	MRDL	MRDLG	Sample Date	Meets EPA Standards
Chloramines (ppm) [6]	Disinfection	3.7	2.0 – 5.2	4	4	2014	☑

[6] Chloramines – Amount detected is the maximum of the annual rolling average; range is the minimum and maximum of all samples used to calculate average

Turbidity

Substance	Likely Source	Richmond's Results	MCL	MCLG	Sample Date	Meets EPA Standards
Turbidity (NTU)	Soil runoff	0.12, 100%[7]	TT, 1.0 NTU, Max ≤0.3 (95% of the time)		9/7/2014	☑

[7] Turbidity – Highest single measurement and the lowest monthly percentage of samples meeting monthly turbidity limits.

2014 Consumer Confidence Report

Lead and Copper

Substance	Likely Source	Richmond's Results	Richmond's Range	MCL	MCLG	Sample Date	Meets EPA Standards
Copper (ppm)	Corrosion of household plumbing; leaching from wood preservatives	0.062	No results exceeded action level	Action Level = 1.3	1.3	2013	☑
Lead (ppb)	Corrosion of household plumbing; erosion of natural deposits	6	5/50	Action Level = 15	0	2013	☑

Unregulated Monitored Substances

Substance	Likely Source	Richmond's Result	MCL	Sample Date	Unit
Aluminum	Erosion of natural deposits; addition of water treatment substances	<0.05		2014	ppm
Manganese	Naturally present in the environment	<0.01		2014	ppm
Nickel	Corrosion of household plumbing	<0.01		2014	ppm
Sodium	Naturally present in the environment; addition of water treatment substances	24.5	*	2014	ppm
Sulfate	Naturally present in the environment; addition of water treatment substances	60.1		2014	ppm

*For low or no salt diets, a limit of 20 ppm is suggested

2014 Consumer Confidence Report

Other Information

Substance	Richmond's Result	EPA's Suggested Limit	Sample Date	Unit
Alkalinity	50.0		2014	ppm
Chloride	20	250	2014	ppm
Hardness	86		2014	ppm
pH (acidity)	6.48	6.5 – 8.5	2014	su
Total Dissolved Solids	128	500	2014	ppm

Richmond gets its water from the James River

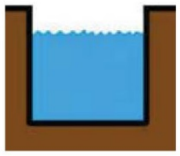
Water from the James River goes to the Water Treatment Plant

Settling basins remove large and medium particles

Filtration removes small to minute particles

Chemicals are added to treat water, correcting pH levels and alkalinity to make it less corrosive

Water reaches contact tank/corrosion control before leaving the plant and transported to water tanks



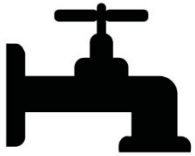
Water transported to and stored in tanks until distributed

Water carried to residences/businesses through a distribution system of pipes

These pipes carry water into your home

Lab sampling and testing done in various stages

Turn on your home faucet for high-quality water to use and drink



DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Lead Monitoring
  - Every three years
  - 50 locations throughout the service area
  - Water tested for lead and copper concentrations; Report submitted to the Department of Health.
  - Since the program started in 1992, we have been in compliance for both lead and copper levels.
  - On-demand monitoring is also performed

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- System Monitoring (pH and chemical dosage)
  - –10 specified locations around City monitored every 6 months for orthophosphate and pH to confirm the corrosion control measures at plant are maintained throughout the system
  - –Alkalinity added as additional measure in 2015
  - –Periodic lead monitoring – leaving the plant and in the system

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Sample Collection Procedures
  - Coordinate sample collection with customer
  - Minimum 6-hr period with no water usage required; 1st morning draw or 1st draw when home from work
  - Kitchen or bathroom cold-water faucet used

DPU's Efforts

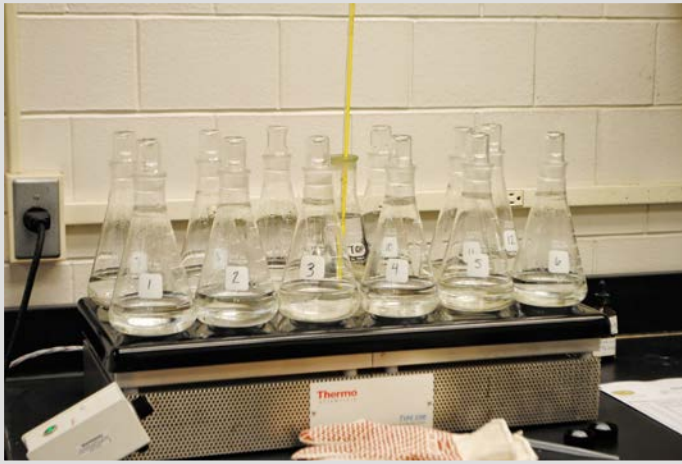
- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Sample Collection Procedures
  - Cap bottle, review label for correctness, place in kit
  - Note any plumbing repairs or replacement in home in past 3 years on label
  - Place sample kit outside residence; City will pick up

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Sample Collection Procedures
  - Results provided to participating customers when reports generated
  - In case of excessive levels of lead or copper, immediate notification is made



DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Monitoring Data

(50 monitoring sites)

Number of Sites	Pb Result (ug/l)	Pb Retest (ug/l)
38	<2.5	
1	2.5	
1	2.6	
1	3.1	
1	3.6	
1	3.8	
1	5.3	
1	5.5	
1	18.3	2.5
1	20.7	<2.5
1	29.5	6.7
1	70.5	<2.5
1	65.9	82.3

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Monitoring Data

(On-Demand samples)

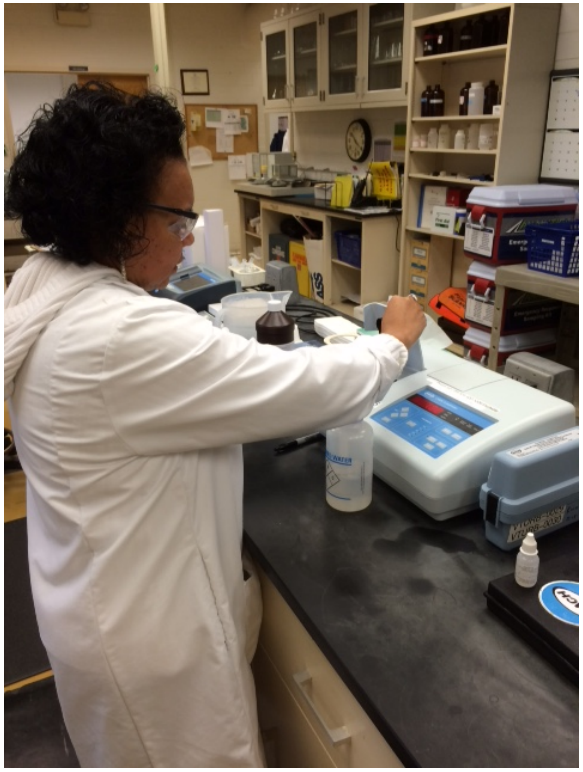
ID	Date	QUAL	Result (ug/L)
AA45353	1/4/2012	<	2.5
AA45352	1/4/2012	<	2.5
AA45356	1/4/2012	<	2.5
AA45351	1/4/2012	<	2.5
AA45355	1/4/2012	<	2.5
AA45354	1/4/2012	<	2.5
AA58300	10/14/2012	<	5
AA72449	8/19/2013	<	2.5
AA80776	3/7/2014	<	2.5
AA82364	4/10/2014	<	2.5
AA84030	4/24/2014	<	2.5
AA84031	5/1/2014	<	2.5
AA88881	8/29/2014	<	2.5
AA95955	12/12/2014	<	2.5
AA95956	12/29/2014	<	2.5
AA99576	3/23/2015	<	2.5
AA99577	4/3/2015	<	2.5
AB01020	5/29/2015	<	2.5
AB02586	7/7/2015		6.2
AB05997	9/25/2015		2.6
AB09943	12/18/2015	<	2.5
AB10449	12/28/2015	<	2.5

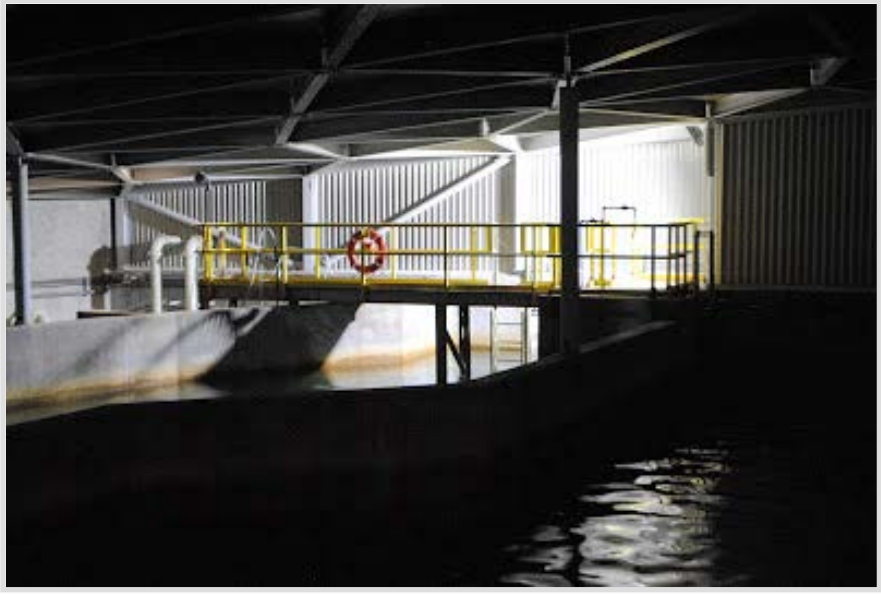
lead action level of 15 parts per billion (ug/l)

DPU's Efforts

- Regulations
- Chemistry
- Sampling/ Monitoring
- Continued Commitment

- Upgrades/Procedures
  - Upgraded ZOP and lime feed systems to help ensure proper chemical doses
  - New calcium hydroxide system going into service in next two months to better control pH of finished water
  - Continual online monitoring of pH levels with instant results
  - Staff perform chemical analysis twice daily to verify proper ZOP
  - Procedures have led to results qualifying for reduced monitoring





Property Owner's Responsibility

- Assessment
- Improvements

- Property owners should know if there is lead in the property
- Best place to test pipes is point where water from distribution pipes enter home
- https://youtu.be/j4mQMYvORsU

Property Owner's Responsibility

- Assessment
- Improvements

- If there is lead, steps should be taken to remove lead piping
- Cost: $6,500 (estimated price to replace pipes from water meter to home and internal plumbing; assumes average length of piping and no additional costs for demolition and repair

Public Education

- Health District
- DPU Lead Service Renewals
- General Tips

- Health District
  - Provides information and testing to City residents
  - Has a Lead Safe & Healthy Homes Initiative

Public Education

- Health District
- DPU Lead Service Renewals
- General Tips

- Lead service renewals
  - Completed on a coordinated schedule City-wide
  - Performed upon customer request when they are completing a renewal

Public Education

- Health District
- DPU Lead Service Renewals
- General Tips

- Consumer Confidence Report provides information on lead in the water
  - Produced each year
    - Published on City's website
    - Featured in Utility Talk
    - Mailed upon request

Public Education

- Health District
- DPU Lead Service Renewals
- General Tips

- Consumer Confidence Report

Public Education

- Health District
- DPU Lead Service Renewals
- General Tips

- Don’t drink hot water directly from tap
- Do not boil water to remove lead; Boiling water does not reduce lead
- Use only cold water to prepare food and drinks, including baby formula

Public Education

- Health District
- DPU Lead Service Renewals
- General Tips

- Flush water outlets used for drinking or food preparation
- Clean debris out of outlet screens or faucet aerators on regular basis

Moving Forward

- Future Regulations
- DPU's Actions

- National Drinking Water Advisory Council (NDWAC)
  - Federal Advisory Committee
- LCR Working Group
  - Richmond DPU participated
- LCR Working Group report – August 2015
- NDWAC forwarded recommendations to EPA - December 2015

LCR Working Group Report

- Recommendations to NDWAC
  - Require proactive lead service line (LSL) replacement programs, which set replacement goals, effectively engage customers in implementing those goals, and provide improved access to information about LSLs, in place of current requirements in which LSLs must be replaced only after a lead action level (AL) exceedance;
  - Establish more robust public education requirements for lead and LSLs, by updating the Consumer Confidence Report (CCR), adding targeted outreach to consumers with lead service lines and other vulnerable populations (pregnant women and families with infants and young children), and increasing the information available to the public;
  - Strengthen corrosion control treatment (CCT), retaining the current rule requirements to re-assess CCT if changes to source water or treatment are planned, adding a requirement to review updates to EPA guidance to determine if new scientific information warrants changes;

LCR Working Group Report (cont)

- Recommendations to NDWAC
  - Modify monitoring requirements to provide for consumer requested tap samples for lead and to utilize results of tap samples for lead to inform consumer action to reduce the risks in their homes, to inform the appropriate public health agency when results are above a designated household action level, and to assess the effectiveness of CCT and/or other reasons for elevated lead results;
  - Tailor water quality parameters (WQPs) to the specific CCT plan for each system, and increase the frequency of WQP monitoring for process control;
  - Establish a health-based, household action level that triggers a report to the consumer and to the applicable health agency for follow up;
  - Separate the requirements for copper from those for lead and focus new requirements where water is corrosive to copper; and
  - Establish appropriate compliance and enforcement mechanisms.

Moving Forward

- Future Regulations
- DPU's Actions

- Reduction of Lead in Drinking Water Act
  - Act which amended Safe Drinking Water Act provides plumbing standards
  - EPA developing regulatory language to implement this law; Proposed rule expected in 2016
- More regulations expected from EPA in 2017

Moving Forward

- Future Regulations
- DPU's Actions

- DPU's Actions
  - Revisit partial lead service replacement policy and revise policy following best practices
  - Change procedures when performing lead service renewals
    - Advise homeowners to flush water during process
    - Provide water filter pitchers and replacement filters for affected properties
    - Recommend timeline

Sources

- www.epa.gov
- www.awwa.org
- www.richmondgov.com/dpu
- Resource: How to test for lead pipe

  https://youtu.be/j4mQMYvORsU