

# Synergistic Impacts of Corrosive Water and Interrupted Corrosion Control on Chemical/Microbiological Water Quality: The Flint, MI Water Crisis



NSF RAPID:

National Science Foundation

*“used for proposals having a severe urgency...., including quick-response research on natural or anthropogenic disasters and similar unanticipated events.”*

Flint  
Water  
is very  
corrosive.

Detroit  
water is  
not.

Table 1. Water quality parameters for drinking water supplied in Flint, MI before and after the April 2014 switch			
Parameter		Before <sup>1</sup>	After <sup>2</sup>
pH		7.38	7.61
Hardness (mg/L as CaCO <sub>3</sub> )		101	183
Alkalinity (mg/L as CaCO <sub>3</sub> )		78	77
Chloride (mg/L)		11.4	92
Sulfate (mg/L)		25.2	41
CSMR <sup>3</sup>		0.45	1.6
Inhibitor (mg/L as P)		0.35	<u>NONE</u>
Larson Ratio <sup>4</sup>		0.5	2.3
<sup>1</sup> Source: City of Flint Monthly Operation Report, June 2015 Available from <a href="http://www.cityofflint.com">www.cityofflint.com</a>			

# Corrosive Water: Destroys Pipe Infrastructure

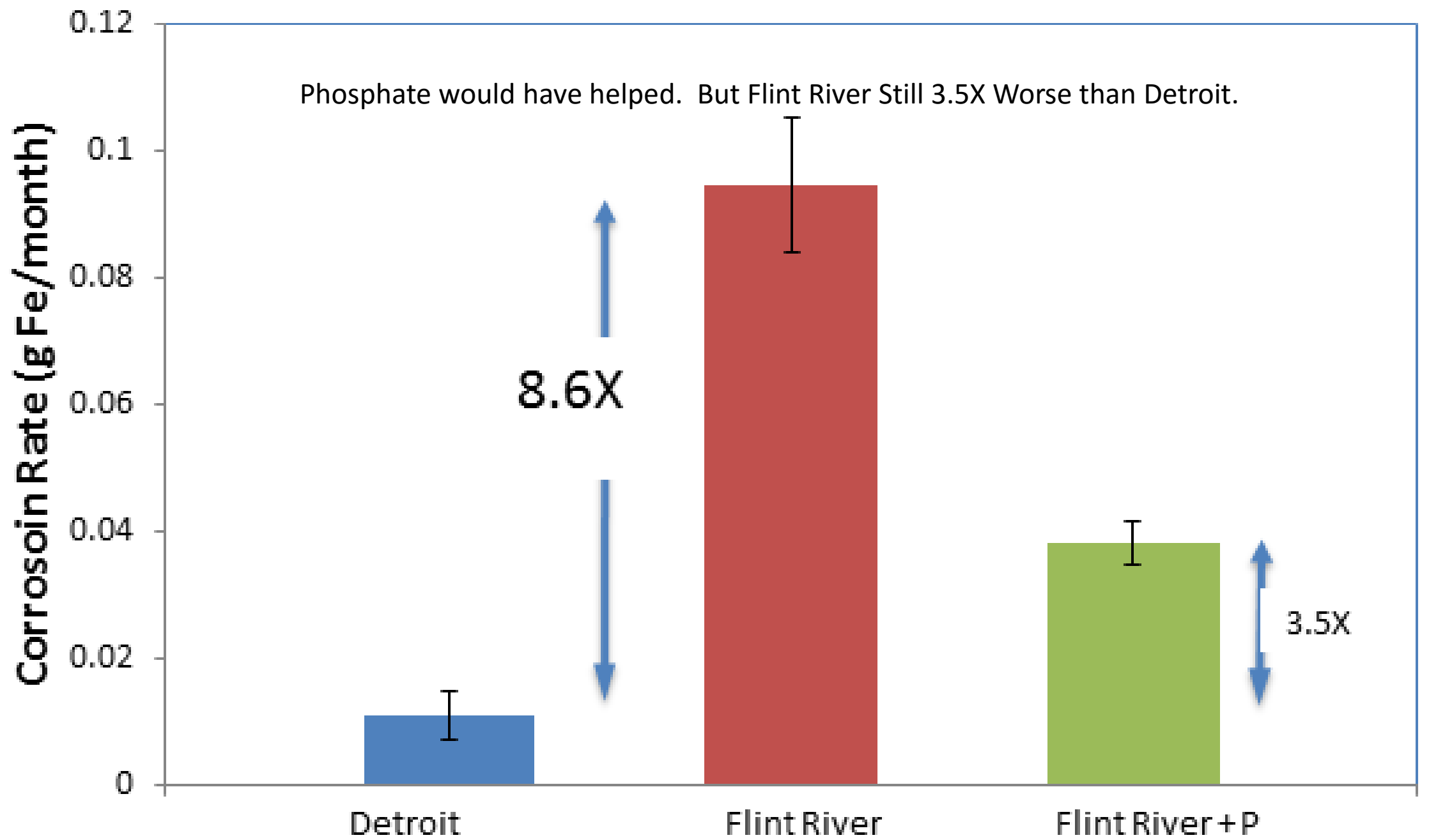




Detroit Water

Flint Water

**Steel Exposed One Month to Detroit vs. Flint River Water**





# Corrosive Water: Causes Odors, Colors, Bad Tastes



# High Levels of Corrosion Causing Bacteria



Heterotrophic  
Bacteria

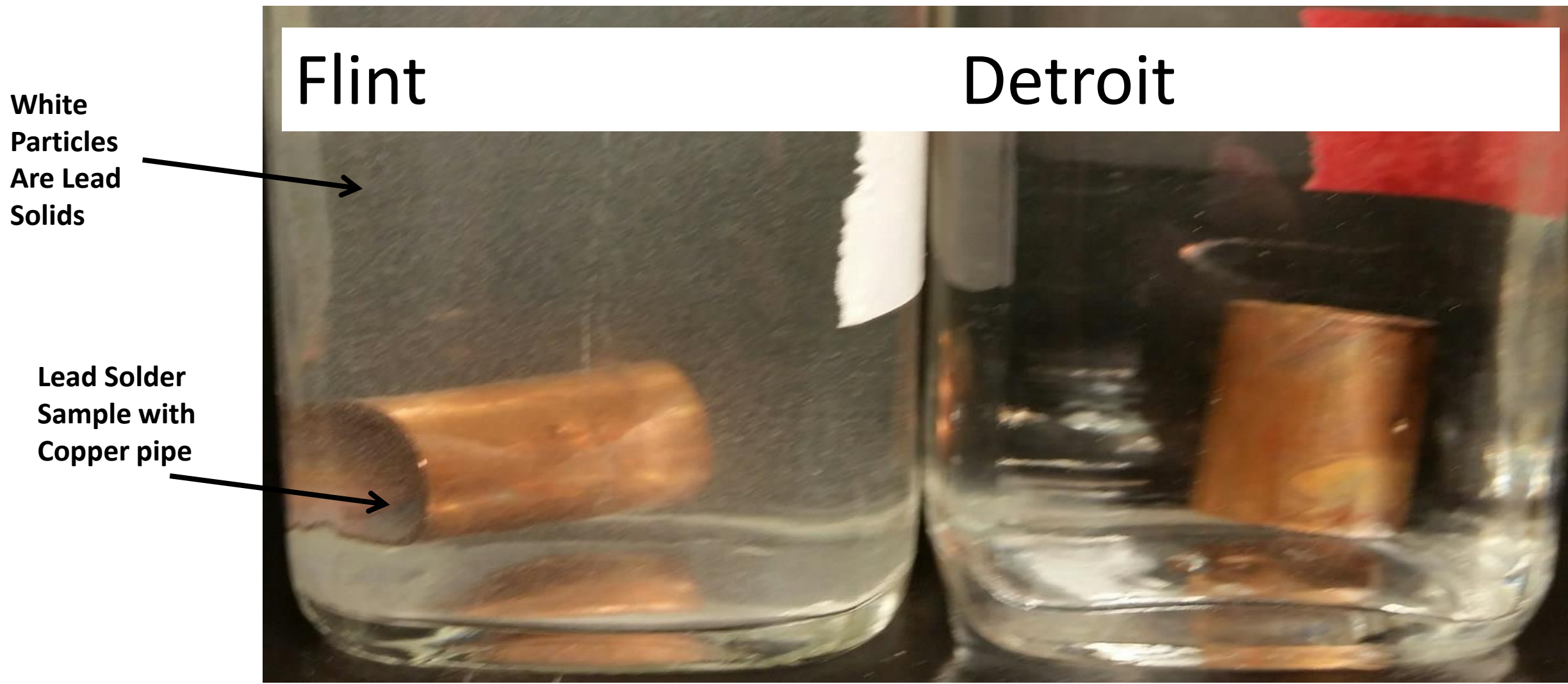
Acid  
Producing  
Bacteria

Iron  
Reducing  
Bacteria

Sulfate  
Reducing  
Bacteria

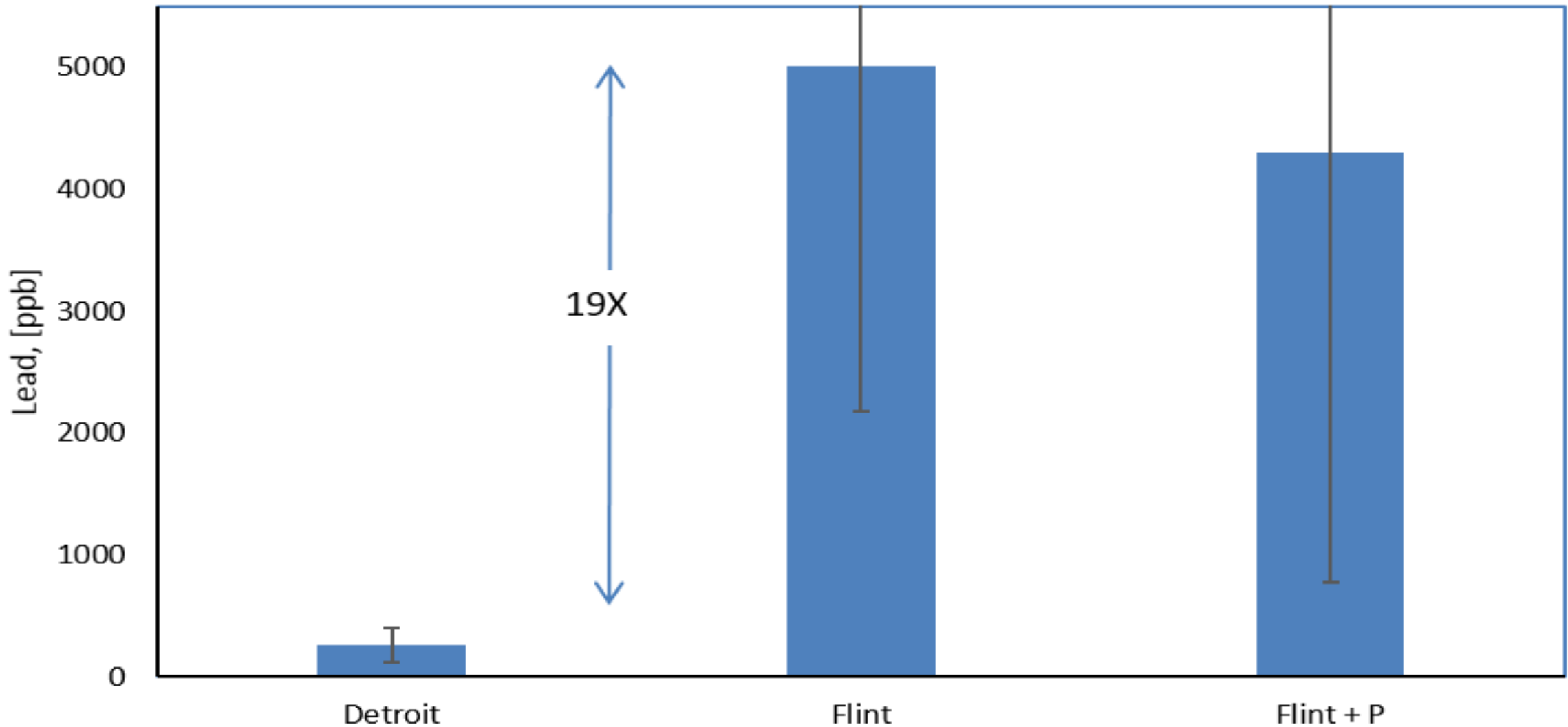
Slime  
Forming  
Bacteria

# Corrosive Water: Increases Lead. Effects VISIBLE immediately in lab tests!

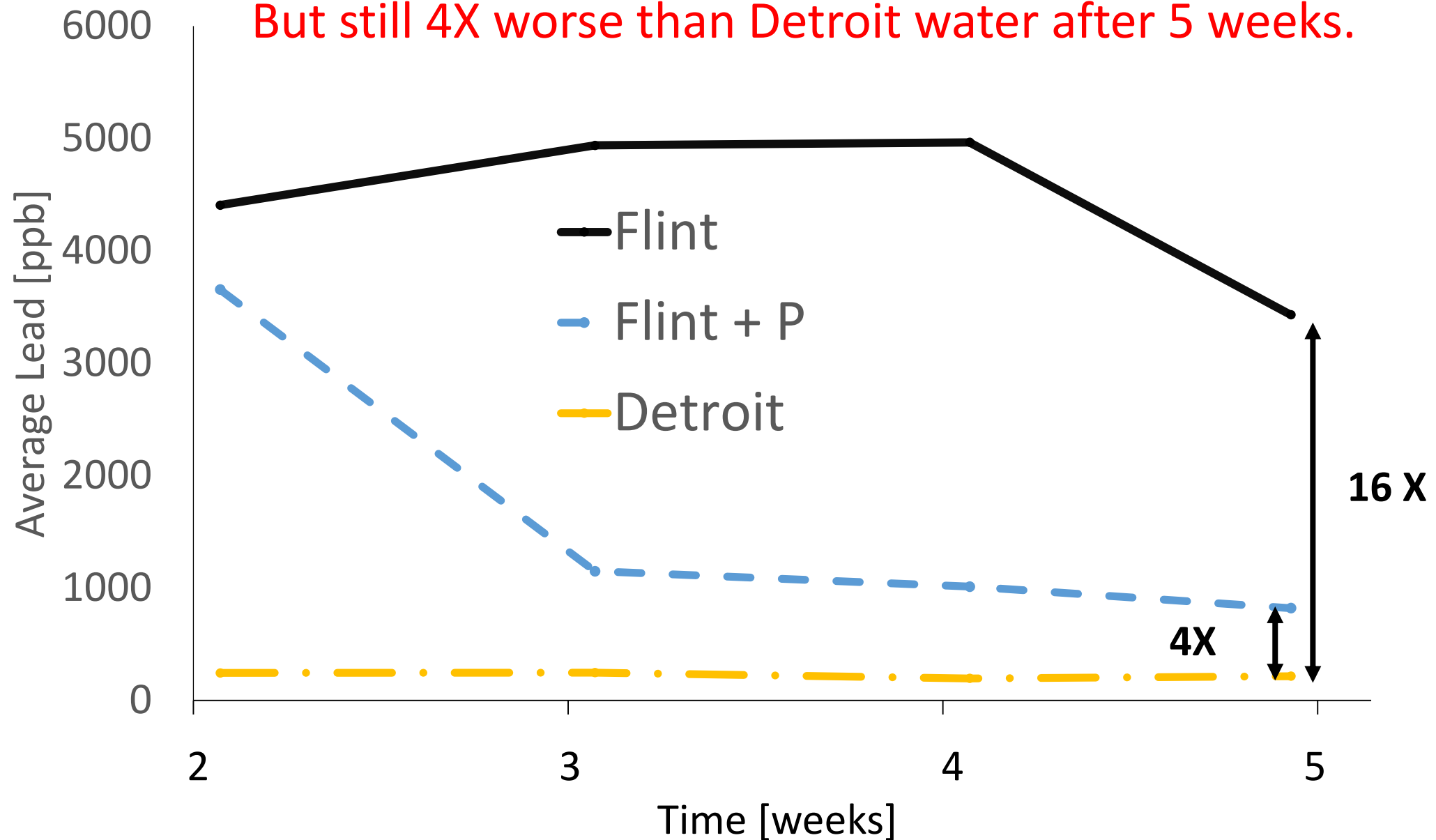




# 5000 ppb = Hazardous Waste Levels of Lead



Phosphate (P) corrosion inhibitor would have helped.  
But still 4X worse than Detroit water after 5 weeks.



# INITIATED CONFIRMATION TESTING OF LEAD CORROSIVITY AT ONE LOCAL ELEMENTARY AND ONE HIGH SCHOOL

**Vickie Weiss**

City School ~ Room 00  
11920 S. Saginaw  
Grand Blanc MI – 48439

4-5<sup>th</sup> Graders  
12+5 Bottles

**Emily Cizmas**

2283 E. Scottwood Ave.  
Burton, MI 48529

Bendle High School,  
Burton  
14+5 Bottles

**Experimental Rigs has  
also been sent to:**

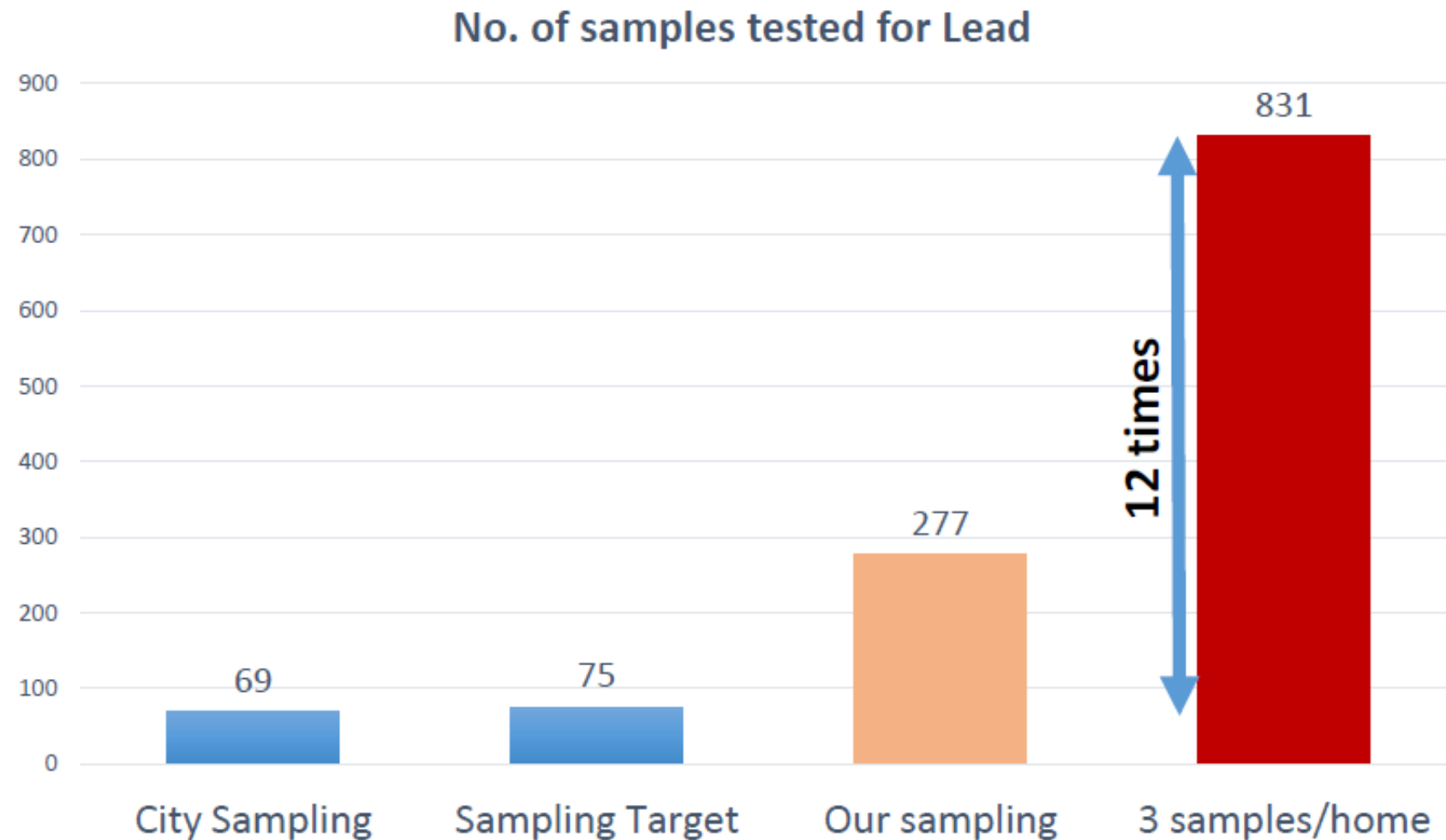
**Brad Wurfel**

Director of  
Communication  
Michigan DEQ  
P.O. Box 30473  
Lansing, MI 48909-6700

9 Bottles

**Aug 20 - Sep 8**

# #FlintWater sampling response from #FlintCitizenScientists





# The Team in Flint and from ACLU-Michigan



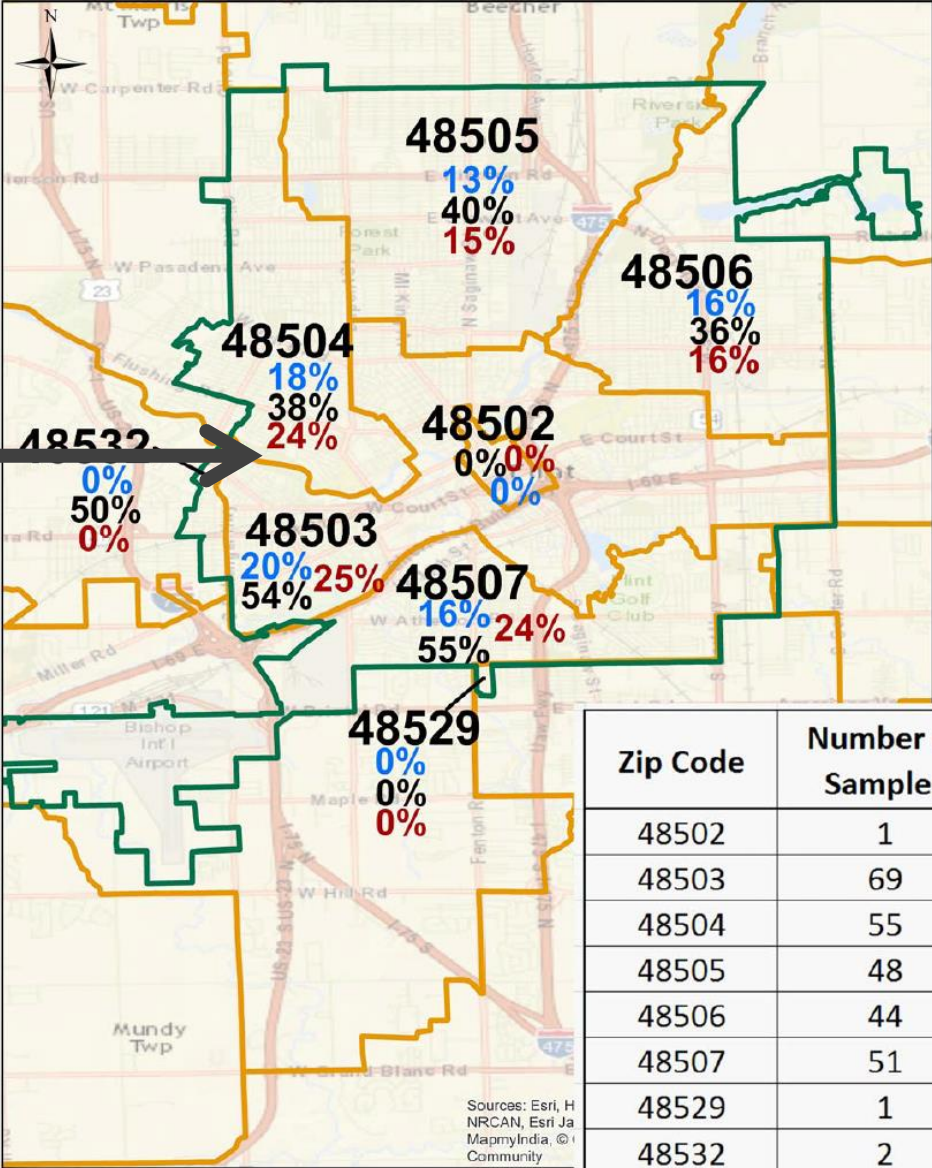
# PEDIATRIC LEAD EXPOSURE IN FLINT, MI: CONCERNS FROM THE MEDICAL COMMUNITY

Higher Risk Zip Codes  
For EBL

90%'ile from low risk homes  
> EPA Action Level

## Flint, MI

Legend:  
Blue %: Percent First Draw Samples over 15 ppb  
Black %: Percent Any Samples over 5 ppb  
Red %: Percent Any Samples over 15 ppb



Sources: Esri, H  
NRCAN, Esri Ja  
MapmyIndia, ©  
Community

## Corrosion control treatment to reduce lead in Flint water.

1. **Switch back to the non-corrosive Detroit water.**

Flint's lead levels would drop markedly in about one month.

2. **Add orthophosphate to Flint River water.** Orthophosphate will not reduce lead leaching from all lead plumbing sources. Based on experimental data, lead levels would likely be reduced by 5X, but still 4X higher than Detroit. Iron corrosion still much higher than Detroit.

*If orthophosphate had been added to Flint water, continuing the corrosion control used in Detroit water, the Flint Water Crisis would not have occurred.*



# About us

## Research Team

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Rebecca **Jones**

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Kelsey **Pieper**, David “Otto” **Schwake**, Fei **Wang**

Principal Investigators: [Dr. Marc Edwards](#), [Dr. Amy Pruden](#), [Dr. Joseph Falkinham III](#)



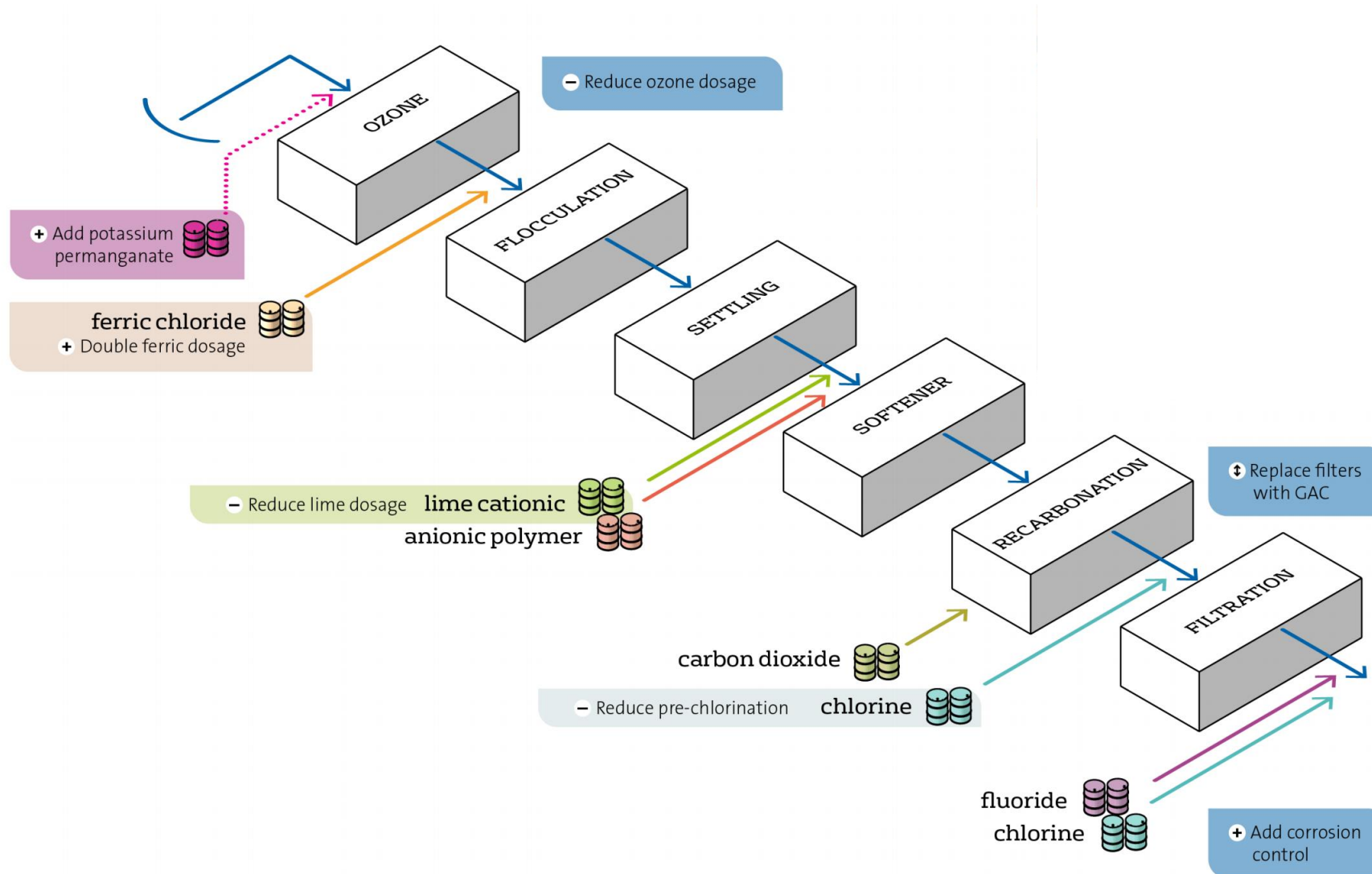




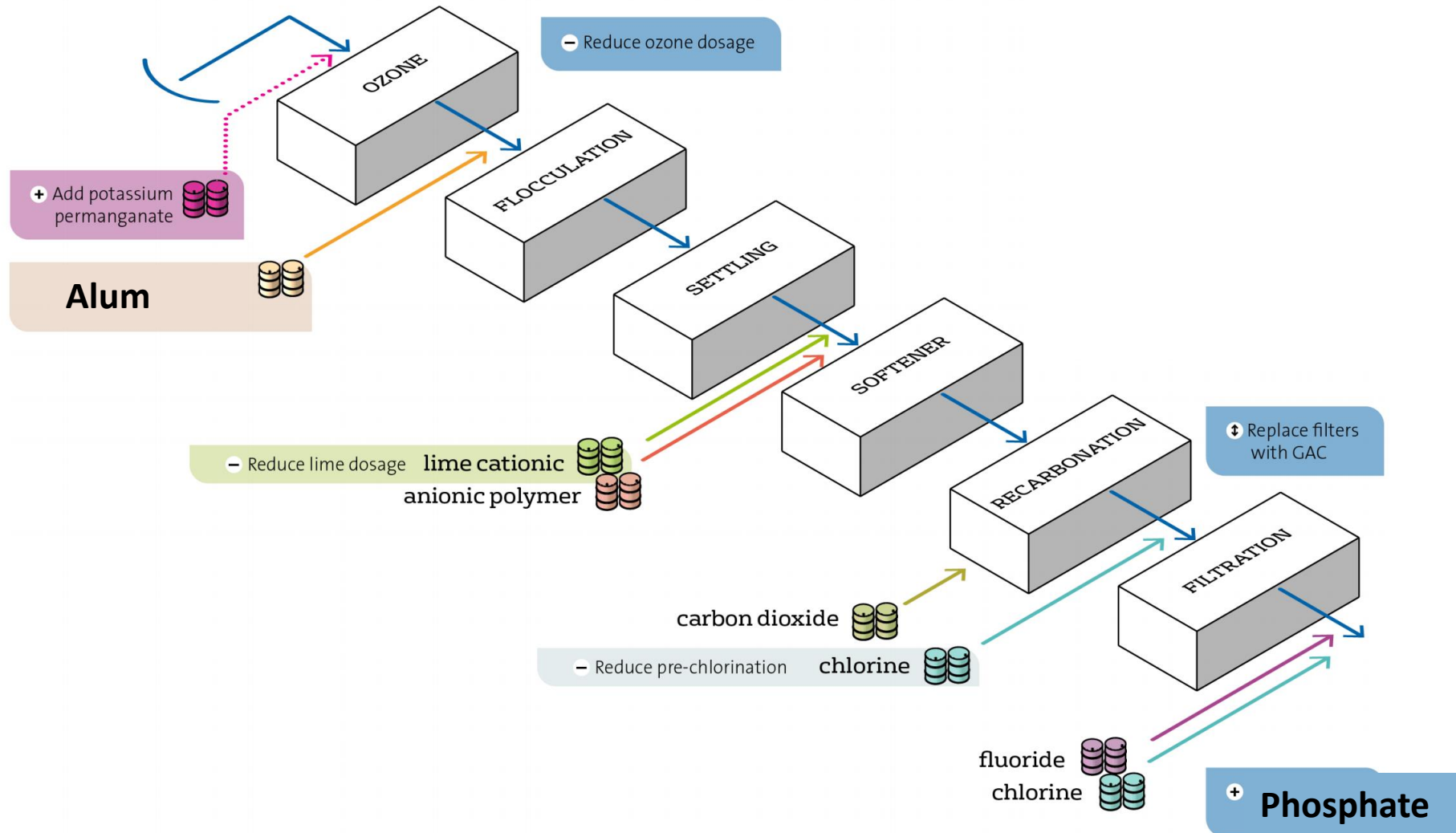
# Acknowledgements

- NSF
  - Flint Citizens
  - Wateryoufightingfor (Melissa Mays and Lee-Anne Walters)
  - Miguel Del Toral (Region 5 EPA)
  - ACLU-MICHIGAN (Curt Guyette)
  - Senator Ananich and Dan Kildee (and Great Staff)
  - **Flint Medical Community (esp. Mona Hanna-Attisha and Hurley team)**
  - Genesee County Health Department
  - Concerned Pastors for Social Action
  - Democracy Defense League
  - Others
- 
- City of Flint Water Department (Glasgow/Croft)

# Treatment Option 1



# Treatment Option 2





# CSMR for Ferric Chloride vs Alum

	Cl <sup>-</sup>	SO <sup>-</sup>	CSMR
Ferric Chloride	80	27	2.96
Alum	44	77	0.57