

# Michigan Water Crisis: Water Infrastructure Study

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## ABSTRACT

The United States is currently facing repercussions for an aging water infrastructure system. The Flint, Michigan Water Crisis serves as a reminder of the consequences that can result from a neglected infrastructure. When we investigated the Flint Michigan case further, the incident highlighted the urgent need for infrastructure upgrades nationwide. In our research, we looked into the systematic failures and socio-economic implications that took place. We analyzed the factors contributing to the crisis, including aging infrastructure and inadequate regulatory oversight. After reading advisory reports, we came to the conclusion that the issues were hasty decisions, poor oversight, and a lack of proper water treatment. This includes the absence of corrosive inhibitors and unbalanced pH levels. These aspects are explored through the study of various articles, government documents, and engineering reports. These documents have shown us key initiatives such as, the Water Infrastructure Finance and Innovation Act (WIFIA), Clean Water State Revolving Fund (CWSRF), and Drinking Water State Revolving Fund (DWSRF). They have provided funding and technical assistance to support infrastructure improvements, address contamination issues, and enhance water resilience across the nation.

## INTRODUCTION

The Flint, Michigan Water Crisis brought to light the detrimental consequences of neglecting water infrastructure maintenance. Our team took the task of researching this event, to learn about the various aspects of how the crisis occurred.

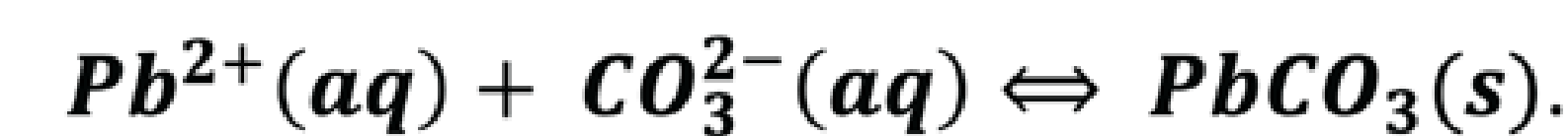
## IMPROPER WATER TREATMENT

After Flint, Michigan switched to Flint River as their main water source the following occurred:

- Michigan Department of Environmental Quality (MDEQ) did not provide proper guidance to engineers
- The MDEQ did not report accurate data to the governor on the water quality.
- pH level readings fluctuated significantly from 7.0 to 8.6
- No corrosion inhibitors were used to prevent pipe corrosion. After the fact, the standard 1 mg/L Phosphoric Acid was pushed to 2.5 mg/L to correct the issue
- About 50% of the infrastructure was not properly documented in Flint, Michigan

## LEAD CORROSION

The chemical reactions involved in pipe corrosion are complex, but can be simplified into a precipitation reaction:



Due to the lack of phosphate ions and having a low pH level, the protective mineral layer broke down and the elemental lead in the pipes leached into the water with no binder to precipitate. By following Le Châtelier's principle, the now excess hydrogen in the system reduced the carbonate supply; and, in return, it generated an excess of soluble lead ions.

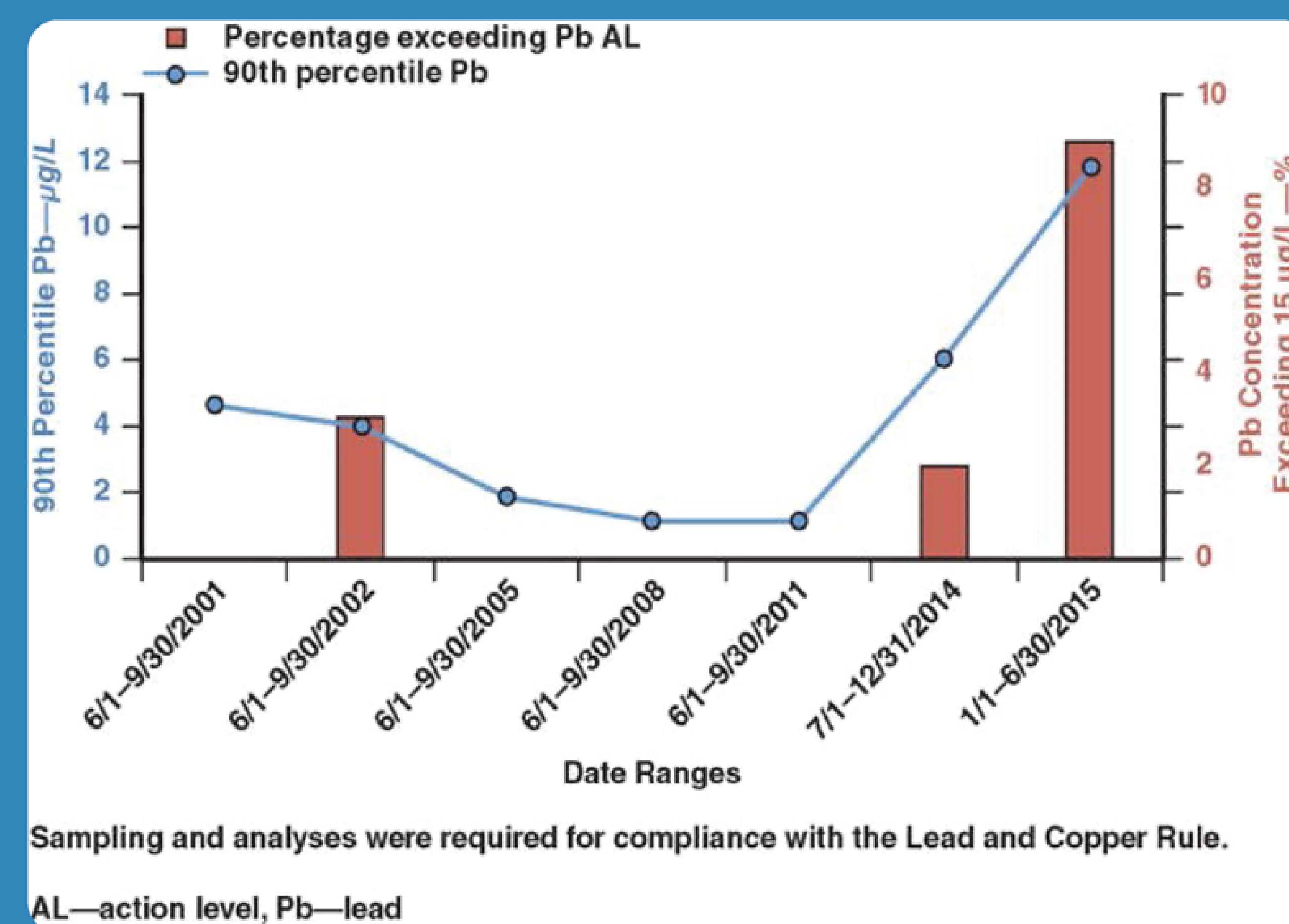


Figure 2. Historical Data for Lead Concentrations in the Flint Distribution Systems

## HEALTH IMPACT

The lead in the pipes brought about several health impacts upon the local population. Some of the health problems that occurred were rashes, skin irritation, and Legionnaire's Disease (which has symptoms similar to pneumonia). Neurological damage within young children also occurred in addition to the health problems above.

THE FLINT, MICHIGAN WATER CRISIS - LEGIONNAIRES' DISEASE OUTBREAK

### LEGIONNAIRES' CASES IN MICHIGAN

Legionnaires' cases in Michigan, per 100,000 residents, 2014 and 2015

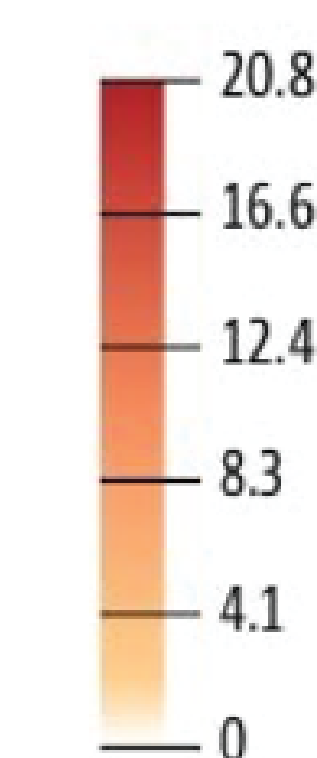


Figure 3. Spread of Legionnaires Disease

## GOVERNMENT RESPONSE

Due to this disaster, the expectations of the local government would have been immediate action; however, there was a delay in response due to improper instruction from the MDEQ. Statistics show that 44.7% of Flint, Michigan distrust the local government and 55.3% said they distrusted their state government. Unlike the local government, the federal government responded quicker and more effectively. A 100 million dollar grant from the Drinking Water State Revolving Fund (DWSRF) was given to the state of Michigan to resolve the issue.

## CONCLUSION

During the research we learned how important it is to be disciplined as engineers. If the engineers had been more meticulous in their job, the crisis could have been avoided. An engineer's work ethic is crucial to their career because their job directly influences many people's lives.

### REFERENCE

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- Webb, J., Abernethy, J., & Schwartz, E. (2020). GETTING THE LEAD OUT: DATA SCIENCE AND WATER SERVICE LINES IN FLINT [https://storage.googleapis.com/flint-storage-bucket/d4gx-2019%20\(2\).pdf](https://storage.googleapis.com/flint-storage-bucket/d4gx-2019%20(2).pdf)verse indent: alphabetical or numerical order.

### ACKNOWLEDGMENTS

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Figure 1. Untreated (Left) vs. Treated (Right) Lead Pipes