In 2013, Flint city managers made a decision to use water from the Flint River, which was once their emergency water supply, as their main source of water. This decision, primarily made as a way to save money, ultimately proved to be disastrous when the Flint River water corroded the city's cast iron pipes and leaked lead into the drinking water. While countless people attempt to identify who is at fault for this tragedy, it is the job of civil engineers all over the country to identify ways to solve the problem and ensure that a similar crisis does not erupt in another city.

It would be wrong for one to conclude that Flint is the only city in the country with a lead pipe problem. In fact, most major cities across the US are currently using cast iron pipes to transport their water from treatment plants to private utility lines. In these cities there is no question as to *if* these pipes will eventually corrode like the pipes in Flint did and leak lead into the system, but *when*. Soon, every one of these cities will be facing problems with these pipes corroding and will need to totally replace both the public and private water utility lines. This proposal to totally replace a city's water pipeline system would appear to be too great a challenge and too expensive a project if it hadn't already been done. Fifteen years ago, the city of Madison, Wisconsin took the first steps in launching the very successful Lead Service Replacement Program after tests showed that chemical additives to the water would not make the water safe to drink. Therefore, the program was deemed necessary and nearly 8,000 of the city's known water utility pipes were replaced. According to the City of Madison's website, "The landmark program (took) 11 years to complete and cost $15.5 million."[1] This program was initially controversial, as many residents did not believe that the lead levels were a threat. However, Madison city planners had the foresight to realize that the lead levels were approaching the legal limits and were able to convince the citizens that replacement measures should be taken before the pipe corrosion became a major problem. The program was funded by Madison Water Utility, who totally funded the replacement of the public pipelines and offered residents up to $1000 to replace their private utility lines.[2]

Observing the success of Madison's Lead Service Replacement program and the recognition the city received as the only major city in the US without lead services, Flint, MI should undoubtedly launch a similar pipe replacement program. Although this program took several years to complete in Madison, the population of Flint is significantly smaller and there would be many fewer pipes to replace. Also, the current state of emergency would expedite the replacement process, and Flint's replacement program could prove to be a very successful, short-term solution. The greatest problem that Flint would most likely face in launching this program in their city would be funding the program. As previously stated, the cost of the replacement program in Madison was $15.5 million. Although the cost of the program would be less in Flint, the city has now spent millions on water quality tests, filtered water, healthcare, etc. and will certainly face hundreds, if not thousands of lawsuits from angry residents once the situation is under control. Therefore, the City of Flint most likely does not have the funds to pay for a Lead Service Replacement program like that in Madison. Therefore, the city of Flint should use FEMA money to begin to replace the most corroded pipes in the system and begin to form an asset management plan to fund the replacement of the rest of the water utility lines. This asset management plan would serve as the city's long-term solution to the current water contamination crisis and act as a model of asset management to other cities around the country that will face similar water corrosion and contamination problems in the near future.

According to the Water Research Foundation (WRF), "there is mounting evidence that the integrity of the U.S. drinking and wastewater infrastructure is at risk", however, "one-third of water utilities have deferred maintenance because of insufficient funding."[3] Again, Flint is not the only city facing a serious infrastructure problem right now. As a solution to this growing problem of funding infrastructure repair and replacement, the WRF has provided a guide to creating a successful asset management plan that requires the participation of engineers and city planners, alike.

The asset management plan that the WRF suggests that most major cities adopt requires city planners and engineers to first create and interpret what is known as a "Nessie Curve". Named after the frightening Loch Ness Monster, the Nessie curve predicts the failure of a city's utility lines based on a number of factors including population growth (or in Flint's case, decline), pipe material, pipe size, etc. As the WRRF explains in a separate project report titled Financial and Economic Optimization of Water Main Replacement Programs, "The Nessie curve is the key that enables them to predict the total cash flows needed for repairs, rehabilitation, and replacement in order to sustain the service capacity."[4] Once a city has used a Nessie curve to predict how much a long term replacement and/or repair program will cost, they can begin to devise a budgeting plan to fund the program. The RRF suggests that cities use one of many software programs to create this plan, including the International Infrastructure Management Manual or the Sustainable Infrastructure Management Program Learning Environment (WERF 2008). This kind of software can prove to be extremely useful in creating a successful plan, but requires a civil engineer to first analyze the collect and interpret data for the software. For instance, a civil engineer must make calculations regarding how the rate of water flow, the pH of the water, the pipe material, the pipe diameter and thickness, etc. will cause utility pipelines to erode over time. While an asset management program may first appear to be the work of a city planner, a civil engineer plays and integral role in making predictions about the current and future state of the city's infrastructure.

Ultimately, assigning blame for the Flint Water crisis is of little importance compared to finding long and short-term solutions to providing the residents of Flint with clean drinking water. This crisis has lasted far too long and the residents of Flint are suffering. While all public utilities are necessary for daily life, water is the only public utility that is ingested, and public health and safety should be the utmost concern. In this case, civil engineers are not needed to create grand, ingenious designs for the city's water system, but to help launch a relatively simple plan to solve the crisis and prevent it from happening anywhere else. There are an infinite number of ways to engineer Flint's water utility system, but the best solution is good planning and being proactive before a crisis like this occurs again.

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[1] Madison Water Utility. "EPA Looks to Madison as Leader on Lead Pipe Issue." *City of Madison*. N.p., 4 Jan. 2016. Web. 4 Apr. 2016.
[2] Madison Water Utility (See Footnote 1)
[3] Water Resources Research Foundation. "Asset Management Fact Sheet." *Water Resources Foundation*. N.p., n.d. Web. 4 Apr. 2016.
[4] Hagler Bailly Services, Inc, Glenn Nestel, John Cromwell, and Rick Albani. "Financial and Economic Optimization of Water Main Replacement Programs." Water Resources Foundation, n.d. Web. 4 Apr. 2016.