Changing the Water Source for Flint

A Case Study on the Decision Process to Change the City's Water Source

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V541 Cost Benefit Analysis

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Glossary of Terms Specific to this Analysis

Benefit cost analysis - referred to as BCA; A comparison of economic costs to benefits using the Kaldor-Hicks model

Cost effectiveness analysis - referred to as CEA; a form of economic analysis that compares the relative costs and outcomes of different courses of action. Cost-effectiveness analysis is distinct from cost–benefit analysis, which assigns a monetary value to the measure of effect.

Legionnaires' disease - Legionnaires' disease, also known as legionellosis, is a form of atypical, and serious, pneumonia caused by any type of Legionella bacteria. Signs and symptoms include cough, shortness of breath, high fever, muscle pains, and headaches.

Detroit Water and Sewerage Department - referred to as DWSD; The Detroit Water and Sewerage Department (DWSD) is a public utility that provides water and sewerage services for Detroit, Michigan and owns the assets that provide water and sewerage services to 126 other communities in seven counties. It is one of the largest water and sewer systems in the United States.

Karegnondi Water Authority - referred to as KWA; Karegnondi Water Authority is a municipal corporation responsible for distributing water services in the Mid-Michigan and Thumb areas of the U.S. state of Michigan. Members of the authority are the cities of Flint and Lapeer, and the counties of Genesee, Lapeer and Sanilac.

Environmental Protection Agency - referred to as EPA; The Environmental Protection Agency is an independent agency of the United States federal government for environmental protection.

Revenue sharing - the state redistributes a portion of the money it collects in sales taxes to local governments

Corrosion - dissolving or wearing away of metal caused by a chemical reaction between water and your plumbing. A number of factors are involved in the extent to which lead enters the water, including: the chemistry of the water (acidity and alkalinity) and the types and amounts of minerals in the water, the amount of lead it comes into contact with, the temperature of the water, the amount of wear in the pipes, how long the water stays in the pipes, and the presence of protective scales or coatings inside the plumbing materials.

Lead and Copper Rule - The treatment technique for the rule requires systems to monitor drinking water at customer taps. If lead concentrations exceed an action level of 15 ppb or copper concentrations exceed an action level of 1.3 ppm in more than 10% of customer taps sampled, the system must undertake a number of additional actions to control corrosion.

Lead poisoning sources – non-inclusive list: mining, smelting, manufacturing and recycling activities, and the continued use of leaded paint, leaded gasoline, leaded aviation fuel, pigments, paints, solder, stained glass, lead crystal glassware, ammunition, ceramic glazes, jewelry, toys and in some cosmetics and traditional medicines

Abstract

April of 2014 changed not only the lives of Flint residents, but of Flint city employees, state of Michigan employees, and Environmental Protection Agency employees. This month is well regarded as the beginning of the Flint water crisis. Nearly 9,000 children were exposed to lead-contaminated water for 18 months. [7] The third-largest outbreak of Legionnaires' disease recorded in history killed 12 and sickened at least 87 people. Over 9,000 lead service pipelines have been replaced within the city, [11] and there are approximately 1,000 households that have yet to be reached [33].

City and state officials have since admitted that the city made errors along the way, including not using a corrosion treatment on the Flint River water. Lead service pipelines faced irreparable damages and were forced to be replaced as soon as possible. Flint enacted the FAST Start Program to replace the pipelines found throughout the city.

Yet, the decision to change water sources for the city began long before 2014, and the aftermath has clearly lasted long beyond then. It remains unclear if the city or state implemented a BCA to determine which department would save the money. A CEA was conducted, yet the results were not implemented and the CEA lack sufficient data surrounding the decisions that were actually made. This decision has cost the government and the public approximately $500-600 million dollars and will have lasting effects well beyond simply replacing the pipelines.

This case study will discuss the follow: the history and demographics of the city, the history of water sources for Flint, the decision process and the complications that surrounded it,

the city's current water source, what a CEA can do versus a BCA and what occurred in Flint. Lastly, this study will analyze what the city and state's decision cost and the lasting effects.

The History of the City

Flint was established as a small village in 1819 by a fur trader [28]. This village, strategically founded on the historic Saginaw Trail, quickly became a trading post for lumber. This allowed for prosperous growth and Flint became a city in 1855. Already established as a lumber city, Flint quickly became the center of the Michigan lumber industry. The lumber industry allowed for the city to branch into the transportation industry. Starting in 1900, the city produced more than 100,000 horse-drawn vehicles a year [37] to later becoming the foundation city in 1908 and the home of the largest General Motors (GM) plant in the nation in the 1950s [13].

Despite a promising beginning, Flint quickly experienced difficulties. "Flint was the most segregated city in the North and the third most segregated city nationwide. And as it became a destination for African-American migrants from the South, where its population was exploding, everybody's coming to these General Motors plants, this was really brought to a point of crisis. It had two neighborhoods where black people could live, and very explicitly they were denied access to other homes. Once there was fair housing laws and school desegregation laws that broke down the system, Flint's population started to decline, as a lot of these white middle-class and upper-class folks left." [42] Relocation of the GM headquarters and downsizing of the remaining plant in the 1980s and 90s also had a hard effect and continued dwindling the city's population and the economy [28].

"Flint today has less than half the number of residents as it had in the 1960s. The infrastructure did not shrink along with the population. So, it has far fewer and poorer people, who are expected to pay to support a water system meant to serve twice as many." The US Census estimates that approximately 100,000 people live in the area. A majority of the people who live there are female (52 percent), between 18 and 65 (54 percent), and African American (53.9 percent) [40]. 41 percent of people live in poverty within the city and the median household income in 2017 was a little over $26,000 [40].

It came to light in late 2011 that the city was running a deficit not only from 2011, but also from 2007, 2008, 2009, and 2010. It was projected that 2011 alone would result in a $25 million deficit [13,34]. In 2008, a deficit elimination plan had been submitted to the state of Michigan's Department of Treasury, yet the state released a statement in 2011 that the city had not been following the plan. The state however had also diverted more than $5.5 billion from the city's budget - as Michigan practices revenue sharing. "As Michigan made cuts, forty-five other states managed to increase revenue sharing to their cities by an average of 48 percent, despite a national economic downturn that affected everyone. Among the five states where revenue sharing declined, Michigan slashed more than any other, by far. For Flint, this translated into a loss of about $55 million between 2002 and 2014 [42]." Michigan then determined it would be best to take over the city's budget. An emergency manager was appointed in 2011. The city needed to save money and the state was determined to make this occur.

As the city was under the state appointed emergency manager's control, the decisions filtered through this role and partially through the city council. Since the crisis began, light has been shed on other decision makers' roles in what partook. The city council voted in March of 2013 to "switch water supply from Detroit to a new pipeline through the KWA," however this is

all their vote consisted of. The former state Treasurer Andy Dillion "made the ultimate decision to let the city leave the Detroit system [27]." The emergency manager Ed Kurtz authorized "an engineering contract to determine how to draw water from the river [43,1]." Kurtz was only one of many emergency managers. Darnell Early, a successor to Kurtz's successor, authorized "the city to separate from the Detroit Water and Sewerage Department and switch to the KWA, connecting to the Flint River in the interim [18]."

All of this goes to show that the decision makers and decision process behind changing Flint's water source was highly convoluted. No part of this was exactly what it seemed to be and as a result, residents were taken advantage of and have been impacted beyond belief.

Water Source

Flint has a few options for water sources: "the Flint and Shiawassee Rivers and their tributaries, inland lakes, ground water, and Lake Huron [44]." From 1964 to 2014, Lake Huron was Flint's main water source. Prior to 1974, the Flint River was used. This changed though due to an increased population and therefore an increased water demand. "City leaders planned to build a pipeline to Lake Huron, but a local millionaire conspired with public officials to defraud the city in a land deal. Voters were disillusioned. Instead of building the pipeline, Flint entered into a 30-year contract to buy water from Detroit's Water and Sewer System [39]."

Since entering into that contract, life in Flint changed. As mentioned previously, the population of Flint has since rapidly declined, and this affects remaining residents and infrastructure. The pipes in the area were originally built with "large circumferences to support all the water that the industrial plants needed [42]." With population declines, the pipelines and

infrastructure became disintegrated. This in turn "directly related to how unaffordable the water was for residents [42]."

In 2013, the city chose yet again to build its own pipeline to connect to Lake Huron and the Karegnondi Water Authority. The pipeline that would be necessary to have this occur would take roughly two years to complete, ideally being finished in 2016. Using Flint River water was an option in the meantime - despite the water being drastically polluted [3]. City management, as mentioned earlier, is the one who broached the topic of how to draw water from the river.

It is believed that the city voted to save the region a projected $200 million over 25 years [24], however evidence that says otherwise has since come to light. The city council solely voted to change water sources, but the decision was finalized from state employees. Building a new pipeline would "open the whole region up to the blue economy," and would create "the potential for job creation by companies that require large volumes of clean, untreated fresh water [22]." These companies would include almond farming and fracking. Additionally, DTE Energy "indicated that it would be interested in purchasing as much as three million gallons of untreated lake water each day from the KWA pipeline once it was completed [22]." An email has also surfaced that shows DWSD was willing to offer Flint a 48% reduced rate of water once the city had announced it would be building a pipeline [31].

In the end, state employees made a decision to use Flint water - something that the city should have been able to handle. Yet, choices were made that hampered this. The main differences between the 1960s and 2014 were the decision to use corrosion control treatment on the water and the treatment plant itself. The water the city was purchasing from Detroit was being treated; therefore, the lead pipelines that can be found all throughout the city stayed within the acceptable EPA's water lead level, aka the lead and copper rule. Michigan's Department of

Environmental Quality told Flint it needed a year to determine what the right treatment would be for the river's water - it is unclear if this actually the case or not and what sparked this decision. Despite what the Department of Environmental Quality claimed to be true, residents were drinking water that had absorbed corroding lead, iron, and other contaminants from the pipes [42].

November of 2017 brought the city back to the Great Lakes Water Authority, finalizing a 30-year contract. Flint had been operating on short-term contracts with GWLA.

Funding Analysis

Entities of all kinds often face significant financial troubles are required to analyze the situation to determine the best move to get out of that trouble. This can be done with a benefit cost analysis or with a cost effectiveness analysis. The situation itself is what will determine which analysis will work better. For the city of Flint, things get a little dicey when trying to determine this. If the city was truly operating under the guise that it needed to save money wherever it could, a BCA was necessary. This could then determine where cuts could be made - from there, a CEA would need to be implemented. There was no evidence that could be found that a BCA took place.

It is implied that the city was operating under the guise savings could only come from cuts in the water department. It was well documented that city officials wanted control over the city's water source and rates that came with that; it is again implied that both city and state officials used the opportunity to "cut costs" to accomplish this goal.

A CEA of water supply options was commissioned from the state treasurer and the emergency financial manager of Flint. The analysis discussed the following options [5]:

"Two water purveyor options were evaluated; the KWA water supply system and continued supply from DWSD. Both suppliers would provide water from Lake Huron as the source. The KWA system is a raw water supply, which means that the water would have to be treated by Flint before distributing potable water to its customers. The DWSD supply is potable or "finished" water and would not need additional treatment.

Additionally, an option for the Flint WTP to supply the City of Flint without being supplied from either DWSD or KWA was initially considered. The preliminary investigation evaluated the cost associated with the required improvements to the plant and to the Flint River dam system. Although it appeared that this was a viable option, Flint in a meeting on December 20, 2012 with the Treasury, stated that the City did not want to pursue the option and it is no longer being considered.

The term of the KWA contract for Flint is 40 years.

DWSD has presented several contractual options to Flint and all of them are based on Flint signing a new 30-year contract. The options shown in Table 2-1 are based on two different supply points; one at the current master meter location FL-1 at Potter and Baxter (P&B) and the other at the location of the Imlay Pump Station. The reason for the varying options is to provide a lower water rate at the Imlay Station, since the DWSD rate formula is based on distance and elevation factors related to the supply location.

The rates are also dependent on the maximum amount of water DWSD supplies. As an example, if DWSD supplies a maximum day demand of 18 MGD that would equal the entire amount of water required by Flint. For the options less than the maximum of 18 MGD means that the Flint WTP would supplement the difference by supplying water treated from the Flint River. These options are known as "blending" and would allow for Flint to blend two sources of water to supply its customers; the Flint River using the Flint WTP and Lake Huron from DWSD system.

Additionally, in recent conversations with the Treasury another option was discussed that could potentially be the most cost-effective solution. Currently the Flint WTP serves as a backup if service is 18 lost through either the DWSD or KWA pipeline. If a twin pipe paralleling the DWSD 72-inch water main were constructed with interconnects with the 72-inch line, then the new water main could serve as the

> backup to Flint and Flint WTP could be abandoned or potentially sold to Genesee County for their use. The construction of the parallel pipeline would be considered in the DWSD capital expenditure as a Common to All (CTA) cost. This means that the capital cost of the pipeline would be shared by all DWSD customers and not just by Flint. Preliminary analysis of this option appears to be the most cost-effective of all the options discussed. However, a more thorough cost analysis is warranted, and this approach would require an agreement between Flint and DWSD [5]."

This CEA lays out the costs for the city quite well. For the next thirty years, it would be cost effective to continue to use DWSD with a blended option of also pulling Flint water, as can be seen in Appendix A. However, after that thirty-year mark is where costs would change drastically. Appendix B shows the drastic difference in costs. However, it is important to note that it would still cost somewhere between $81-107 million dollars to complete the new pipeline. There are naturally risks with each potential option, but this paper will not discuss these; they can be found within the CEA [5].

It is important to note that the analysis does not discuss the potential for using only Flint River water - as noted above, the treasury department no longer wished for this to pursue as an option. This leaves both city council members and state officials in the dark about what this option would have cost at the time and whether it was even viable still. Through a resolution, it became known that the cost for operating with the Flint River was $171,000. Additionally, it would cost a total approximately $12,500,000 to upgrade the Flint Plant to treat the water. These price tags would need to be added on top of the $107 million it would cost to build the new pipeline. Lastly, water treatment is the final cost. While treatment upgrades were discussed above, choosing to use anti-corrosion treatment would have cost the city $140 per day [26].

In the end, the state officials decided to use the promise of potential sales in no sooner than five years was too good to pass on. They chose to stick with their decision of building a pipeline and using the Flint River in the interim. This decision cost the city, the state, and the federal government between $560-600 million [12].

Flint River water cost the city $400,000 a year when GM decided to not use flint water after it corroded the equipment at the plant [15]. Replacement of the pipelines is estimated to cost between $55 million and 1.5 billion [32], which would increase the overall water crisis costs tremendously. State and federal funds have been granted, as well as philanthropist funds from people such as Elon Musk [29].

The choice of not following along with the CEA, or rather not enlisting a CEA's full potential, caused lasting effects for years to be found in Flint and the surrounding area.

Lasting Effects

The city of Flint and the state of Michigan, and the federal government within the Environmental Protection Agency, in the time since 2014 have had a breakdown in the relationship between government and citizens. Residents of Flint have filed a class-action lawsuit which claimed that 14 officials are liable for allowing the city to use water that was "dangerous, unsafe and … inadequately treated." This includes the former Flint Mayor Dayne Walling, two of the former emergency managers, and the former Michigan Governor Rick Snyder. Total, 15 state and city leaders faced criminal charges at the time, but these have since been dropped.

The FAST Start program, funded by the state of Michigan and the city of Flint, is the result of the water emergency. The mission of the program is to remove and replace lead and galvanized steel service lines, which led to home all over the city. There were approximately

29,100 Flint residents who had lead or galvanized steel service lines that need to be replaced. As of April 2018, the total number of lines replaced is 6,242 and the total number of full copper lines identified is approximately 2,500. The FAST Start program launched in March of 2016 and is working in phase 6 through the remaining of 2019. As of 2018, there were approximately 12,000 remaining homes that require lines to be replaced. While a majority of the pipeline has been replaced, "residents say that they are uncomfortable drinking anything but bottled water anymore [6]."

Nearly 9,000 children were exposed to lead-contaminated water for 18 months. [7] The third-largest outbreak of Legionnaires' disease recorded in history killed 12 and sickened at least 87 people. It has been documented that "an estimated 8,000 children to lead and other toxins could amount to almost $400 million in future costs to the city and thousands of cumulative years of poor health for those affected [35]."

Conclusion

Flint has been left in a state of lasting distrust and dysfunction, as the city remains with a large deficit and continues to receive funding cuts. In the end, it is impossible to know how long it will take for residents to trust their tap water and their government. It is impossible at the moment to fully comprehend the lasting financial damage done to the community – this is something that scholars will be discussing long into the future. There was a lack of consideration raised initially about whether there were some other services that might have been better candidates for efficiency improvements. There was a lack of discussion surrounding the short-term and long-term possibilities and strategies. Instead, a focus was found on the ideal of having autonomy in the water department and the potential of income. This has cost $560-600 million to all levels of

government and the public. It will cost approximately $400 million in health services for those affected. The Flint water crisis is a resounding example of why it is important to conduct a BCA, a CEA, and to believe and follow what those results show.

Appendix A

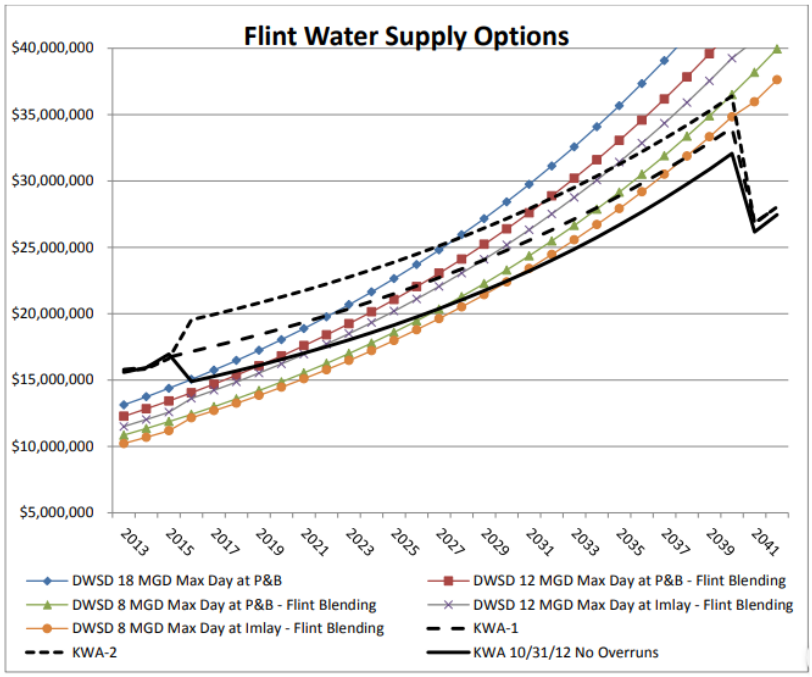

Figure 6-1: Flint Water Supply Options through 2042

Appendix B

Option	Costs through 2042 ($)	Ranking by Cost
DWSD 8 MGD Maximum Day at Imlay Station	634,795,488	1
KWA *(10/31/12 No Overruns, As Provided)**	649,775,166	2
DWSD 8 MGD Maximum Day at FL-1	672,671,705	3
KWA-1 *(10/31/12 No Overruns with Cost of Financing)*	707,279,715	4
DWSD 12 MGD Maximum Day at Imlay Station	725,576,803	5
DWSD 12 MGD Maximum Day at FL-1	762,110,308	6
KWA-2 *(Treasury Estimate)*	766,784,313	7
DWSD 18 MGD Maximum Day at FL-1	821,226,268	8

* $686,375,920 with 15% overrun in construction and a one year delay in operations

Table 6-1: Total Cost of Options through 2042

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