Vulnerable Infrastructures

An Analysis of Accountability Through the Flint Water Crisis

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Abstract

Each occurrence of infrastructural failure raises questions about dependencies upon resources that are distributed through increasingly complex networks. The widespread water contamination that occurred in Flint, Michigan, exemplifies a recent example of the failure of water infrastructure. The Flint water crisis was a prolonged series of events in which improper water treatment and delayed responses resulted in the lead poisoning of tens of thousands of Flint residents.

Looking at multiple series of relationships, such as the relationships between the social and technical nature of water infrastructure, or the power relationships between actors within the water management system, this paper discusses the role of water infrastructure management in creating the Flint water crisis. Using evidence in the form of information exchanges to analyze the system of organization behind water infrastructure management, I argue that the sociopolitical management of water infrastructure was a rigid, hierarchical, and seemingly public system that lacked a framework for the cross-exchange of knowledge. These limitations facilitated the manipulation, delay, and obstruction of information that enabled the widespread infrastructural failure.

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I. Introduction

Widespread infrastructure networks enable the large supply and quick distribution of resources, quietly defining modern living by operating behind the scenes. However, what happens when infrastructures fail? Through their breakdown, infrastructures reveal their vulnerabilities and our dependencies upon them. As infrastructural systems become increasingly complex, those vulnerabilities and dependencies will continue to grow.

Water, in particular, is a resource that is as necessary as it is ubiquitous, distributed through a complex network. One of the most widespread recent examples of infrastructural failure occurred in Flint, Michigan when multiple layers of failure contributed to the extensive water contamination that affected over 40% of the homes in the area.[1] The expectation—and legal policy—of tap water in America is that our faucets will supply a consistent source of clean, potable water.[2] This expectation was violated at Flint, and the resultant consequences to its residents epitomize an instance where infrastructure failed.

To introduce the extents of the situation that contributed to the broader failure at Flint, Section II defines the schema of infrastructure operation, explains the major series of events in the Flint water crisis, and evaluates the primary components involved—both human and nonhuman. Through a framework in which infrastructure is interpreted as not just a technical system but as a *socio*technical one, one can scrutinize how the social organization of the system plays a primary factor in bringing about the crisis.

Section III looks more specifically at roles and responsibilities through examining key players and decision-makers. Documented information exchanges, in the form of emails, statements, and reports, indicated power relationships from one person or entity to another. The sociopolitical management of water infrastructure is investigated through the people, roles, and power dynamics.

Section IV discusses how these series of relationships, between the social and technical, between exchanges of information, and between power relationships, are the systems of organization in which water infrastructure management was organized. Through evaluating the sources and events, this paper argues that the sociopolitical management of the water infrastructure at Flint was overly rigid, hierarchical, and seemingly public. It was rigid due to its insistence on maintaining policy that favored inaction and delayed crisis response; hierarchical because those in positions of power discredited evidence from outside the water management structure; and seemingly public by stating inaccurate information as truth and putting forth a false pretense of transparency. These organizational vulnerabilities facilitated the manipulation of information, resulting in the widespread infrastructural failure that created the Flint water crisis.

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[1] *Poisoned Water.* NOVA, *PBS*, May 31, 2017.
[2] Safe Water Drinking Act, EPA, 1974.

II. How did Flint happen?

There is never a singular reason or simple explanation behind large scale infrastructural failures. Hundreds of people have tried to get to the bottom of the question: how exactly did Flint happen? Was it the lack of certain crucial steps in the water treatment, or the environmental context of the river? Was it the combination of poor decisions and government inaction that grew into increasingly serious repercussions? Which issues were simply contextual, versus faults that were perhaps symptomatic of a larger, structural problem?

By defining a framework through which to understand infrastructure as a sociotechnical series of relationships, followed by an overview of the series of events, and then laying out the context and key factors, this section creates a topography of various components for evaluating the decisions and events that contributed to the Flint water crisis.

A Sociotechnical Approach to Infrastructure

The failure of infrastructures can be defined in a number of ways, but in most cases any unmet expectation of an infrastructural role—whether that be a physical breakdown, a disruption, or a harmful consequence—is often classified as a failure of that system. Yet, how *do* infrastructures fail?

One could argue that there might always be inevitable failures because of unpredictable, uncontrollable factors. For example, natural disasters create a type of crisis, and often cause infrastructural failures. However, while those failures are certainly still disastrous and serious, they are different from the structural management of infrastructure. It is the controllable factors that are essential to the operation and resiliency of an infrastructural system, because the organizational structure determines both the day-to-day functioning as well as the ability of the system as a whole to respond to external stressors. The Flint water crisis was not because of an uncontrollable factor that was later fixed—it was the product of multiple layers of decisions that transformed problems into a crisis.

Water infrastructure is as much the physical nature of its parts as it is the people who operate it. In addition to the physical components such as pumps, pipes, and water, the processes of treatment, monitoring, and distribution are only possible through the coordination of the people behind those operations. Using the approach by Paul Edwards in understanding how "all infrastructures are in fact sociotechnical in nature,"[3] the relationship is established between material systems and management systems. Infrastructures are sociotechnical because they are the co-construction between technological affordances as well as the social organizations that operate them. This sociotechnical framework of infrastructure will be used to relate later parts of the Flint water crisis, with an emphasis on the role of social organization in the management of water infrastructure.

Brian Larkin provides an anthropological framework for understanding infrastructure as a series of relationships. He writes, "Their peculiar ontology lies in the fact that they are things and also the relation

[3] Paul Edwards, "Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems," in Modernity and Technology (MIT Press, 2002), 188.

between things. . . . We often see computers not cables, light not electricity, taps and water but not pipes and sewers."[4] Combined with Edward's definition, these relationships can also be understood as a series of material and human dependencies. Flowing tap water is dependent upon the entire process of supply through distribution, beginning with the water source and traveling through pipes and treatment plants before its eventual release through a faucet. Similarly, the system is dependent upon the monitoring, enforcement, and implementation by layers of organizational hierarchy that determine where the water is sourced, how it is treated, and measure its quality. The relationship from one process to another, and how all of these processes ultimately relate to each other, provides a schema for relating the different factors of the Flint water crisis. Just as the sociotechnical definition of infrastructure stresses the co-construction, rather than separate aspects of social and technical infrastructure, the factors that are described as "reasons" for the Flint water crisis are not distinct entities, but related in a web of conditions that influence each other. Essentially, infrastructure is a series of sociotechnical relationships.

One can also evaluate factors based on a spectrum of human and nonhuman. Bruno Latour introduced actor-network theory to describe how power relations are not just social—i.e. human—because objects have roles as nonhuman actors that participate within the dialogue of action.[5] For example, in the Flint water crisis, the nonhuman actors—like the water treatment plant, the lead service lines, the contaminants within the water, or even the water itself—were all still actors in the unfolding of events, that influenced the methods through which people were able to manipulate them. While objects are not inherently good or bad, the relationship between the motivational power of people and the intrinsic power of the objects enables those objects to have large impacts. In Flint, it was the decisions made by people that caused the water itself to become became charged with a host of social and political implications.

Within the social organization of infrastructure, the medium of information exchange shapes the structure of decision-making flows, communication, and accountability. This structure is comprised of roles and responsibilities that can be described overall as a series of power relationships, and thus infrastructural management is inherently political.[6] In Flint, the information exchanges are documented through emails, calls, statements, accounts, and reports. While the official political structure encompasses government officials with roles in water infrastructure management, this definition of power relationships extends to all of the actors involved, regardless of whether or not they are defined by the roles of water infrastructure management.[7] Power relationships lay the groundwork for understanding how the entire organization of the water management system was rigid in its inability to handle new information, or hierarchical in its decision-making flows.

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[4] Brian Larkin, "The Politics and Poetics of Infrastructure," Annual Review of Anthropology 42, no. 1 (2013): 329.

[5] Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network Theory*, (Oxford: Oxford University Press, 2005), 70–82.

[6] In "The Politics and Poetics of Infrastructure," Brian Larkin also describes how this phenomena can holistically be referred to as the "technopolitics" of infrastructure.

[7] Paul Edwards elaborates in "Infrastructure and Modernity" about how information is communicated and understood within the collective organization as embedded cultural practices. He says, "Organizations, socially communicated background knowledge, general acceptance and reliance, and near-ubiquitous accessibility are required for a system to be an infrastructure."

There are possible descriptions or schema that could be discussed, but the the overarching definition of infrastructure as a sociotechnical series of relationships helps to situate the focus on the spectrum of human to nonhuman contextual factors and the power relationships within sociopolitical management. These guidelines help to structure analyses of information exchanges by providing a more holistic view of the events, bridging relationships between seemingly disparate issues, and allowing for insights into how the entire system of organization structurally contributed to the Flint water crisis. Ultimately, infrastructures do not fail by themselves; they fail because of disruptions and vulnerabilities present within these systems of organization.

Understanding the Flint Water Crisis

The events of the Flint water crisis are complicated, but a description of major events provides some background for understanding the later analysis into how the water infrastructure failed. The Flint water crisis is still ongoing, although the main series of events occured from the water switch in 2014 (discussed below) through the federal state of emergency that was declared in early 2016.

Prior to the Flint water crisis, the City of Flint, Michigan, was declared to be in a state of financial emergency by Governor Rick Snyder in 2011 (and was declared over in 2015).[8] Flint had already been in a series of recent financial emergencies by that point, and similar to those previous situations, an emergency council was appointed by Governor Snyder to deal with the city's financial issues. In 2013, Emergency Manager Ed Kurtz, Mayor Dayne Walling, and other Flint officials committed the city to join the Karegnondi Water Authority (KWA), a water pipeline project joining together the city of Lapeer, Genesee, Lapeer and Sanilac counties, to create their own direct pipeline to Lake Huron.[9] This would remove the need to purchase Lake Huron water through the Detroit Water and Sewerage Department (DWSD) in efforts for Flint to save at least $4 million annually.[10] During the interim period following the expiration of the DWSD contract and before the completion of the pipeline's construction, Flint would source its raw water from Flint River and treat it at the Flint Water Treatment Plant. On April 25th, 2014, while the city was led by Emergency Manager Darnell Earley, Flint changed its public water supply from DSWD to locally-treated water.[11]

Typically, water is treated with an anti-corrosive to protect the layer of buildup that protects the water from metals in the pipe.[12] No corrosion control treatment was applied to the Flint River water coming in. Later investigations revealed multiple warning signs, such as recommendations to upgrade the facility or delay the switch.[13] Emails from Michael Glasgow, a Flint Water Treatment Plant employee, show his concern over the

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[8] Oona Goodin-Smith, "Flint's history of emergency management and how it got to financial freedom," *Mlive*, January 16, 2018.
[9] Ron Fonger, "Flint emergency manager endorses water pipeline, final decision rests with state of Michigan," *Mlive*, March 29, 2013.
[10] Ibid.
[11] Dominic Adams, "Closing the valve on history: Flint cuts water flow from Detroit after nearly 50 years," *MLive*, April 25, 2014.
[12] *Poisoned Water*, NOVA.
[13] Associated Press staff journalists, "Emails reveal Flint supervisor warned officials water plant wasn't ready," *The Guardian*, February 12, 2016.

switch because he felt the plant was not yet equipped to handle the water.[14] Within two months, complaints about the water emerged from city residents, while Dayne Walling and Darnell Earley assured them that the water was safe.

The Lead and Copper Rule (LCR) is a federal Environmental Protection Agency (EPA) policy for controlling pipe corrosion in water treatment within cities of populations greater than 50,000 people, and the Michigan Department of Environmental Quality (MDEQ) monitors and enforces this policy. While DWSD water was pre-treated with corrosion control, the new Flint water was not. An interpretation of the LCR was used that allowed Flint to monitor the water over two six-month periods before deciding whether or not to apply corrosion control treatment, which led to later continued claims by MDEQ officials that Flint was supposedly meeting federal rules for action on lead.[15]

In August, a boil water advisory was issued after the discovery of fecal coliform bacteria, and higher levels of chlorine were added to the water. Many homes are serviced with lead service lines, and the lack of corrosion control in the water allowed that lead to leach into the water. By the end of the year, despite evidence of elevated lead in the MDEQ LCR testing, in addition to later evidence that officials in Governor Snyder's office, the EPA, and MDEQ were aware of the problem, little action was taken.

In February 2015, LeeAnne Walters, a Flint resident later dubbed the "whistleblower", showed some of the effects of the water in a City Council meeting. Walters called EPA Region 5 on February 25th, informing them of high levels of lead in her tap water, which were recorded at 104 parts per billion, or nearly seven times the federal action limit of 15 ppb.[16] That same month, Mayor Walling and new Emergency Manager Jerry Ambrose formed a water advisory committee, comprised of 40 groups and individuals.[17] Their first public meeting was held on March 5th, and met with anger and distrust from residents.[18]

At this time, emails are circulating in the EPA Region 5 office and MDEQ. Del Toral inquired at the DEQ asking about adding phosphates, a corrosion control treatment, in order for Flint to comply with the LCR. Stephen Busch, the MDEQ district coordinator in the Office of Drinking Water and Municipal Assistance Division (DWMAD), responds that Flint has "an Optimized Corrosion Control Program" and has never exceeded 15 ppb.[19]

By September 2015, Virginia Tech researcher Marc Edwards had been testing water samples in Flint, including Walters' home, and relayed the information to Robert Scott, Data Manager for the Healthy Homes and Lead Prevention at Michigan Department of Health and Human Services (MDHHS), that "MDEQ has publicly stated that your blood lead records, are showing that there is no public health concern for residents in Flint. The levels of lead in Flint water, that we are finding in our water sampling, are certainly in a range that

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[14] Bridge Staff, "Disaster Day by Day: A detailed Flint crisis timeline," *Bridge Magazine,* February 4, 2016.
[15] Todd Spangler, "E-mails shed light on EPA's role in Flint water crisis," *Detroit Free Press*, March 5, 2016.
[16] Ibid.
[17] Jiquanda Johnson, "Flint water advisory committee's first meeting erupts in shouting match," *Mlive*, March 5, 2016.
[18] Ibid.
[19] Spangler, "E-mails shed light."

can cause childhood lead poisoning."[20] On September 24th, Pediatrician Mona Hanna-Attisha and a number of doctors from Hurley Medical Center presented their findings to the press that they had found a doubled number of elevated lead levels in children from the area.[21]

Widespread water contamination resulted in dangerously high levels of lead being exposed to tens of thousands of residents. Many of those included children, for whom lead poisoning is even more serious and can result in decreased IQ, increased likelihood of behavioral problems, and potential hematologic, cardiovascular, and immunologic effects.[22] In October 2015, Flint switched back to Detroit-supplied water. In December of 2015, Flint declared a state of emergency, and soon after on January 16th, 2016, a federal state of emergency was declared. In March of 2017, a settlement allotted $87 million dollars from the state to replace 18,000 water service lines,[23] while many residents continued to rely on bottled water. The state of Michigan provided Flint with free bottled water from January 2016 until April 2018, claiming that water levels had not exceeded federal limits in almost two years, despite the fact that only about 6,200 lines had been replaced by that time.[24]

Context and Causes

Using the framework of the human-nonhuman spectrum, contributors to the Flint water crisis can be evaluated for their degree of contribution to the Flint water crisis. In addition, looking at a longer trajectory of the historical or environmental context around Flint and the Flint River also places these components within a broader understanding.

The decision to make the switch to the Flint River itself was a crucial component to the Flint water crisis. The switch itself was human-motivated, particularly because the city was in a state of financial crisis and the role of the Emergency Manager and Emergency Council allowed for large-scale sweeping decisions.[25] Governor Snyder and the Republican state supported the role of emergency managers for intervening in financially struggling municipalities and school districts, despite arguments that the law is unconstitutional for disproportionately targeting black communities.[26] The switch was prompted by an attempt to save money in the long-term by investing in a pipeline unconnected to the DWSD water lines.[27] Within the Final Report of the Flint Water Advisory Task Force (FWATF), it was stated that, "With the CIty of Flint under emergency

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[20] M. Edwards, S. Roy, W. Rhoads, E. Garner, and R. Martin, "Chronological compilation of e-mails from MDHHS Freedom of Information Act (FOIA) request #2015-557," *Flint Water Study*, 2015.
[21] Siddhartha Roy, "Pediatric Lead Exposure Presentation from Hurley Medical Center doctors concerning Flint MI," *Flint Water Study*, September 24, 2015.
[22] Ibid.
[23] Tresa Baldas and Paul Egan, "Judge Approves $87 Million Settlement in Flint Water Lawsuit, " *Detroit Free Press*, March 28, 2017.
[24] Jacey Fortin, "Michigan Will No Longer Provide Free Bottled Water to Flint," *New York Times*, April 8, 2018.
[25] Goodin-Smith, "Flint's history of emergency management."
[26] Ibid.
[27] Fonger, "Flint emergency manager endorses water pipeline."

management, the Flint Water Department rushed unprepared into full-time operation of the Flint Water Treatment Plant, drawing water from a highly corrosive source without the use of corrosion control."[28]

The motivation of monetary gain in the role of water management is already a charged political subject, particularly with the tension between private and public interests and the role of profit in determining the supply or access to basic resources like water.[29] While Flint is a case in which there is a municipal authority that is in charge of the water, the management of water has been an ongoing debate between the typical economic or efficient affordances of privatization models versus the transparency and nonprofit approach of more public models.[30]

When the city switched to using the Flint River as a water source, it meant that raw water from the river was being processed directly at the Flint Water Treatment Plant (WTP), located in the northeast corner of the city. The water exiting the WTP was not necessarily harmful, but it lacked anti-corrosives. Water travels from the WTP through large main lines made of iron to smaller service lines which are made out of a variety of metals including lead, although lead can also be found in brass, galvanized iron, and lead soldering.[31] Most of the time, people are protected from that lead because of a protective layer ringing the pipes, called scale, which is maintained by the anti-corrosives that are added to the water.

Soon after the switch, the presence of increased bacteria led to a boil-water advisory, and increased chlorine was added to the water in response. However, the result of adding chlorine, in combination with the lack of anti-corrosives, broke down the protective mineral layer around the pipes which allowed the lead to leach into the water distribution network.[32] When looking at the nonhuman, chemical properties of the Flint water crisis, it is primarily the lack of anti-corrosives that are cited as the primary reason for such widespread lead poisoning. However, LeeAnne Walters had been inquiring into the EPA about her water since January 2015, and it was another seven months before the city finally made the switch back to DWSD water.[33] The disconnect between the knowledge that anti-corrosives were not being added did not transfer to direct actions until much later, partially because the issues were brought from below, rather than the typical top-down decision-making that is typical of decisions regarding water quality and treatment.

One consideration is the nature of the pipes themselves; why are so many of the service lines that are responsible for supplying safe drinking water made out of lead in the first place? Despite evidence in the late 19th and early 20th century that there were negative health effects from lead, the Lead Industries Association heavily lobbied to promote the use of lead pipes,[34] resulting in their continued and frequent use in water

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[28] Flint Water Advisory Task Force, Commissioned by the Office of Governor Rick Snyder, State of Michigan, *Flint Water Advisory Task Force—Final Report*, March 2016.
[29] Maude Barlow and Wenonah Hauter, "The Dangerous Return of Water Privatization." *Utne Reader*, January/February 2014.
[30] Naser Faruqui, "Balancing between the eternal yesterday and the eternal tomorrow: Economic globalization, water and equity," in *Rethinking Water Management: Innovative Approaches to Contemporary Issues*, ed. Caroline Figueres et al. (Earthscan Publications, 2005).
[31] *Poisoned Water*, NOVA.
[32] Adrian Dingle, "The Flint Water Crisis: What's Really Going On?", *ChemMatters* (December 2016).
[33] Bridge Staff, "Disaster Day by Day."
[34] Richard Rabin, "The Lead Industry and Lead Water Pipes "A MODEST CAMPAIGN," *American Journal of Public Health* 98, no.9 (September 2008).

infrastructure up through 1986, when the Safe Water Drinking Act of 1974 was amended to ban the use of lead in water supply lines.[35] Approximately 18,000 services lines in Flint were identified as having lead in them.[36]

Other sources have looked at the history of Flint and the Flint River, to place the issue of Flint along a greater trajectory and general decline of the city as a whole that has struggled economically over the past half-century.[37] The Flint water crisis, in some ways, was a more extreme extension of that pattern. The city's deficit, and the fact that the water plant had been built in 1952, hardly made it equipped to handle such high volumes of water for the whole city.[38] Despite being supposedly upgraded to try and handle those changes, the reality is that the plant wasn't yet equipped to deal with the necessary corrosion control treatment that was required. On March 18th, 2014, a little over a month before the official switch, Michigan treasury department official Eric Cline recommended the approval of a $676,000 contract to upgrade Flint's WTP.[39] The plant did not start making those upgrades until November 2015. Studies show that the cost of corrosion control treatment is only around $150 dollars per day,[40] but within the context of a plant that was both underequipped and understaffed,[41] the focus of the problem is not just a matter of the cost for treatment, but a matter of how that information was handled by the authorities responsible.

The Flint river in itself had already been a topic of controversy. A long history existed of increased bacteria and chemical pollution from industrial processes and local sewage in the Flint River, when processes upstream resulted in both natural and chemical imbalances in the water.[42] Immediately following the switch, the increased bacteria led to an outbreak of Legionnaires disease, which is what initially encouraged the increase in chlorine that eventually made the water more corrosive.[43] Looking at water sourcing for supply and distribution, river water is different from treating lake water because it is much more variable, and requires more stringent monitoring.[44] Despite a history of pollution, the Flint River Watershed Coalition has done studies in recent years that prove the Flint River water itself does not actually exceed any of levels of contamination that are not typical of most rivers.[45] Their website states explicitly, "It was improper treatment of the water, rather than the health of the river itself, that sparked the suite of issues with Flint's drinking water."[46] Despite popular opinion, the Flint River is not especially unique as a river water supply source, nor is

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[35] "President Signs Safe Drinking Water Act Amendments," *EPA Archives*, June 20, 1986. https://archive.epa.gov/epa/aboutepa/president-signs-safe-drinking-water-act-amendments.html

[36] Baldas and Egan, "Judge Approves.".

[37] Andrew Highsmith. *Demolition Means Progress : Flint, Michigan, and the Fate of the American Metropolis* (Chicago: The University of Chicago Press, 2015).

[38] "Water Treatment Plant," City of Flint.

[39] Associated Press, "Emails reveal."

[40] Nancy Kaffer, "Why didn't Flint treat its water? An answer, at last," March 30, 2016.

[41] Bridge Staff, "Disaster Day by Day."

[42] Tim Carmody, "How the Flint River Got so Toxic," *The Verge*, February 26, 2016.

[43] Ibid.

[44] *Poisoned Water,* NOVA.

[45] "Flint River testing in light of Flint's drinking water crisis," #ItsNotTheRiver, The Flint River Watershed Coalition, March 31st, 2017.

[46] Ibid.

the use of lead pipes itself necessarily dangerous, because these are common issues in many other water infrastructural systems in the United States.

With all of the complexities to consider—the miles of pipes buried underground, the treatment processes, and the number of people required to make water infrastructure work—is the physical infrastructure to be blamed for the Flint water crisis? In the discussion of the history of water infrastructure, particularly in this situation as a system first implemented almost a century ago, there are inherent problems that need to be addressed in the maintenance, upkeep, and replacement of old systems.[47] Particularly in looking at other examples of water infrastructure failure, such as a similar case in Washington D.C. in 2001, where improper water treatment also resulted in lead poisoning, one wonders about whether this is simply a pattern that will continue to repeat itself.[48]

There will always be contemporary issues related to the consequences of past decisions, especially regarding the material system of water infrastructure or the environmental consequences to our water sources, but ultimately those are issues that the infrastructural system as an organization is *intended* to be capable of dealing with. River water is a viable water source when properly treated and lead pipes typically have a protective scale that prevents lead from entering the water.[49] The purpose of policies, monitoring, and enforcement is to uphold the expectations of safe drinking water. In the case of Flint, while it was improper treatment that led to the contamination of the water, the more crucial problems existed within the social hierarchy of organizational communication and decision-making that transformed an issue of water contamination into a full-blown crisis.

[47] Barlow and Hauter, "The Dangerous Return."
[48] *Poisoned Water,* NOVA.
[49] Ibid.

III. Accountability and Responsibility

While the context and causes of the Flint water crisis involved a spectrum of human to nonhuman actors, the crisis was still inherently man-made because it was the social organization of infrastructure that had agency in creating, prolonging, and ignoring the crisis. Who were the people, and what were their roles? In addition to leaders and key decision-makers, there were also those who were silenced or overlooked. More specifically, what were the responsibilities of different actors or departmental entities? Within the entire system of water management infrastructure, there were existing, defined expectations and responsibilities already set in place. Part of the failure of the system was due to the series of mismatched expectations, in which certain departments did not fulfill their responsibilities, and people outside of the typical water management system had to play active roles within the Flint water crisis.

Within the sociotechnical understanding of infrastructure, the discussion of accountability and responsibility focuses on the social aspect of water infrastructure organization. The information exchanges documented through emails, calls, statements, accounts, and reports reveal the dynamics between how knowledge was often suppressed, manipulated, or dismissed. Using power relationships to understand how specific individuals or departments related to each other creates a sociopolitical map of how entities transferred information between each other. This web of exchange and communication exhibits patterns within the organizational structure, and those patterns reveal limitations that were crippling in the events of the Flint water crisis.

Information Exchanges

Information regarding the specifics and severity of the Flint water crisis was crucial knowledge for informing the public to the widespread health concern and inciting action within the water management system to take action. Furthermore, the manipulation of that information resulted in some voices being reduced, discredited, or altered. The nuances of the information exchanges between key actors and different departments exposed power relationships between the people and entities involved.

In addition to statements and reports documented after the crisis, most of the documents below contain evidence regarding the exchange of information found through email correspondences during the peak time of the crisis, made available through multiple Freedom of Information Act (FOIA) requests. They are concentrated primarily throughout 2015, the period of time in which information about the crisis was becoming increasingly evident, despite government and departmental officials doing very little in response. The timeline of evidence reveals a dragged-on period of denial, misinterpretation, miscommunication, or suppression of information.

In January 2016, Governor Snyder released a 274-page document of emails from 2014–2015.[50] In May 2016, the EPA released 5,155 pages of documents relating to the Flint water crisis in response to a FOIA

[50] Ryan Felton, “Flint water crisis: emails reveal governor Snyder informed of problems a year ago,” *The Guardian*, January 21, 2016.

request.[51] The Governor released an additional 303,000 pages in June of 2016.[52] The paper also references MDHHS emails from FOIAs by Marc Edwards.[53,54]

The main observations to be made from these information exchanges are time (when these took place in relation to each other, or when information became known, or exposed); departments (whether it was internal to the department, interdepartmental, or external to the department); individuals involved (their level of authority or specific role within the department); and tone (urgency or complacency, as well as insistence on definitive claims).

The rest of the paper uses documented information exchanges, supported by observations and conclusions made in reports after the crisis, to analyze the organization of the water management system.

Management and Relationships of Power

There are specific governmental departments involved within the formal, sociopolitical management of water infrastructure. Most of the time, there is a clear hierarchical structure of federal, state, and local tiers that are tasked with managing water quality. When the water infrastructure is functioning smoothly, these systems of checks are adequate at maintaining water quality, with certain departments overseeing others to enforce compliance with certain regulations and requirements, such as the SWDA and the LCR. The failure of these departments to act promptly or deliberately in response to water contamination and public health concerns resulted in the involvement of people typically outside of the sociopolitical management structure.

Following the typical structure of water management, Flint water quality is regulated through multiple layers of departments in the government related to the environment, drinking water quality, and lead in water. The Environmental Protection Agency (EPA) is the federal authority that oversees compliance with the Lead and Copper Rule (LCR) and Safe Water Drinking Act (SWDA),[55] and EPA Region 5 is the regional branch that encompasses Michigan. The State of Michigan's executive branch is led by the Governor and his staff. Under the state government of Michigan, the Michigan Department of Environmental Quality (MDEQ) is responsible for monitoring and enforcing compliance with the LCR and SWDA.[56] The Michigan Department of Health and Human Services (MDHHS) is tasked with addressing public health concerns. Within MDEQ and MDHHS, specific departments such as the Drinking Water and Municipal Assistance Division (DWMAD) or the Healthy Homes and Lead Prevention Program are responsible for assuring that the City of Flint is following the LCR and SWDA, as well as National Primary Drinking Water Regulations (NPDWRs), which are legally enforceable standards that apply to public water systems.[57] The City of Flint is the municipal government, led by a mayor, although during temporary periods in which the state has declared a

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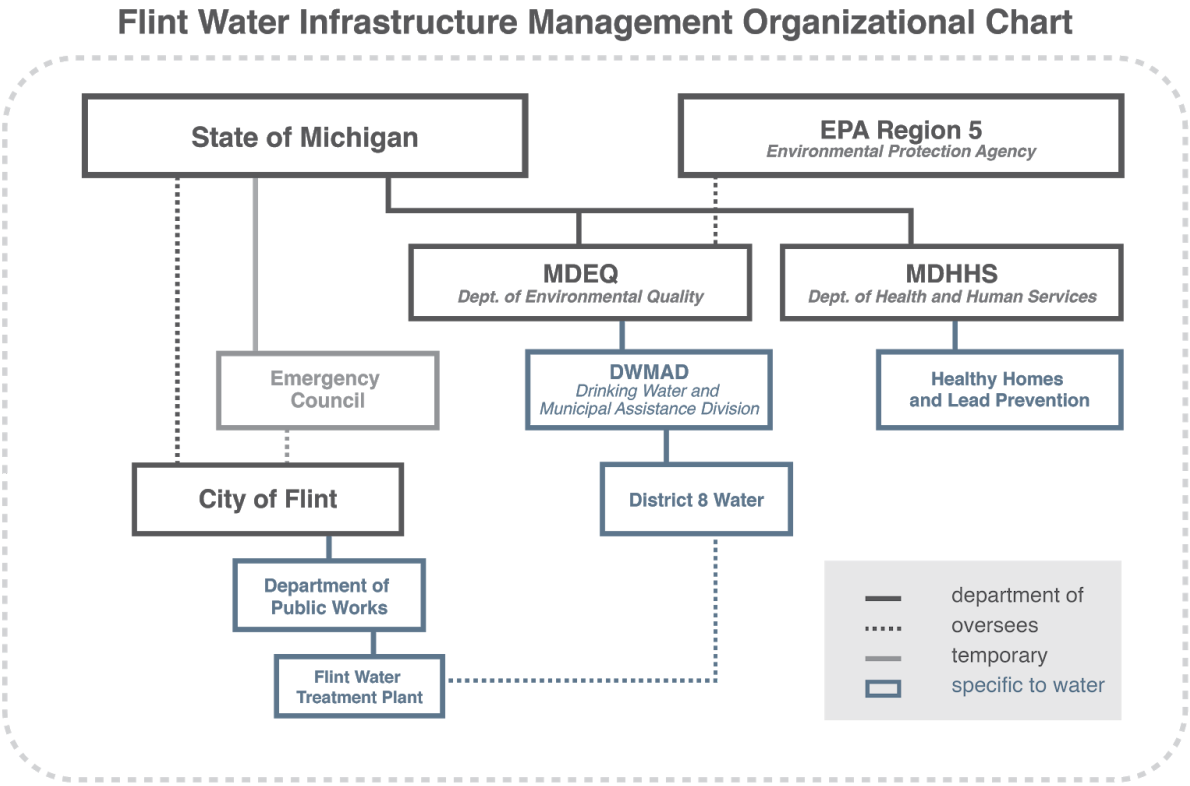
[51] Russ Kick, "Over 5,100 Pages of EPA Docs on Flint Water Crisis," *The Memory Hole 2*, June 15, 2016.
[52] Fleming, "Snyder releases 303K pages."
[53] Edwards, "Chronological compilation of e-mails."
[54] S. Roy, and M. Edwards, "Chronological compilation of e-mails from MDHHS Freedom of Information Act (FOIA) request #2015-557 Part II," *Flint Water Study*, 2016.
[55] "Organization Chart for EPA's Region 5 Office," United States Environmental Protection Agency.
[56] "State of Michigan Departments," State of Michigan.
[57] "Inside DEQ," Department of Environmental Quality.

municipality to be in a financial crisis, the city can be placed under the jurisdiction of a state-appointed Emergency Council and Emergency Manager.[58] Within the City of Flint, the Water Treatment Plant falls under the Utilities department of the Department of Public Works.[59] This chain of federal, regional, state, and municipal authorities are responsible for monitoring and overseeing issues of water quality in Flint, Michigan. They serve as the primary, established system for decision-making and power in relationship to water infrastructure management. The departments are simplified and organized in the diagram below:



In typical instances, the operations within and between these organizations function adequately for the steady supply of drinking water, and the general practices of governmental departments involve specific titles and roles that are intended to transparently define the jurisdictions of the departments and the individual officials within them. Using the framework of role and responsibility charting, commonly referred to as RACI, there are explicit structures for understanding how different roles need to have consistent perceptions of responsibility in order to cohesively form a common understanding.[60] Unmet expectations, or implicit roles, create vulnerabilities in the organizational system. Role expectation refers to what the organization, or other people in the organization, think that the individual is responsible for. In Flint's water management structure, it is expected that EPA Region 5 oversees MDEQ's compliance with SDWA and the LCR, while MDEQ specifically monitors Flint's water treatment plant and water quality. In events of financial crisis, the

[58] Goodin-Smith, "Flint's history of emergency management."
[59] "Water Treatment Plant," City of Flint.
[60] Michael L. Smith and James Erwin, "Role & Responsibility Charting (RACI)."

state-appointed Emergency Council has the power to make decisions for the City of Flint that bypass its typical political process.[61] In response to public health concerns, MDHHS is expected to take measures to try and address or mitigate those health concerns.

In Flint, misalignments between conception, expectation, and behavior created communication gaps and delayed action. In October of 2015, Governor Snyder and the State of Michigan commissioned the Flint Water Advisory Task Force (FWATF) to conduct interviews and investigate the events of the Flint Water crisis to reach conclusions about who failed in their responsibilities to act appropriately, and who should be held accountable for their actions. They released a final report on March 21st, 2016, which partially aimed to "clarify and simplify the narrative regarding the roles of the parties involved, and assign accountability clearly and unambiguously."[62] As part of this initiative, part of the conclusion was that, "The Michigan Department of Environmental Quality (MDEQ) failed in its fundamental responsibility to effectively enforce drinking water regulations. The Michigan Department of Health and Human Services (MDHHS) failed to adequately and promptly act to protect public health."[63] Both departments fundamentally failed to fulfill their respective expectations to enforce regulations related to drinking water regulations and public health, as later evidence revealed that both were aware of the the issue for many months and still continued to discredit that there was a serious problem.[64]

Throughout 2015, there were multiple instances that revealed confusion about individual or departmental responsibilities. On February 26, 2015, Jennifer Crooks (EPA Region 5) emailed her superior, Thomas Poy (EPA Region 5), with the question:

> Tom—Since we have Susan Hedman's attention about Flint, is this high lead result enough to get Susan to push Mark Johnston with ATSDR[65] to act on this? Or for Susan to get Tom Grubbs[66] to look into this from a Distribution system perspective?[67]

There was a clear confusion about which individuals to get involved, because the responsibilities related to the crisis were not clear. In addition, despite the fact that Crooks was a part of the EPA, she had less influence and decision-making power than her superior Thomas Poy, who later discredited the severity of the crisis.

Similar conversations between the state, EPA, and MDEQ reveal ambiguities and unclear expectations about who was responsible to act in response to the crisis. On September 26th, 2015, an email with call summary notes was sent by an EPA official[68] said:

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[61] Felton, "Flint water crisis."
[62] Flint Water Advisory Task Force, Commissioned by the Office of Governor Rick Snyder, State of Michigan, *Flint Water Advisory Task Force—Final Report*, March 2016.
[63] Ibid.
[64] Bridge Staff, "The email trail of the latest workers charged in the Flint water crisis," *Bridge Magazine,* July 29, 2016.
[65] Agency for Toxic Substances and Disease Registry
[66] EPA employee, author of *Initial Distribution System Evaluation Guidance Manual*.
[67] Flint Water Documents Interim Release, EPA FOIA, May 12, 2016.
[68] Stan Meiburg (EPA Region 5 Acting Deputy Administrator).

> We are not certain what additional actions the State of Michigan is contemplating. Susan [Hedman] is reaching out this weekend to the Director of Michigan DEQ to gain additional insight on this point. There is a sense that the state knows they bear some responsibility because of the financial dynamics of the source water switch, but what this may specifically mean is unclear. Issues with past mismanagement (in prior administrations) of Flint water utility revenues complicate these discussions.[69]

This correspondence occurred following the press releases about elevated lead levels in blood found in children in Flint, and shows the confusion about which department within the organizational chart should be responsible. Since the State of Michigan appointed the Emergency Council and Emergency Managers who made the decision to switch to the Flint River, there was ambiguity about how much of a role the state should play in acknowledging their responsibility in the situation. Furthermore, the relationship between departments, i.e. the state, MDEQ, and EPA, indicates how the confusion regarding responsibilities resulted in delayed action and responsibility evasion.

During the crisis, residents had been actively protesting problems with the drinking water quality,[70] and emails indicate that officials in Flint, MDEQ, MDHHS, the governor's office, and the EPA clearly were not blind to those issues.[71] The water management structure had the decision-making power to implement changes, because they were the authority in the management of the operation of drinking water. The failure of the departments within the water management structure to make significant changes quickly resulted in people outside of the water management structure to take matters into their own hands to try and address the lead contamination affecting the population of Flint.

Dubbed "whistleblowers," a few figures emerged as individuals who, in attempts to seek out truth, had to subvert the authoritative structure in order to expose knowledge.[72] By themselves, they had very little power to change the water infrastructure, but through other forms, such as using the press or scientific research, they were able use attention and legitimacy to increase their agency.

LeeAnne Walters, a Flint resident, took matters into her own hands to investigate and get her water tested, after seeing the discoloration in her water and the rashes it was giving her children. On February 25th, 2015, LeeAnne Walters contacted the EPA Region 5 office regarding the fact her home had levels of lead at 104 ppb.[73]

Walters' investigation connected her with Miguel del Toral, the Regulations Manager for EPA Region 5, who used his position with the EPA to try and address concerns with the water. On June 24, 2015, Miguel Del Toral wrote an interim report, titled "High Lead Levels in Flint, Michigan — Interim Report," to Thomas Poy (EPA Region 5, OGWDW).[74] Within the report, he explicitly stated:

> Following a change in the water source, the City of Flint has experienced a number of water quality issues resulting in violations of National Primary Drinking Water Regulations (NPDWR)

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[69] Flint Water Documents Interim Release, EPA FOIA, May 12, 2016.
[70] Eric Dresden, "Flint residents protest drinking water problems outside City Hall," *Mlive*, January 13, 2015.
[71] Bridge Staff, "The email trail."
[72] John McQuaid, "Without These Whistleblowers, We May Never Have Known the Full Extent of the Flint Water Crisis," *Smithsonian Magazine*, December 2016.
[73] Flint Water Advisory Task Force, *Final Report*.
[74] Miguel Del Toral, "High Lead Levels in Flint, Michigan — Interim Report," *EPA*, June 24, 2015.

> . . . . In addition, as of April 30,20l4, when the City of Flint switched from purchasing finished water from the City of Detroit to using the Flint River as their new water source, the City of Flint is no longer providing corrosion control treatment for lead and copper.[75]

This report regarding the city's lack of corrosion control was also circulated to Walters, and released to the American Civil Liberties Union (ACLU).[76] An EPA email a few days later notes how Del Toral's draft report was provided to Walters, which would not normally happen.[77] However, Del Toral's report was discredited by EPA Region 5 Administrator Susan Hedman, who said that the draft should not have been released until it "[had] been revised and fully vetted."[78] Within this interaction, there were dynamics between Del Toral (an EPA employee), his superior (Susan Hedman), LeeAnne Walters (a Flint resident), and the press. As a resident, Walters had very little power, and tried to contact the EPA to try and address the water issue. Although Del Toral was part of the EPA, his power was discredited by Administrator Susan Hedman. As a result, the press acted as a public-facing agent through which Walters and Del Toral leveraged influence to gain attention, and bring greater scrutiny to entities such as the EPA and MDEQ. The typical power relationship of water infrastructure management was challenged through these external sources.

LeeAnne Walters also contacted Virginia Tech scientist Marc Edwards, someone with previous experience in lead contamination research, who eventually exposed the severity of the lead contamination in the Flint water through independently testing water samples.[79] By the end of August, the study had indicated that of the 120 samples analyzed, 42% showed lead over 5 ppb and 23% indicated levels over 15 ppb, the federal action limit.[80] Walters contacted Edwards, who had the credibility, resources, and academic-backing provided through the university, to try and verify the amount of lead within her water. However, Thomas Poy from EPA Region 5, who was also Del Toral's superior, emphasized that EPA Region 5 was not involved in Edwards' work, and questioned his methods.[81]

On September 24, 2015, Dr. Mona Hanna-Attisha, a pediatrician at Hurley Medical Center, held a press conference to reveal the amount of increased lead poisoning on children.[82] According to the study, the number of Flint children with elevated blood-lead levels jumped from 2.1% in the 20 months prior to Sept. 15, 2013, to 4% between Jan. 1 and Sept. 15, 2015.[83] Her testing was independent of the water infrastructure management system, but still backed by the influence of Hurley Medical Center, and publicized through a press conference. The very same day, Snyder's Deputy Press Secretary emailed other staff, in addition to the MDHHS and MDEQ.[84] He wrote:

> Here's the data that will be presented at the Hurley Hospital press conference at 3 p.m. As you'll see, they are pointing to individual children, a very emotional approach. Our challenge

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[75] Ibid.
[76] Spangler, "E-mails shed light."
[77] Ibid.
[78] Ibid.
[79] *Poisoned Water,* NOVA.
[80] Spangler, "E-mails shed light."
[81] Ibid.
[82] Mattie Kahn, "Promised Lands," *ELLE*, August 8, 2016.
[83] Spangler, "E-mails shed light."
[84] Dave Murray, Governor Snyder's Deputy Press Secretary, emailed other people within Snyder's staff, includign Dennis Muchmore, Chief of Staff, Jerrod Agen, Lasher, and Brad Wurfel, MDEQ.

> will be to show how our state data is different from what the hospital and the coalition members are presenting today.[85]

Rather than acknowledging the serious implications revealed by the data, there was an effort to actively discredit the information and research being conducted externally by Hurley Medical Center and Dr. Hanna-Attisha. The fact that this email was between Snyder's office, MDEQ, and MDHHS, and the emphasis on state data versus hospital data, shows the clear distinction made between those within the typical system of water management and those outside of it.

In multiple instances, individuals such as LeeAnne Walters, Miguel Del Toral, Marc Edwards, and Dr. Hanna-Attisha had to circumnavigate the typical water infrastructure management structure in order to try and effect change within it. Using scientific evidence to back up their claims, and the press to release that knowledge to the public, they had to fill in the gaps where the management failed. The FWATF also acknowledged "the critical role played by engaged Flint citizens, by individuals both inside and outside of government who had the expertise and willingness to question and challenge government leadership, and by members of a free press who used the tools that enable investigative journalism."[86] When the system of water management failed to act quickly, individuals outside of the typical organizational structure resorted to using tools such as the press or external researchers to bring legitimacy to their claims, ultimately subverting the government in order to prompt decisive actions to fix the crisis and notify the public.

Within the water management system, many of the key decision-makers are being held accountable for their actions. Currently, many government officials, incriminated through email correspondences, are being investigated and held accountable for their inactions. Some of the charges that are being brought up include a combination of involuntary manslaughter, misconduct in office, and/or obstruction of justice.[87] Multiple officials within the MDEQ, MDHHS, and Flint government, are being accused and brought to trial, many of which are still ongoing.[88,89] There are also a number of individuals who, while not being prosecuted, came under scrutiny for their prominent roles as authority figures related to the Flint water crisis, such as Flint Mayor Dayne Walling, Governor Rick Snyder, or EPA Region 5 Administrator Susan Hedman, who resigned shortly after the Flint water crisis.[90] Various levels of government authority and regulatory departments are

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[85] Bridge Staff, "Disaster Day by Day."
[86] Flint Water Advisory Task Force, *Final Report*.
[87] Cynthia Price, "Top state government officials charged in Flint water and Legionnaire's Disease crisis," *Legal News*, June 16, 2017, http://legalnews.com/grandrapids/1444199.
[88] Within MDEQ, the accused include Liane Shekter-Smith (Chief of DWMAD), Adam Rosenthal (DWMAD), Patrick Cook (Community Drinking Water), Stephen Busch (District 8 Water Supervisor), and Mike Prysby (District 8 Water Engineer). Under MDHHS, the accused include Nick Lyon (Director), Eden Wells (Chief Medical Officer), Corinne Miller (Director of the Bureau of Epidemiology), Robert Scott (Data Manager for the Healthy Homes and Lead Prevention), and Nancy Peeler (Maternal, Infant, and Early Childhood Home Visiting). Within the municipal government, Howard Croft (Flint Director of Public Works) and Darnell Earley (Flint emergency manager) are being accused.
[89] Scott Atkinson and Monica Davey, "5 Charged With Involuntary Manslaughter in Flint Water Crisis," *New York Times*, June 14, 2017, www.nytimes.com/2017/06/14/us/flint-water-crisis-manslaughter.html.
[90] Mark Brush and Sarah Hulett, "EPA Region 5 Administrator Susan Hedman to resign in wake of the Flint water crisis," *Michigan Radio*, January 21, 2016. http://michiganradio.org/post/epa-region-5-administrator-susan-hedman-resign-wake-flint-water-crisis.

under investigation by the Michigan Attorney General's office, Genesee County Prosecutor, and U.S. Attorney's office, and the individual actions of key decision-makers are under intense scrutiny.[91] The legal prosecutions and investigations reveal a critical assessment of specific individuals who should be held accountable for their actions during the Flint water crisis.

The system of water management had a responsibility to maintain water quality and inform the public of health concerns. The failure of that sociopolitical system resulted in those outside of the system to exert their power to try and bring critical information to the public, that would in turn place scrutiny upon the water management system to fix the water problem. The existing relationships within the water infrastructure management system, as well as the relationship to the entities outside of it, were altered in the face of the crisis. The switch to a new water source brought along a host of new problems and stresses that the people within the organizational system were unequipped to deal with.

[91] Merrit Kennedy, "Lead-Laced Water In Flint: A Step-By-Step Look At The Makings Of A Crisis," *NPR*, April 20, 2016, https://www.npr.org/sections/thetwo-way/2016/04/20/465545378/lead-laced-water-in-flint-a-step-by-step-look-at-the-makings-of-a-crisis.

IV. Systems of Organization

The previous sections discussed the components of the Flint water crisis through a human-nonhuman framework, followed by an analysis into how information exchanges revealed power relationships between the involved entities. These relationships are in dialogue with one another, all as systems of organization, used here to describe the multiple series of relationships that exist: the system for information exchange, the system of water management, the system of roles and responsibilities, and the system of power.

The structure of the water infrastructure management system was overly rigid, hierarchical, and seemingly public. These three characteristics explain how the systems were ill-equipped to deal with the water crisis, because they lacked of a proper framework for information exchange. Those vulnerabilities ultimately explain how the systems of organization facilitated the suppression, manipulation, and distortion of information that brought about the Flint water crisis.

Rigid

The system of water infrastructure management was overly rigid, because the system tended to default to assumptions based on maintenance and policy rather than acknowledging the severity of implications in the crisis. Rigidity meant a lack of adaptability through an insistence on status quo—sticking to policy (or misinterpreting policy) that favored inaction and delayed responses, often through inaccurate information. Although the water management system that was in place was previously able to maintain drinking water quality, an analysis of its sociopolitical structure reveals its limitations when faced with problems that are counter to expectation. Flint was a case that epitomized how, under stress, this structure was vulnerable to failure.

For example, when the EPA questioned the MDEQ about high levels of lead found in LeeAnne Walters' home, Mike Prysby (MDEQ DWMAD) responded, "They should offer to re-sample for PB [lead] after flushing the tap to demonstrate that flushing the tap will reduce the lead concentration."[92] Instead of expressing alarm at the high lead levels, the MDEQ recommended tampering with the sampling methods in order to get lower lead results from tests. Lead of any level is a health concern, but lower lead level test results would allow the MDEQ to comply with federal and state water regulations. Del Toral from the EPA responded, "People are exposed to the particulate lead on a daily basis, but the particulate lead is being flushed away before collecting compliance samples which provide false assurance to residents about the true lead levels in the water."[93] This was an instance in which the MDEQ deliberately tried to manipulate the data based on regulation standards, by favoring the path of inaction and maintenance over crisis-response to address public health concerns.

When questioned by the EPA about the use of Phosphates or Alkalinity Adjustment for Optimal Corrosion Control Treatment, Stephen Busch (MDEQ DWMAD) responded that Flint had a 90th-percentile lead level of

[92] Flint Water Documents Interim Release, EPA FOIA, May 12, 2016.
[93] Ibid.

6ppb in the most recent monitoring period, had an Optimized Corrosion Control Program, and had never exceeded 15 ppb, which is the minimum acceptable level.[94] The FWATF also concluded, "Coordination between MDEQ and MDHHS was inadequate to properly address the public health issues related to water quality in Flint. Communication was infrequent, and when it did occur, the default position was to conclude that the health problems were not related to the water supply switch — rather than to assume that the problems might be related to the switch."[95] The fact that these departments defaulted to denying the water switch, and favored claims that supported compliance with regulations, exemplify how the water management system was rigid by choosing inaction over active response.

Following the primary events of the Flint water crisis, a program review of the MDEQ was published by the EPA to try and address some of the gaps or problems found within the management or departmental structure. They highlighted the inadequacies within the management of the water infrastructure to handle complications and unusual circumstances because of the organizational structure and gaps of knowledge present within the organization. The MDEQ Review determined:

> Many deficiencies in the MDEQ drinking water program stem from MDEQ's inefficient and antiquated drinking water data management systems . . .
>
> Deficiencies in the MDEQ drinking water program stem from long-standing inadequate resources and the difficulty of managing a program with a decentralized structure in a consistent manner. It is resource-intensive to ensure staff coordination and consistent implementation across eight decentralized MDEQ District Offices and 44 local health departments (LHDs) . . .
>
> Staff departures and retirements have caused a significant loss in expertise and technical knowledge . . . these staff have not been replaced due to a lack of resources and/or hiring constraints . . .
>
> MDEQ's drinking water program has not fully implemented certain required activities, such as public notification of monitoring and reporting (M/R) violations, due to serious resource limitations.[96]

The issues of data management, centralization, decentralization, and staff knowledge are all related to how gaps in information, in combination with the characteristics of the organizational relationships, hindered the MDEQ's ability to deal with the Flint water crisis. While these reasons do not excuse the individual decisions made by officials within the crisis, they provide insight into how the entire organizational structure was systemically vulnerable to failure.

The FWATF also warned about "the risk of over-reliance—in fact, almost *exclusive* reliance—on a few staff in one or two departments for information on which key decisions are based."[97] As evidenced earlier, replies from Stephen Busch and Mike Prysby from the MDEQ DWMAD department insisted upon corrosion control and compliance with regulations, despite the fact that this was untrue. Due to the power of these two individuals within the water management system, their information was able to discredit and override the

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[94] Spangler, "E-mails shed light."
[95] Flint Water Advisory Task Force, *Final Report*.
[96] Final 2016 Michigan Program Review. *EPA*, 2016.
[97] Flint Water Advisory Task Force, *Final Report*.

multiple claims made periodically by other sources of information. Similarly, Thomas Poy and Susan Hedman of the EPA repeatedly disregarded information from Del Toral or Edwards. These scenarios reveal the tendency to assume that there is no issue, rather than to seriously consider the multiple claims and points of evidence that pointed to a serious lead contamination problem.

Several instances displayed a lack of urgency within the water management system. On June 30th of 2015, EPA Region 5 official emailed the director of MDEQ DWMAD:[98]

> We understand that the city is finishing up its second set of 6-month initial monitoring and I have scheduled a call with you on July 21st so we can discuss the Flint situation in more detail. . . .
>
> Please know that Region 5 management is still being briefed on the lead issues in Flint and we look forward to the opportunity to discuss the situation with you in more detail so we can better characterize what MDEQ is already doing in Flint and how public health protection can best be provided to the citizens of Flint. If you would like to discuss this in advance of our call, please feel free to contact myself, or Tim Henry (312-886-6107).[99]

Although the language still acknowledges the issue of lead in the Flint water and addresses public health protection, there is a disconnect between the language versus the tone and actions associated. There is no strong imperative for action besides discussing the situation more, which is surprising particularly if the EPA has recognized the seriousness of the lead issue in Flint. Furthermore, the call with MDEQ is scheduled for July 21st, a full three weeks following the date of the email. In light of public health concerns, such deliberate delays are confusing, and display a departmental lack of urgency.

This was also found in MDHHS correspondences, such as when Virginia Tech research Marc Edwards tried to obtain data on lead tests from the MDHHS. On September 11, 2015, following an email request by Edwards to obtain data through a Data Usage Agreement, the data manager of MDHHS[100] responds with:

> If you are in need of a reasonably-quick turnaround—i.e., a week rather than a month or so—then please send me a paragraph explaining why. I'll pass that along with your DUA.
>
> If you're not in a hurry, then I'm all set for now—I'll submit your DUA as is.[101]

Again, the assumption that information on critical data should go through the typical process of a month, rather than be expedited in the events of serious lead poisoning, indicate a lack of urgency. While policy and procedure serves as a general baseline, the fact that MDHHS deferred to typical procedure rather than acknowledging the seriousness of the crisis is indicative of the departmental rigidity and inertia. The FWATF also claimed, "reluctance to share state data with Dr. Mona Hanna-Attisha and Professor Marc Edwards prolonged the Flint water crisis."[102] The department dealt poorly with requests for information from outside of the water management system, clinging to policy despite evidence of serious concerns that required

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[98] Tinka Hyde, email to Liane Shekter
[99] Spangler, "E-mails shed light."
[100] Robert Scott.
[101] Edwards, "Compilation of e-mails."
[102] Flint Water Advisory Task Force, *Final Report*.

expedited action. Various forms of evidence, in multiple departments, reveal how those involved within the typical water infrastructure management system often defaulted to policy, delays, and nonaction.

Hierarchical

The system of water infrastructure management was hierarchical, which became an issue when the authorities and key decision-makers were not making responsible decisions in the best interest of the public. Multiple instances in which superiors dismissed information from their subordinates, or where the entire system of organization as a whole discredited information that was external to its standard departments, prolonged the crisis. While hierarchical organizational structures and top-down decisions are typical, the danger or limitation becomes evident if that system also discredits or silences those with less power. In this case, the organization was not only hierarchical, but also actively dismissive of information coming from external or unofficial methods, which also reinforces the system's rigidity. Without proper frameworks for bottom-up communication or external claims to be legitimized in the water infrastructure management process, knowledge was delayed, obstructed, and silenced.

Interdepartmental relations often resulted in certain individuals or departments to diminish the urgency and claims made by those who were closer to the events happening at Flint. For example, by February 26, 2015, Jennifer Crooks (EPA Region 5) sent the following email to Stephen Busch (MDEQ DWMAD) and Mike Prysby (MDEQ DWMAD):

> The main purpose of my email is to alert you to the high lead levels reported to a citizen yesterday by Flint Water Dept. I have been discussing the water situation with [LeeAnne Walters] since January, and she has been talking with Mike Glasgow at the plant about the black sediment in her water. . . WOW!!! Did he find LEAD! 104 ppb.
>
> So, Steve, this goes back to what you and I were talking about yesterday. . . . I think Lead is a good indication that other contaminants are also present in the tap water, that obviously were not present in the compliance samples taken at the plant.[103]

In this email, Jennifer Crooks' tone is urgent, and insistent about the seriousness of the high lead levels. The response from Stephen Busch was:

> The City of Flint . . . has a 90th percentile lead level of 6.0 ppb based on 100 samples collected in its most recent monitoring period of 7/1/2014–12/31/2014, with 2 samples (23 & 37 ppb) over the AL[104] . . . [the city] has an Optimized Corrosion Control Program; conducts quarterly Water Quality Parameter monitoring at 25 sites and has not had any unusual results; has never had a 90th percentile lead AL exceedance; continues to meet all applicable plant tap standards and treatment technique requirements at its WTP; has developed and implemented an Operation Evaluation of its treatment and distribution systems, and continues to adjust this OE based on updated quarterly results.
>
> . . . Our office continues to work with our community water systems to follow these and all other requirements of the current lead and copper regulations.[105]

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[103] Flint Water Documents Interim Release, EPA FOIA, May 12, 2016.
[104] Acceptable Level.
[105] Ibid.

The tone of the response removed the urgency present in Crooks' email, and insisted that there was proper compliance with the LCR, which was later proven to be false.[106] Furthermore, this exchange took place in February, but the information took an additional few months to reach the public. There were even greater disconnects between the EPA and MDEQ, as well as within the MDEQ, when the rhetoric used by the MDEQ [107] still publicly announced on July 7th of 2015 that, "Anyone who is concerned about lead in the drinking water in Flint can relax."[108] Despite the fact that other members of the MDEQ had already been briefed on the memo by the EPA about lead in Flint, the communications director was unaware, and relayed false claims through a public broadcast.[109] This series of events further emphasizes the disconnect in knowledge between different people within the water management system.

Another hierarchical aspect of the system of organization was the role of the Emergency Council and Emergency Manager, which exacerbated the power of a few key decision-makers over the public. It was the Emergency Council's decision to make the switch in the first place, despite recommendations against doing so.[110] The Emergency Manager's disproportionate power also prevented an earlier fix to the problem. Disregarding warning signs, such as the boil water advisory and Legionnaires outbreak in 2014, in October of 2014, Darnell Earley, as the acting Emergency Manager, said that it would be too cost prohibitive to switch back to Detroit water, despite public outcry.[111] He had too much power in the decision regarding the use of Flint water, particularly when his motivations were financial rather than public.

LeeAnne Walters testified in the Meeting of the House Oversight and Governmental Reform Committee on February 3, 2016, in regards to the Flint Water crisis. As a resident of Flint, who was unassociated with the water management infrastructure or an external organization of credibility, she was the epitome of the ultimate whistleblower who had no power and had to use alternate methods to try and gain agency in the system. She said:

> State-appointed Emergency Managers replaced local representative decision-making in Flint, removing the checks and balances and public accountability that come with public decision-making. Emergency managers made key decision that contributed to the crisis, from the use of the Flint River to delays in reconnecting to DWSD once water quality problems were encountered. . . .
>
> We fought the city and the state saying there was something wrong, and we were dismissed. I decided we needed to get to the science if anyone was ever going to believe us. . . . In a meeting I had with MDEQ, Liane Shekter-Smith bragged to me about how Mr. Del Toral had been handled, that his report was flawed, and that there would be no final report. This was the ultimate betrayal for the citizens. Susan Hedman [EPA] cared more

[106] Del Toral, "High Lead Levels."
[107] Brad Wurfel, MDEQ Director of Communications.
[108] Spangler, "E-mails shed light."
[109] Lindsey Smith, "After blowing the whistle on Flint's water, EPA "rogue employee" has been silent. Until now," *Michigan Radio*, January 21, 2016.
[110] Associated Press, "Emails reveal."
[111] *Mlive,* "Flint water crisis: Timeline of communication," May 2, 2016, *Youtube*, video.

> about policy than the welfare of an entire community while punishing and silencing the one person that was willing to help us.[112]

Leanne Walters was continuously disregarded because of her lack of power within the system of water infrastructure organization. While in typical instances where water infrastructure is managed behind the scenes and the public receives clean drinking water, the hierarchy of the structure is not necessarily detrimental. However, it was a limitation in the organization of the system that, when facing a crisis, suddenly became an obstruction in the communication of truth or transparency. The hierarchical power relationships enabled the silencing of people who were suffering the most from the consequences of the water infrastructure failure.

Seemingly Public

The seemingly public nature of the water management system was another weakness that created misaligned expectations and delayed action in the water crisis. The water management system often tried to present information to the public that was not in the public's best interest, and in some instances gave the misleading appearance of transparency.

Since the water management system for Flint falls entirely within the government, there is public expectation that the government entities are in service to the public. However, this expectation of the water infrastructure system working in the public's best interest served to be detrimental, because the system's appearance of transparency and public service only masked and delayed the issues of water contamination.

At multiple instances, information was communicated to the public that there was nothing wrong with the Flint river water. A few months after the switch, Mayor Dayne Walling assured Flint residents that there was nothing wrong with the water, despite complaints of discoloration.[113] Even after the release of Del Toral's report in June 2015, Susan Hedman from the EPA and Mayor Dayne Walling continued to reassure the public that there were no issues with the water.[114] In July of 2015, the MDEQ said, "Anyone who is concerned about lead in the drinking water in Flint can relax."[115] That same summer, Snyder said that his staff was meeting with citizens who raised concerns about the possibility of lead in Flint water.[116] These were all instances in which those within the water management system repeatedly assured the public that there were no issues with the Flint River water, or that measures were being taken to consider the public, in spite of public protests or emerging information that claimed otherwise.

In February 2015, LeeAnne Walters had brought forth the results of the lead in her water at a City Council meeting. Also in February 2015, Mayor Walling and the Emergency Manager formed a water advisory

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[112] Flint Water Committee, *Transcript of February 3, 2016 Meeting of the House Oversight and Governmental Reform Committee*.
[113] Kahn, "Promised Lands."
[114] *Poisoned Water*, NOVA.
[115] Spangler, "E-mails shed light."
[116] *Mlive,* "Flint water crisis: Timeline of communication," May 2, 2016, *Youtube*, video.

committee to try and address the water quality issues.[117] Despite holding public meetings, these had very little effect on the actual water infrastructure management system. The City of Flint, in these cases, was attempting to pacify the residents through the implementation of seemingly public acts, that ultimately had very little power in the ultimate decision-making.

Another example of how public perception played a role in prolonging the crisis was evidenced through the actions of Governor Snyder and his office. Governor Snyder, as a person in a position of power, had large decision-making ability regarding the distribution of funds, resources, and allocations for dealing with emergency situations. Emails show that he was aware of problems in Flint as early as February 2015,[118] and yet the downplay of the issue by the state governor played a crucial role in delaying aid to Flint. Despite requests from Mayor Dayne Walling for state assistance around that same time period, staff emails reveal that it was interpreted as an exaggerated plea for money from a financially-struggling city—it wasn't until October, following large amounts of national press after Dr. Hanna-Attisha's reports, that Snyder finally agreed to dedicate state funds towards Flint recovery.[119]

Despite being a public, elected official, the motivations behind Snyder's actions seem to stem from concern over the perception of transparency and public good, rather than the actual value of public good. Instead of taking the concerns of Flint residents seriously, he chose instead to overlook its significance, perhaps because he had somewhat of a stake in the success of the Flint water switch due to Flint's appointed Emergency Council and Emergency Managers. It was Flint Emergency Manager Darnell Earley who made the decision to switch Flint's water source from DWSD to the Flint river.[120] Only after extensive press and public outcry, and when Snyder acknowledged the Flint water crisis, did he he seem committed to working on the "public safety issue," through the release of his emails in January 2016.[121]

It was not only during the crisis, but also following the acknowledgment of the emergency that there was also a continuation of false transparency. The release of a 274-page document of emails with missing information and blacked out emails show another instance in which Snyder's actions appear under the pretense of transparency and commitment, yet are perhaps more instances of obscuring reality. Michigan is one of the only states that is protected from FOIA. He later released another set of emails and documents totaling at 303,000.[122] In a statement relating to this release, Governor Snyder said:

> After the initial batches from state departments were released in February, we continued our search for emails and other materials related to the Flint water crisis as part of an ongoing effort to increase transparency and make information more accessible to the public. . . . Residents can read these materials for themselves, and then we can continue to work together to help Flint families recover from this crisis.[123]

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[117] Jiquanda Johnson, "Flint water advisory committee's first meeting erupts in shouting match," *Mlive*, March 5, 2016.
[118] Felton, "Flint water crisis."
[119] Ibid.
[120] Goodin-Smith, "Flint's history of emergency management."
[121] Felton, "Flint water crisis."
[122] Leonard N. Fleming, "Snyder releases 303K pages of Flint emails, documents," *The Detroit News*, June 21, 2016.
[123] Ibid.

While the rhetoric suggests a commitment to transparency and accessibility, the fact that these documents were released in large, thousand-plus page documents, was in itself a form of shielded transparency, because availability does not equate to accessibility. The documents are difficult to comb through, and most Flint residents would certainly not take the time to look through 303,000 pages of documents. There are also no emails that specifically incriminate Snyder that seem to be apparent; they mostly involve his staff members. This is another instance in which the appearance of public good can be dangerous, by obstructing crucial information.

V. Conclusion

The Flint water crisis was a case study of large-scale water infrastructure failure. Surveying the series of events, the context of the situation, and the key actors, reveals the relationships of information exchange and power dynamics that define the sociopolitical management of the water infrastructure system. Overall, these relationships define how the entire system of organization operates, revealing vulnerabilities present in the organization of water infrastructure management.

While typically clear organizational structures regulate and maintain water quality, the challenges brought on by the water source switch highlighted the limitations of the water management as a rigid, hierarchical, and seemingly public system. While policies and regulations usually provide a baseline requirement to protect the public, the rigid system organization used these policies as a tool to delay action and maintain the status quo. The hierarchical power structure discredited information coming from bottom-up or external sources, and placed decision-making power on too few people. Finally, the seemingly public nature of the system created mismatched expectations through the continued denial of problems or obstruction of information.

The organization of the water infrastructure system lacked a framework for effective informational cross-exchange, which facilitated repeated instances where information was manipulated, distorted, delayed, and obstructed, thereby enabling the widespread infrastructural failure that irrevocably harmed the residents of Flint.

Key People

LeeAnne Walters	Flint resident, “whistleblower,” investigated water treatment
Marc Edwards	Virginia Tech researcher, showed that samples of Flint water had elevated lead
Mona Hanna-Attisha	Hurley Medical Center Pediatrician, exposed elevated levels of lead in children

EPA Region 5

Susan Hedman	Administrator (until 2016)
Stan Meiburg	Acting Deputy Administrator
Thomas Poy	Chief of OGWDW
Jennifer Crooks	Program Manager in OGWDW
Tinka Hyde	Water Division Director
Miguel Del Toral	Regulations Manager, wrote interim report on Flint water

Michigan Gov.

Rick Snyder	Governor (2011–present, as of 2018)
Dennis Muchmore	Snyder’s Chief of Staff (2011–2015)
Jarrod Agen	Director of Communications
Sara Wurfel	Press Secretary
Dave Murray	Deputy Press Secretary
Michael Gadola	Snyder’s Legal Counsel
Valerie Brader	Deputy Legal Counsel

MDEQ

Dan Wyant	Director
Brad Wurfel	Communications Director
Liane Shekter-Smith	Chief of DWMAD
Adam Rosenthal	DWMAD
Patrick Cook	Community Drinking Water
Stephen Busch	District 8 Water Supervisor
Mike Prysby	District 8 Water Engineer

MDHHS

Nick Lyon	Director of MDHHS
Eden Wells	Chief Medical Officer
Corinne Miller	Director of the Bureau of Epidemiology
Geralyn Lasher	Deputy Director for External Relations
Robert Scott	Data Manager for the Healthy Homes and Lead Prevention
Nancy Peeler	Maternal, Infant, and Early Childhood Home Visiting
Kory J. Groetsch	Environmental Public Health Director
Michelle Bruneau	Special Assistant to Environmental Public Health Director
Susan Moran	Deputy Director of Population Health Administration
Stan Bien	Women, Infants, and Children Director
Mary Baker	Women, Infants, and Children Policy Specialist
Nancy Grijalva	Assistant to Director Nick Lyon

State-Appointed Emergency Managers

Ed Kurtz	Flint Emergency Manager (2012–2013)
Darnell Earley	Flint Emergency Manager (2013–2015)
Gerald Ambrose	Flint Emergency Manager (2015)

Flint Gov.

Dayne Walling	Mayor (2009–2015)
Karen Weaver	Mayor (2015–present)
Howard Croft	Director of Public Works
Michael Glasgow	Water Treatment Assistant Plant Supervisor

Abbreviations

AL	Acceptable Level
DCH	Department of Community Health; merged with DHS to become part of MDHHS in 2015
DHS	Department of Human Services, merged with DCH to become MDHHS in 2015
DUA	Data Use Agreement
DWSD	Detroit Water and Sewerage Department
DWMAD	Drinking Water and Municipal Assistance Division; subsection of MDEQ
EPA	Environmental Protection Agency; Michigan is a part of Region 5
FOIA	Freedom of Information Act
FRWC	Flint River Watershed Coalition
FWATF	Flint Water Advisory Task Force
GCHD	Genesee County Health Department
GCDC	Genesee County Drain Commission
LCR	Lead and Copper Rule
KWA	Karegnondi Water Authority
MCL	Maximum Contaminant Level
MDEQ	Michigan Department of Environmental Quality; department of State of Michigan
MDHHS	Michigan Department of Health and Human Services; department of State of Michigan
NARUC	National Association of Regulatory Utility Commissioners
NPDWR	National Primary Drinking Water Regulations
NSDWR	National Secondary Drinking Water Regulations
OGWDW	Office of Ground Water and Drinking Water; part of EPA
SWDA	Safe Water Drinking Act
TTHM	Total Trihalomethanes
WRD	Water Resources Division; subsection of MDEQ
WTP	Water Treatment Plant
WWS	Waste & Water Services

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