

# **Aging Water Infrastructure in Michigan**

4 December 2023

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## Executive Summary

This report identifies and explores several significant challenges concerning aging water infrastructure in Michigan, focusing on public perception, trusting in governmental agencies, and effective risk communication. Specifically, the research goes beyond the conventional tangible issues related to aging water infrastructure, such as pipe replacements, and delves into the socio-economic and informational aspects of these challenges.

A major finding is the pervasive lack of awareness among Michigan residents about health and safety risks associated with aging water infrastructure due to the infrastructure's invisibility in everyday life. The concern here is not just about the aging infrastructure itself but the widespread misinformation that further exacerbates the problem due to mistrust and skepticism within the community.

A detailed exploration of current communication strategies revealed both gaps and opportunities for improvements. Moreover, our research identified the need for increased community engagement, and an expansion in educational frameworks about aging infrastructure. We also highlighted challenges regarding reaching socially vulnerable individuals and households and combating misinformation spread.

Our research underlined the impact of aging water infrastructure on daily life, with residents prioritizing functional services and expressing concern when infrastructure work disrupts daily routines. It further highlighted the complex interplay between socioeconomic factors and communication challenges affecting various communities differently.

The report also revealed insights into the intention of keeping water infrastructure hidden from the public and the associated consequences leading to limited public awareness of potential health and safety risks related to aging water infrastructure.

Next steps include targeted strategies to bridge the education gap and combat misinformation through community engagement, effective communication, and improved data collection that takes socio-economic factors into account. We also recommend collaboration across various stakeholders (residents, businesses, schools, local governments, and local municipal agencies) for approaching these challenges in a multisectoral way.

In essence, the report reveals the multifaceted nature of the aging water infrastructure in Michigan, extending its implications beyond physical assets to societal consequences, primarily via public awareness, misinformation, and risk communication. The solutions require integrated efforts encompassing community education, proactive communication strategies, data collection, and diversified stakeholder engagement towards a more sustainable water infrastructure.

## Introduction

This project explores an often-underappreciated aspect of water infrastructure challenges: the intricate interplay between public trust and effective risk communication concerning aging water systems. While mainstream discourse predominantly focuses on tangible issues such as replacing lead pipes, our research shifts attention to the more nuanced arenas of public perception, governmental trust, and the dissemination of information. The Environmental Protection Agency (EPA) estimates a requirement of approximately \$625 billion to maintain and improve the United States' drinking water infrastructure (Mills, 2023). However, our inquiry extends beyond these substantial funding needs to explore the less tangible yet equally vital aspects of water infrastructure challenges.

In Michigan, where water systems vary significantly in age, size, and operational approaches, there is a noticeable gap in funding and resources, as noted by Kris Donaldson (2023) from EGLE (Environment, Great Lakes, and Energy) (Donaldson). This project explores how these funding and infrastructure challenges in Michigan are further complicated by public trust and misinformation issues, particularly in the aftermath of incidents like the Flint Water Crisis. We seek to understand the efficacy of strategies like risk communication, to rebuild trust and accurately inform the public about the state of water infrastructure.

Our research is embedded within the broader context of drinking water-related problems, explicitly focusing on education, outreach, and public engagement in areas like Ann Arbor. Through detailed interviews and analysis, we uncover that the ramifications of aging water infrastructure transcend the mere replacement or upgrade of physical systems. They encompass the prioritization of essential community needs and the intricacies of effective communication. In addressing these facets, our project contributes a more comprehensive understanding of the vast and complex landscape of drinking water-related challenges.

## **Updated Problem Statement**

Michigan is grappling with a critical issue concerning its aging water system infrastructure, and its most alarming aspect in regard to information is the pervasive lack of awareness among its residents, particularly those in vulnerable communities. This challenge is deeply rooted in the fact that many residents, including parents, children at home, and school students, are unaware of the potential health and safety risks of aging water infrastructure. This is one result of creating infrastructure that is hidden from the public. Infrastructure is often not a major subject of discussion due to its invisibility. The aging infrastructure is not merely a distant concern, but a present and immediate one, and the community's lack of knowledge on this matter exacerbates the problem.

Adding complexity to this issue is the widespread misinformation. Communicating false and misleading information concerning water infrastructure safety circulates widely, leading to confusion, mistrust, and skepticism within the community. This misinformation complicates educating residents about the genuine risks they face and further erodes trust in official sources of information.

Failure to tackle the challenge of community education and misinformation can result in adverse health outcomes, financial losses for individuals and organizations, and reminiscent of past crises such as the Flint Water Crisis. Therefore, it is imperative to develop strategies that bridge the education gap to combat misinformation, ensuring the safety and security of Michigan's water systems for all residents.

### **Updated Problem Statement Revisions**

Through our interviews, we got insights into the intention of keeping water infrastructure hidden to the public. The Problem Statement section has been revised to have more background information about what led to many residents being unaware of the potential health and safety risks of aging water infrastructure.

## Process

Because we were given a general topic instead of a specific problem or research question, we first had to come up with our own information-based problem related to the theme of aging water infrastructure. We did this by first endeavoring to understand the overall context of the issue of aging water infrastructure in the state of Michigan, through the presentation from Kris Donaldson from the Michigan Department of Environment, Great Lakes, and Energy (EGLE) and searching the internet for government resources, peer-review literature, and lay press sources to gather information on this issue and its impact on people and their communities. After this more general overview, we began to narrow down a specific aspect of the issue of aging water infrastructure related to information. We first deliberated the following questions: how much does the average community resident know about their water infrastructure and quality? How do residents know if their water is unsafe to drink or use? We also wanted to incorporate the issue of misinformation. We then decided that we wanted to focus locally, in the city of Ann Arbor, in order to make the scope of the problem more manageable for the restrictions of this class project. Through this process, we identified several key stakeholders who are affected by aging water infrastructure in Ann Arbor: residents, businesses, schools (including the University of Michigan), local governments, and local municipal agencies. This allowed us to more fully develop our research questions for our problem statement:

- 1) What are the current communication strategies that are implemented and how can we improve upon them to provide information about the potential risks of aging infrastructure to individuals and community advocacy groups?
- 2) To what extent does our current educational framework that informs the public about aging infrastructure reach people with a high degree of social vulnerability on a household level and how might we improve this system to combat the spread of misinformation?

We then proceeded to do additional research and gain more insight into our chosen issue through more secondary sources, such as articles in the lay press, an additional keynote presentation by Lieutenant Governor Gilchrist, subject matter experts in water infrastructure and quality John W. Allan and Drew Gronewald, and web pages published by the Minnesota Department of Health and the National Communication Association. We organized and synthesized information from these sources into a spreadsheet and identified key themes, quotations, and statistics for inclusion in our affinity wall and to help guide our interviews. For this project, we interviewed two additional subject matter experts: an Ann Arbor administrator with extensive knowledge of the city's water system and infrastructure issues and a professor from the University of Michigan School for Environment and Sustainability (SEAS) (See Appendices A and B).

After conducting our interviews, we held interpretation sessions to take key points and notable quotations from our interviews and secondary sources, and transform them into notes for our affinity wall. We then held an affinity wall session using Miro, a virtual collaborative workspace. Organizing our affinity notes in small thematic clusters, then grouping those clusters into larger and larger clusters, we were left with four main topics: the government's role in water infrastructure issues, community challenges and its relationship to water infrastructure awareness, cooperation across different stakeholder groups, and effective management requires public education alongside the combatting of misinformation and apathy.

Although we were initially interested in exploring the efficacy and equity of current strategies and outcomes regarding aging water infrastructure, our understanding of the problem expanded during our interviews, where our interviewees had some divergent opinions about how, or even if, certain aspects related to aging water infrastructure should be communicated to the public when there are so many problems that they already face considered to be more immediate. This shifted our focus slightly to considering how the status quo of slowly deteriorating water infrastructure leads to apathy amongst the public until an emergency strikes, action is demanded, the emergency is resolved, and the cycle begins over again. These insights highlight that there is much more to developing better communication strategies than simply making sure that people have access to high-quality information, but requires fostering public engagement and support for improvements in the day-to-day.

## Findings

One of the major insights that our team has found is the relationship aging infrastructure has to other important challenges that our communities are facing. Through one of our interviews, we learned that current water infrastructure problems will only be addressed once they affect people's daily lives. Our insights show that residents prioritize functional services and express concern when infrastructure work disrupts everyday workflow, suggesting a need to focus on efficient, non-intrusive improvements in the infrastructure. This is apparent, considering water infrastructure may not be the most important issue to be fixed in certain areas. Our discussion with an academic professional suggests that basic necessities such as food, water, and shelter are widespread issues that should be prioritized in communities. Allocating substantial public resources to educational campaigns during this time is debated upon to be effective, given other prevailing issues and the limitations in human attention, according to our interviewee. It is once basic human needs are met that local municipalities can get the support they need from people on a household level.

One surprising turn was shifting the focus away from water infrastructure and to prioritizing basic necessities. From a holistic perspective, tackling basic needs prior to solving our problem space could result in more support from the public. Some of the limitations we experienced include not being able to find actual statistics of the communities that are struggling with securing these necessities. We can only make assumptions about what the problems are by the points made by our interviewee. Some of the next steps we could take include surveying people on the household level to acquire this data and their insights about how we can solve them. With this information, we can speak to local officials in the relevant fields to understand how aging infrastructure is related to these issues. With more varied data, we can make more accurate and accessible solutions to all of the communities' needs.

Our second finding indicates that residents prioritize functional services and express concerns when infrastructure work disrupts daily life, suggesting a focus on efficiency and improvements. To address this, enhancing community engagement through diversified, simplified communication and active presence in local gatherings and community events is crucial. This approach not only aligns with our understanding of residents' priorities but also aids in effectively communicating complex infrastructure issues in a manner that is accessible and relevant to different community groups. Securing community backing is essential for endorsing necessary rate increases to fund vital infrastructure investments and ensure water safety and quality. Our research underscores the need for clear and efficient communication strategies, especially when addressing diverse groups with varied information needs. Effective engagement is not just about disseminating information but also about actively listening to and incorporating community feedback into infrastructure planning and decision-making.



This is particularly important in areas where water infrastructure may not be the most pressing issue but still requires attention and investment. It's highly recommended that for the effective funding and maintenance of crucial water infrastructure, and to ensure its safety and quality, a concerted effort be made to enhance community engagement. Achieving this involves adopting simplified communication approaches and actively participating in local events. Such engagement is key to building the necessary support among residents for endorsing rate increases. The suggested approach not only adheres with the community's need for functional services but also addresses their concerns regarding the disruption caused by infrastructure work, thereby facilitating more efficient and non-intrusive improvement strategies.

Our findings, specific to the City of Ann Arbor, may not be representative of the entire state. Additionally, our interviews were limited to government and academic viewpoints, lacking input from the residents. Our research highlights that community engagement is essential for addressing infrastructure issues in Michigan. However, the absence of community input in our study limits our ability to ascertain the extent of community engagement and awareness regarding these issues.

Our third key finding highlights a complex interplay between socioeconomic factors and communication challenges, shaping a diverse infrastructure and information needs landscape. Our interviews indicate that different social and economic factors, alongside urban growth, significantly impact water infrastructure in diverse communities. For instance, affordability issues are less pronounced in Ann Arbor compared to less affluent areas like Detroit, leading to fluctuating costs and increased pressure on water systems. A paramount challenge identified is the need for effective communication and engagement with diverse, often underrepresented groups, such as renters and transient populations, to ensure their involvement in local infrastructure and service decisions. Moreover, managing the evolving requirements of infrastructure, including stormwater systems and water supply, is complicated by changing environmental conditions and the intricacies of regional cooperation. This multifaceted situation underscores the importance of tailored strategies to meet the unique needs of each community while fostering inclusive and efficient infrastructure development.

Regarding the distinct challenges in communities with varied socio-economic backgrounds, our study reveals no definitive next steps for potential solutions. The realization of these representational gaps was an unexpected aspect of our research. This underscores the importance of inclusive research design and challenges us to think more critically about our approach. Our current interviews did not address this aspect, indicating a need for further investigation into effective strategies for addressing these challenges. We recommend more inclusive and diverse sampling strategies for future research. Employing culturally sensitive engagement methods and establishing feedback loops with participants could significantly enhance the quality and applicability of our findings.

## Next Steps

### **Finding One: Aging Infrastructure and Its Impact on Daily Life**

Our research underscores the criticality of enhancing our approach towards aging infrastructure, especially if granted unlimited resources and time. A key strategy involves conducting in-depth surveys or interviews to comprehend how residents prioritize their daily life needs, particularly concerning water infrastructure. This step is designed to narrow the gap between the public's awareness and the pressing nature of aging infrastructure issues, as highlighted in Finding One.

In parallel, there must be a grassroots movement to address these challenges at the local level, recognizing that state and federal funding and leadership can be unreliable. This movement calls for proactive, community-driven initiatives to manage aging infrastructure effectively.

The foundation of this approach lies in developing and implementing robust communication strategies. These strategies should focus on crafting clear, concise, and relatable messages about the significance and impact of aging infrastructure on everyday life. Utilizing diverse media platforms, organizing community meetings, and leveraging interactive online tools are pivotal in reaching and engaging different demographic groups.

An essential aspect of these communication efforts is public education aimed at dispelling misinformation and overcoming public apathy. It's vital to foster community engagement and understanding about the urgency of addressing infrastructure issues, even when they are not in a state of immediate crisis. By aligning our communication efforts with the residents' priorities for functional and uninterrupted services, we aim to cultivate a stronger community consensus and garner robust support for proactive infrastructure maintenance and improvement.

In essence, the goal is to empower residents with knowledge and motivate them to actively participate in local efforts to tackle the challenges posed by aging infrastructure. This dual approach of community involvement and effective communication is crucial for achieving sustainable and resilient infrastructure solutions that resonate with the public's daily life experiences and expectations.

### **Finding Two: Shifting Focus to Basic Necessities and Limited Data**

In our investigation, we recognized the critical need to expand community engagement and improve data collection, with a particular focus on the aging infrastructure and water resource management. Understanding community needs, especially in the context of basic necessities like water conservation and maintaining water quality, became a central theme of our approach. This

step is dedicated to gathering detailed and representative data through surveys and interviews, emphasizing the inclusion of voices from socio-economically challenged areas.

Our efforts are directed not only at uncovering the overt needs but also at understanding the underlying issues residents face concerning water infrastructure and resources. A nuanced understanding of the community's perspective is essential for formulating solutions that are relevant and effective in water resource management. This initiative also involves educating the community about the importance of their role in preserving water resources, thus enabling a more informed approach to prioritizing infrastructure projects. The cooperation of all stakeholders is imperative to address the complex challenges of aging infrastructure, ensuring that solutions align with the actual needs and concerns of the community.

### **Finding Three: Socioeconomic Factors and Diverse Infrastructure Needs - GOVERNMENT**

Our research delves into the intricate relationship between socioeconomic factors and water infrastructure needs. We are committed to conducting an in-depth analysis that considers how different socioeconomic backgrounds uniquely shape the perceptions, requirements, and challenges associated with water infrastructure. This involves comparative studies across various communities, such as Ann Arbor and Detroit, to uncover distinct needs and adapt our strategies accordingly.

To ensure a holistic approach, our team is collaborating with local economists, social scientists, urban planners, and community leaders. These collaborations aim to blend technical expertise with a deep understanding of social dynamics, ensuring that proposed infrastructure strategies are not just technically sound but socially equitable as well. We will focus on identifying and addressing disparities in access to clean and reliable water sources, considering factors like income levels, education, and cultural backgrounds.

Moreover, we will explore innovative financing models and policy frameworks that can support infrastructure development in a way that is both sustainable and equitable. This includes examining potential subsidies, grants, and community-based funding initiatives that can help bridge the financial gap in under-resourced areas.

Community workshops and forums will be integral to our approach, providing platforms for residents to voice their concerns, share experiences, and contribute to solution-building. These engagements will be crucial for gaining insights into the lived experiences of different socioeconomic groups and for fostering a sense of ownership and participation among community members.

In essence, Finding Three is about creating a comprehensive strategy that acknowledges the diverse socioeconomic realities of communities. Our goal is to propose infrastructure solutions

that are efficient, equitable, and responsive to the varying capacities and challenges of different communities, ensuring that everyone has access to safe and sustainable water infrastructure.

## Conclusion

While aging infrastructure is an underappreciated and relatively out of sight for the public problem in Michigan, it is a crucial one with costly consequences for failure to act. The largest one is the issue of funding, but others are worthy of our time. This report focused on four main parts of this problem: the funding aspect, the communication aspect, the misinformation aspect, and the lack of and need for political care and interest from politicians and residents.

Our report built upon data collected from two subject matter experts, one from academia and the other from government, and ten secondary sources, and focused more on the City of Ann Arbor than the state of Michigan. From our affinity wall, we had three main findings. First, we concluded that the public and political salience for aging infrastructure is very low. Residents and politicians focus their attention on issues affecting their day-to-day lives, such as the push for public power in Ann Arbor, instead of aging infrastructure. Second, we concluded that simple and regular communication with residents through local events is necessary to keep them informed without overloading them with information many residents need help understanding. This is especially crucial when increasing rates to upgrade infrastructure is needed. Third, we concluded that the relationship between socioeconomic factors and communication problems significantly impacts aging infrastructure issues for different populations.

We conclude with next steps focused on local, proactive measures to address aging infrastructure. For example, strengthening local initiatives to manage infrastructure needs, emphasizing community involvement and local solutions due to the uncertainty of state and federal support. Implementing targeted education campaigns to raise awareness about infrastructure importance, combat misinformation, and foster community engagement, particularly during non-crisis periods. Furthermore, encouraging cooperation among government, private sectors, and residents to address the multifaceted challenges of aging infrastructure effectively, while simultaneously enhancing education on water resource management. This approach emphasizes the community's role in both cooperation and conservation, integrating local initiatives and targeted educational campaigns to raise awareness about the importance of infrastructure. It stresses the need for collective effort in managing infrastructure needs and maintaining water quality, particularly in the face of uncertainty from state and federal support and the need to foster engagement and combat misinformation consistently.

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## Appendix A

### Primary Sources

This appendix contains quotations from our two SME interviews and affinity notes from our affinity wall.

#### SME Interview 1

Code	Affinity Note
P-01	I think our permanent residents in Ann Arbor have a pretty good understanding [of aging water infrastructure in Ann Arbor]. (P-01)
P-01	[to communicate infrastructure issues] it used to be a newsletter that people would subscribe to via email. Now it's through our Gov delivery program so you all could sign up to get that if you wanted to. (P-01)
P-01	[About the newsletter] We have about 10,000. Over 10,000 subscribers. There are, we have about 26,000 accounts in Ann Arbor. So if you look at it on an account basis, it's a pretty substantial percentage. (P-01)
P-01	But probably not really well informed are people like renters and maybe some of the more transient population, like students, and folks like that. (P-01)
P-01	We try to go where people are. So if there's neighborhood associations that exist, we try to go to those meetings. We've done pop up events at things like Mayor's Green Fair, also, we go to the Farmers' market. (P-01)
P-01	There were some recommendations [from UMSI students] on things like chat bots being something that might be worth facilitating the conversation with people who are interested in what we're doing. (P-01)
P-01	We've also reached out to some groups that have been sort of underrepresented or underserved and we are trying to think of some of the things we've gone to. (P-01)
P-01	Have dealt with some organizations that connected with some of those population groups like housing groups that are not permanent housing but rental housing for example– reaching out to them and asking them to share with their clientele so a bunch of efforts have happened, but we're pretty new. (P-01)



P-01	It's also hard to know how successful efforts to reach out to underrepresented groups, students, renters, and other transient populations have been. (P-01)
P-01	Water [in Ann Arbor] is still quite affordable. But [affordability is] becoming more of a challenge. (P-01)
P-01	Because the Ann Arbor community is more affluent in general, affordability concerns are not as big of an issue here as it may be in some other communities like Detroit. (P-01)
P-01	We've spent a lot of time and resources developing public engagement programs to keep them up to speed on what we're working on. (P-01)
P-01	The building boom has had more of an impact on our wastewater infrastructure than our drinking water infrastructure. (P-01)
P-01	I think Flint changed a lot of perception about water infrastructure for people. (P-01)
P-01	I think [water infrastructure] used to be out of sight out of mind. We didn't want to be in the news. We wanted to be hidden. We were like "we're a lot of buried infrastructure like all the pipes under the ground." So as long as we were not hearing from people that's good news. (P-01)
P-01	Lots of people were thinking, well, you know, do we want to continue to invest in this water system that's having all of these issues? (P-01)
P-01	We needed to convince the community that, you know, we have a handle on water safety and quality issues (such as the protozoan cyst in Huron River, which is their water supply). (P-01)
P-01	You don't [build trust in the community] by hiding. So that really changed our approach and is when we started doing some new branding. (P-01)
P-01	We started to issue our newsletter and give people more real time information about their water quality. (P-01)
P-01	We're asking for things like rate increases to support infrastructure. (P-01)
P-01	Our plant was built in 1938 and we're still operating portions of the plant that are original, so over 80 years old. (P-01)
P-01	We need to make sure that the community is behind us or else we're not going to get

	the support for the rates that we need in order to sustain the system. (P-01)
P-01	Now we're thinking about having to reinvest and replace [aging water system infrastructure], at the cost of up to a hundred million dollars. (P-01)
P-01	So we need to make sure that the community is behind [rate increases] because our council has to determine whether they're going to support the rate increases we need for this infrastructure investment. (P-01)
P-01	We're not replacing enough of the buried infrastructure fast enough to keep up [with its life expectancy] (P-01)
P-01	If you have 500 miles of pipeline and they're all going to last about a hundred years, you need to be replacing on average about 5 miles a year. We've been doing more like a half to 2 thirds of a percent a year. (P-01)
P-01	Staying on top of the buried infrastructure is a challenge because it's not popular. (P-01)
P-01	Historically we would post a public meeting and expect people to attend that, but we've been changing from that approach. So we're doing much, much less of that. (P-01)
P-01	We are trying to figure out how we can leverage virtual engagement. Based on the fact that it's hard to get people to come to things. (P-01)
P-01	When a crisis happens, then the interest from the public arises, but once you manage it, residents return to the status quo (P-01)
P-01	We're sort of at the point where a lot of our water main is reaching the end of its life and will be over the next several decades. (P-01)
P-01	With our strategic plan, we've done a bunch of focus groups too, so we brought in some major stakeholders to the table, including the townships that A2 serves. (P-01)
P-01	People don't like when you dig up their roads. We call it orange barrel fever because you can't get around town because every road is torn up. (P-01)
P-01	When we're doing infrastructure replacement, if another utility like an electric utility is going to be tearing up a road where we have a water main, should we leverage that investment so we're doing all the buried work at the same time and not having to tear the road up twice. (P-01)
P-01	The tolerance in the community for flooding and things like that is pretty low. And we

	need to make pretty substantial investments in stormwater infrastructure in order to sort of keep up with the pace of climate change and we haven't. (P-01)
P-01	Right now 2 public engagement specialists in the city for everything, which doesn't match the complexity of all the services provided. (P-01)
P-01	When customers have a complaint, they are frustrated when a solution can't be reached immediately, and might not know the behind-the-scenes work of coordinating with other utilities, schedules, etc. (P-01)
P-01	When working regionally as a cooperative, it is a challenge to align interests in order to make progress. (P-01)
P-01	Part of the issue when upgrading infrastructure in the city is the political horizon of city council, the people who make the decisions are affected more by short term goals than long term goals. (P-01)
P-01	Politicians are not running on preparing water infrastructure for the next fifty years but rather about cutting taxes or water rates for their term in office. (P-01)
P-01	Have used tools like focus groups and surveys to get community feedback, which was more successful than having meetings. (P-01)

## SME Interview 2

<b>Code</b>	<b>Affinity Note</b>
(P-02)	Intentionally, we've created an infrastructure design, installation maintenance system that we wear, we don't want people to know about it. (P-02)
(P-02)	The public uses different services provided by complex infrastructures like wastewater plants, gas lines, storm water systems, etc. without in-depth knowledge (P-02)
(P-02)	people have little or not understanding of the infrastructure that facilitates daily services like water and electricity (P-02)
(P-02)	the public was not intended to be informed about the workings and building of infrastructure like sewage systems, bridges, and electrical lines (P-02)
(P-02)	there is no established system to ask citizens to detect and report issues like a failing stormwater system (P-02)

(P-02)	engineers design, contractors build, and community departments maintain the infrastructure with no public involvement (P-02)
(P-02)	most people only become aware of infrastructure when it directly impacts them, such as road closures for maintenance (P-02)
(P-02)	some individuals show interest in the technical aspects of infrastructure (P-02)
(P-02)	majority of the public lack understanding about infrastructure and are okay with it as long as services are running smoothly (P-02)
(P-02)	the current design of the infrastructure system intentionally leaves the public uninformed about its inner workings (P-02)
(P-02)	The infrastructure is designed to be unnoticed and unobtrusive to the public (P-02)
(P-02)	people are generally unaware of the of the aging infrastructure because the only have to pay taxes for maintenance (P-02)
(P-02)	The public and politicians are indifferent to the poor grading of infrastructure (P-02)
(P-02)	Intentionally, we've created an infrastructure design, installation maintenance system that we wear, we don't want people to know about it. (P-02)
(P-02)	The transition to green infrastructure would still ideally sustain the public's ignorance of the mechanics. (P-02)
(P-02)	The public is primarily interested in the services like clean water and a good bike path, rather than understanding infrastructure. (P-02)
(P-02)	Some education programs attempt to use buildings or outdoors as a "third teacher" for understanding infrastructure. (P-02)
(P-02)	Programs like the environmental program at Oberlin College use infrastructure to teach students where resources come from. (P-02)
(P-02)	Despite these attempts, such educational approaches are rare and often only employed by environmental educators. (P-02)
(P-02)	The view among most educators is that people shouldn't know about the infrastructure and it should remain unseen. (P-02)

(P-02)	Humans have a limited capacity for cognitive processing, interest, and motivation. (P-02)
(P-02)	Requiring individuals to know an excessive amount of information can lead to overwhelm, preventing them from focusing on other life aspects. (P-02)
(P-02)	Despite the importance of infrastructure, it's not reasonable to force people to know everything about it. (P-02)
(P-02)	There's an ongoing debate about the relative importance of different fields of knowledge. (P-02)
(P-02)	The intention is for people to use infrastructure and possibly report issues, but not necessarily understand the underlying systems fully. (P-02)
(P-02)	There has never been a particular drive to increase public knowledge about infrastructure. (P-02)
(P-02)	In modern technical societies, it is not reasonable to expect people to become experts in infrastructure. (P-02)
(P-02)	adding the burden of understanding infrastructure can be unreasonable due to their existing struggles. (P-02)
(P-02)	The welfare of vulnerable populations should focus on alleviating hardship rather than expanding knowledge on infrastructure. (P-02)
(P-02)	Any demands upon these struggling populations to understand or maintain infrastructure are seen as unfair. (P-02)
(P-02)	There is a challenge in how to address the infrastructure in economically and socially struggling areas. (P-02)
(P-02)	Infrastructure has been intentionally made invisible to relieve the public of the burden of understanding it. (P-02)
(P-02)	Asking vulnerable populations to engage intensively in understanding the infrastructure is deemed unreasonable (P-02)
(P-02)	Infrastructure is often not a major subject of discussion in social media due to its invisibility. (P-02)

(P-02)	Possible misinformation about infrastructure is likely connected to a larger agenda, such as fostering distrust in infrastructure management. (P-02)
(P-02)	Historical debates about infrastructure treatments such as chlorination and fluoridation resulted in accusations of misinformation from both sides. (P-02)
(P-02)	The public has varying opinions on issues related to infrastructure, and misinformation does not always flow in one direction. (P-02)
(P-02)	Cases of misinformation about infrastructure may exist but are likely not as widespread or as prominent as in other areas. (P-02)
(P-02)	The main challenge is that the public has been largely uninformed about infrastructure. (P-02)
(P-02)	Any misinformation about infrastructure, if it exists, would likely follow similar patterns to misinformation in other fields. (P-02)
(P-02)	Though misinformation might be present, the larger issue remains the significant lack of information about infrastructure. (P-02)
(P-02)	Creating climate leaders often involves a technocratic, top-down approach, focusing on expert-led solutions. (P-02)
(P-02)	Another approach involves empowering citizens to become leaders in their communities, advocating for local expertise and self-reliance. (P-02)
(P-02)	Many global communities, especially in the Global South, handle their infrastructure needs independently without waiting for expert intervention. (P-02)
(P-02)	Historical evidence shows how human societies have long managed community and infrastructure needs through mutual aid and cooperation. (P-02)
(P-02)	Innovative solutions can arise from common property resource regimes where people self-organize without top-down expertise. (P-02)
(P-02)	Current solutions that are technocratic, market-driven, and policy-driven have not been fully effective; thus a fresh approach is necessary. (P-02)
(P-02)	Calls for a shift towards more low-tech, local, and behavior-oriented solutions to complement existing high-tech strategies. (P-02)

(P-02)	Leaders need to learn to step back and let communities lead their own path to solutions, providing support only when asked. (P-02)
(P-02)	Few educational institutions teach this approach, focusing instead on producing leaders for top-down solutions. (P-02)
(P-02)	There is a need for a shift in education towards empowering supporters and encouraging humility in leaders for a more balanced approach to environmental issues. (P-02)
(P-02)	The current push is mainly for educating people about incentives offered by top leaders, indicating a need for a more comprehensive form of education. (P-02)
(P-02)	Normal citizens taking action might involve acquiring skills typically taught in universities, such as landscape architecture and environmental engineering. (P-02)
(P-02)	There is a question about the reasonableness of expecting community members to educate themselves to the level of experts. (P-02)
(P-02)	Local community members possess different, but valuable, sets of knowledge not necessarily related to managing infrastructure. (P-02)
(P-02)	The concept of specialization in various fields allows for more efficient distribution of tasks in society. (P-02)
(P-02)	It may not be practical for citizens to directly engage in complex infrastructure management, such as maintaining sewage systems. (P-02)
(P-02)	However, promoting awareness about the workings of infrastructure might foster appreciation for the services it provides. (P-02)
(P-02)	Implementing education about infrastructure can lead to increased respect for those who design, build, and maintain it. (P-02)
(P-02)	The proposal instead suggests a focus on fostering public appreciation and respect for the infrastructure that supports daily life. (P-02)

## Appendix B

### Secondary Sources

This appendix contains our secondary data sources which includes interviews, keynote talks, peer-reviewed literature, academic articles, news articles, and webpages.

#### A-01:

**Source Type:** Article

**Source Notes:**

[https://www.pewtrusts.org/en/research-and-analysis/articles/2023/09/25/more-federal-funding-needed-to-improve-drinking-water-epa-study-finds#:~:text=Water%20utilities%20throughout%20the%20United,Environmental%20Protection%20Agency%20\(EPA\).](https://www.pewtrusts.org/en/research-and-analysis/articles/2023/09/25/more-federal-funding-needed-to-improve-drinking-water-epa-study-finds#:~:text=Water%20utilities%20throughout%20the%20United,Environmental%20Protection%20Agency%20(EPA).)

**Data of Data Collection:** 9/11/23

**Key Themes/Topics:** Funding

**Quotes/Extracts:**

Water utilities throughout the United States will need to spend \$625 billion over the next 20 years to fix, maintain, and improve the country's drinking water infrastructure, according to the results of a periodic assessment done by the Environmental Protection Agency (EPA).

As localities delay repairs because of budget shortages, the problems continue to grow and become more expensive. And although water utilities do not typically affect state balance sheets directly (most U.S. water systems are owned and maintained at the local level), the cost of mitigating water emergencies has increasingly become an issue in the nation's statehouses.

**Citation:**

Mills, M. (2023, September 25). More Federal Funding Needed to Improve Drinking Water, EPA Study Finds. Pew.org; The Pew Charitable Trusts.  
<https://www.pewtrusts.org/en/research-and-analysis/articles/2023/09/25/more-federal-funding-needed-to-improve-drinking-water-epa-study-finds>

**Notes:** From our background research.

#### A-02:

**Source Type:** Article



**Source Notes:**

<https://www.americanscientist.org/article/the-hand-in-hand-spread-of-mistrust-and-misinformation-in-flint>

**Data of Data Collection:** 9/11/23

**Key Themes/Topics:** Communication/Environment

**Quotes/Extracts:**

**Citation:** Roy, S. (2017). The Hand-in-Hand Spread of Mistrust and Misinformation in Flint. American Scientist, 105(1), 22. <https://doi.org/10.1511/2017.124.22>

**Notes:** From our background research.

**A-03:**

**Source Type:** News Article

**Source Notes:**

<https://www.npr.org/2021/11/05/1050012853/the-house-has-passed-the-1-trillion-infrastructure-plan-sending-it-to-bidens-des>

**Data of Data Collection:** 11/03/23

**Key Themes/Topics:** Joe Biden, Infrastructure Bill, Federal Government

**Quotes/Extracts:** The massive \$1.2 trillion dollar Infrastructure Investment and Jobs Act of 2021 only allocated \$55 billion to water infrastructure. Other infrastructure: Broadband internet: \$65 billion, Power infrastructure: \$73 billion, Clean drinking water: \$55 billion, Resilience and Western water storage: \$50 billion, Removal of pollution from water and soil: \$21 billion

**Citation:**

Sprunt, B., Kim, C., & Shivaram, D. (2021, November 6). Biden says final passage of \$1 trillion infrastructure plan is a big step forward. NPR.

<https://www.npr.org/2021/11/05/1050012853/the-house-has-passed-the-1-trillion-infrastructure-plan-sending-it-to-bidens-des>

**Notes:****KN-01:**

**Source Type:** Keynote

**Source Notes:**

<https://www.notion.so/Week-3-Keynote-Speaker-cc76cfeb966f440cbbab773a8401985d>

**Data of Data Collection:** 09/11/23

**Key Themes/Topics:** State of Michigan Water Issues

**Quotes/Extracts:** For the state of Michigan alone, Kris Donaldson (2023) from EGLE estimates a one billion dollar funding gap for water infrastructure. She further noted that most of our infrastructure is between 50 and 100 years old, and that many systems are under and overbuilt throughout the state as populations have sifted, nearly every municipality operates differently, and the source of drinking water varies from private wells (1.2 million), public water supply systems (1,400), and non-public water supply systems (9,500) (Donaldson, 2023).

**Citation:** Donaldson, K. (2023, September 11). Drinking Water Access: An Information Perspective [In-person]. SI 501 Keynote.

**Notes:**

**KN-02:**

**Source Type:** Keynote

**Source Notes:**

<https://docs.google.com/document/d/1j6tFDfqPPI5inHauA7-eN6veLuXljEVgLhjFbrz91YY/edit>

**Data of Data Collection:** 09/28/23

**Key Themes/Topics:** UMSI Theme Year

**Quotes/Extracts:** Annual funding gap of at least 1 billion dollars. Invested millions of dollars to protect water

And access to water and solve different needs

Some need new wastewater systems

Funding sources need to be flexible

Money to local municipalities to improve their systems and infrastructure to handle climate change induced rain

**Citation:** *Gilchrist II, G. (2023, September 28). UMSI Theme Year Keynote [In-Person]. UMSI Theme Year Keynote with Lt. Governor Garlin Gilchrist II.*

**Notes:**

**PRL-01:**

**Source Type:** Peer-reviewed literature

**Source Notes:**

<https://www.tandfonline.com/doi/full/10.1080/07352166.2018.1499415#:~:text=Only%202.2%25%20strongly%20agreed%20and,residents'%20trust%20is%20likely%20lower.>

**Data of Data Collection:** 09/11/23

**Key Themes/Topics:** Local and state governments, community trust

**Quotes/Extracts:** A large proportion of our participants do not trust their local government. Only 2.2% strongly agreed and 9.1% agreed with the statement, “I trust my local government.” In addition, 19.3% were unsure; 24.0% disagreed; and 44.7% strongly disagreed. Compared to Michiganders’ level of trust in their local government, as indicated by the SOSS results shown in Table 1, Flint residents’ trust is much lower.

Interestingly, Wang and Van Wart (Citation2007) found that one mechanism for enhancing trust in government is public participation—but only when public officials behave ethically and with transparency and follow through on the actions and plans that were promised during participatory processes.

**Citation:** Morckel, V., & Terzano, K. (2019). Legacy city residents’ lack of trust in their governments: An examination of Flint, Michigan residents’ trust at the height of the water crisis. *Journal of Urban Affairs*, 41(5), 5.  
<https://doi.org/10.1080/07352166.2018.1499415>

**Notes:** From our background research.

**SME-01:**

**Source Type:** SME Interview

**Source Notes:**

**Data of Data Collection:** 10/8/23

**Key Themes/Topics:** Communication/Sharing Information

**Quotes/Extracts:** Generating data and information, communicating this to people in terms of conservation - In terms of infrastructure, the cost, as long as congress is willing to act in ways that are equitable, we should be able to afford these infrastructure projects. It will be interesting to see how money leveraging will happen for water

**Citation:** *Gronewold, D. (2023, September 14). UMSI Water Theme Year - Expert Interview: Drew Gronewold [Interview].*

**Notes:**

**SME-02:**

**Source Type:** SME Interview

**Source Notes:****Data of Data Collection:** 10/23/23**Key Themes/Topics:** Conservation/Protection; Contamination; Infrastructure**Quotes/Extracts:****Citation:**

Allan, J. (2023, October 23). *Conservation/Protection; Contamination; Infrastructure* [Video]. Zoom.

[https://umich.zoom.us/rec/play/JmRX9IYhZNIT2DmIJXbconY56dJtKlkfMPvyfJ3T81NIXmg6q8FOz7iRU2Cgfs4-SklU1cnJdpT8GxBJ.lBd7pV4eHeaXNsrN?canPlayFromShare=true&from=my\\_recording&continueMode=true&componentName=rec-play&originRequestUrl=https://umich.zoom.us/rec/share/v1bCtF9GPmrPILx5Hh2wvYDWE2L0A6SfsdzrZndhvZZHMX5oCS04yVkVqE8oA9W5.dFur3l-TwDpD-pmh](https://umich.zoom.us/rec/play/JmRX9IYhZNIT2DmIJXbconY56dJtKlkfMPvyfJ3T81NIXmg6q8FOz7iRU2Cgfs4-SklU1cnJdpT8GxBJ.lBd7pV4eHeaXNsrN?canPlayFromShare=true&from=my_recording&continueMode=true&componentName=rec-play&originRequestUrl=https://umich.zoom.us/rec/share/v1bCtF9GPmrPILx5Hh2wvYDWE2L0A6SfsdzrZndhvZZHMX5oCS04yVkVqE8oA9W5.dFur3l-TwDpD-pmh)

**Notes:****W-01:****Source Type:** Webpage**Source Notes:**

<https://www.health.state.mn.us/communities/environment/water/toolkit/aboutriskcomm.html>

**Data of Data Collection:** 9/11/23**Key Themes/Topics:** Communication/Sharing Information**Quotes/Extracts:** Use clear communications - simplify your language and presentation not your content

Have a defined goal for communications

Whenever possible, use concrete examples and information that can be put into perspective

Communicate Early, Often, Fully, and Consistently

Remember that perception is reality

Know your audience – listen and respond to specific concerns

Use many forms and methods of communication to meet your audience where they are

Uncertainty is reality and uncertainty is different for everyday, issue and crisis communication

**Citation:** Minnesota Department of Health. (n.d.). Drinking Water Risk Communication Toolkit: About Risk Communication. Wwww.health.state.mn.us.

<https://www.health.state.mn.us/communities/environment/water/toolkit/aboutriskcomm.html>

**Notes:** From our background research.

## W-02:

**Source Type:** Webpage

**Source Notes:**

<https://www.natcom.org/spectra/infrastructure-what%E2%80%99s-communication-got-to-do-it>

**Data of Data Collection:** 11/03/23

**Key Themes/Topics:** Infrastructure, Communication

**Quotes/Extracts:**

Because most damage to these critical forms of infrastructure is out of sight, what can't be seen is not a priority for politicians or considered a return on investment for taxpayers. It is so much easier to justify fixing a broken power line than spending the money to maintain it and replace it before it breaks.

People want transparency and will hold technical organizations accountable through public forms of communication like social media. We are also seeing infrastructure failures that reveal key justice and equity issues—including systematic marginalization—since the populations most often affected and at risk tend to be under-served and vulnerable to infrastructure failures.

**Citation:** Stephens, K. (2023, June 26). *Infrastructure, what's communication got to do with it?* National Communication Association.

<https://www.natcom.org/spectra/infrastructure-what%E2%80%99s-communication-got-to-do-it>

## Appendix C

Prompt: proofread and “Encouraging cooperation among government, private sectors, and residents to address the multifaceted challenges of aging infrastructure effectively. Enhancing education on water resource management, emphasizing the community's role in water conservation and maintaining water quality. get two into one, and make it coherent with " For example, strengthening local initiatives to manage infrastructure needs, emphasizing community involvement and local solutions due to the uncertainty of state and federal support. Implementing targeted education campaigns to raise awareness about infrastructure importance, combat misinformation, and foster community engagement, particularly during non-crisis periods."

Chatgpt: "Encouraging cooperation among government, private sectors, and residents to address the multifaceted challenges of aging infrastructure effectively, while simultaneously enhancing education on water resource management. This approach emphasizes the community's role in both cooperation and conservation, integrating local initiatives and targeted educational campaigns to raise awareness about the importance of infrastructure. It stresses the need for collective effort in managing infrastructure needs and maintaining water quality, particularly in the face of uncertainty from state and federal support and the need to foster engagement and combat misinformation consistently."

\*We inputted our entire report into UM GPT and provided the beginning and end of our prompt and response below.

Prompt: write an executive summary highlighting the key points of the report, and summarizing its sections: This project explores an often-underappreciated aspect of water infrastructure challenges: the intricate interplay between public trust and effective risk communication concerning aging water systems. While mainstream discourse predominantly focuses on tangible issues such as replacing lead pipes, our research shifts attention to the more nuanced arenas of public perception, governmental trust, and the dissemination of information. The Environmental Protection Agency (EPA) estimates a requirement of approximately \$625 billion to maintain and improve the United States' drinking water infrastructure. However, our inquiry extends beyond these substantial funding needs to explore the less tangible yet equally vital aspects of water infrastructure challenges...his approach emphasizes the community's role in both cooperation and conservation, integrating local initiatives and targeted educational campaigns to raise awareness about the importance of infrastructure. It stresses the need for collective effort in managing infrastructure needs and maintaining water quality, particularly in the face of uncertainty from state and federal support and the need to foster engagement and combat misinformation consistently.

U-M GPT: This report identifies and explores several significant challenges concerning aging water infrastructure in Michigan, focusing on public perception, trust in governmental agencies,

and effective risk communication. Specifically, the research goes beyond the conventional tangible issues related to aging water infrastructure, such as pipe replacements, and delves into the socio-economic and informational aspects of these challenges...In essence, the report reveals the multifaceted nature of the aging water infrastructure in Michigan, extending its implications beyond physical assets to societal consequences, primarily via public awareness, misinformation, and risk communication. The solutions require integrated efforts encompassing community education, proactive communication strategies, data collection, and diversified stakeholder engagement towards a more sustainable water infrastructure.