

## **Jackson Cleaner Environmental Remediation**

### **Analysis of the Sociotechnical Failures that caused Jackson, Mississippi Water Crisis'**

A Thesis Prospectus

In STS 4500

Presented to

The Faculty of the

School of Engineering and Applied Science

University of Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science in Civil Engineering on the Environmental and Water Resources Track

Minor in Environmental Sciences

By

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December 6, 2022

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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## **Introduction**

Ypsilanti, Michigan, a small, average-income city with a population less than 20,000, 61.9% white, 25.5% black, and 12.6% other, have been facing not only water quality issues, but also soil, soil vapor and indoor air contamination throughout the city since (U.S. Census, 2022). What resulted in city-wide contamination? A small dry cleaning business located directly adjacent to the Huron River, called Jacksons Cleaners, released tetrachloroethylene known as PCE and its daughter products, trichloroethylene (TCE), 1,2-Dichloroethane (DCE), and Vinyl chloride (VC) into the surrounding community and eventually spread into the Huron River. These toxins being released has resulted in multiple effects on human health varying from dizziness and throat irritation, to respiratory diseases (EPA, 2023). Regarding water quality, groundwater contamination can result in poor drinking water supply and high costs for alternative water supplies that the city has been struggling to (EPA, 2015). As such, the Environmental Protection Agency (EPA) and the city itself, are looking for a technological solution that will clean up the contamination in an efficient way and develop remediation processes that can be implemented to prevent future spills.

As a solution, my team and I will propose a structural design to the city's contamination problem that will provide remediation techniques for the soil and groundwater at and surrounding the Superfund site. However, as the project continues to be under investigation, a recurring theme of social, political, and economic factors that play a large part in historical contaminations like the Jackson Cleaners spill regarding lack of efficient solutions in smaller cities. For example, the Jackson, Mississippi water crisis that occurred in August of 2022 as a result of previous pipe issues not being met, left communities with unsafe drinking water for

(Russell, 2022). To analyze the relationship between both water quality historical events, I will use the STS framework of Actor-Network Theory (ANT) to consider how smaller communities have consistently been affected by these contamination issues due to the socially constructed designs that fail to meet the current needs of these evolving communities (Cressman, 1970). The argument is as such: what are the factors as to why smaller, low-income communities are continuously at risk when it comes to basic necessities such as clean water

If the city and state do not develop efficient remediation techniques as well as efficient clean up rate, residents not only risk their health and safety but also the health and safety of the environment itself. Below, I will outline a technical project proposal that provides many deliverables necessary to clean the Jackson Cleaners spill. I will also discuss an STS project proposal that issues-ANT framework to analyze how cases like the Jackson Mississippi water crisis and the Jackson Cleaners spill have many actors that played a part of the water crisis implemented in these socially constructed designs. The result of this analysis will help connect the missing factors most historical events fail to unpack when attempting to solve these recurring environmental quality issues.

### **Technical Project Proposal**

Researchers surveyed in 89 countries and more than 75,000 bodies of water to find that over 40% of natural rivers, lakes, ponds, streams, etc. are polluted with some contaminant or (Murray, 2021). Contamination spills happen frequently throughout not only the United States, but also universal. With a long history of use of toxic and persistent chemicals in the heart of urbanized areas, contamination from dry cleaning is a widespread and persistent environmental

challenge. This project addresses the contamination impacts by a historic release of perchloroethylene from a drycleaning operation, Jackson Cleaners.

With the spill being only one incident out of many, solving this contamination issue can provide a pathway to multiple sustainable designs when treating contaminated water, air, soils, and vapor soils. The goal of designing this technical project is to create a conceptual site model (CSM), build an environmental remediation technology matrix, design possible remediation strategies, and recommend one of the design strategies to the Geosyntec, environmental company the team is working with.

Since the contamination spill occurred in 2019, there have been many approaches to solving this problem. Although these designers have made progress in remediating, the site is nowhere near being cleaned and designers lack the approach of developing a design that will prevent future dry cleaning spills (U.S. Census, 2022). As a result, the stakeholder in this project is the state due to their funding of the remediation techniques. The practical benefit for the stakeholders with developing the team's deliverables, would be the efficiency and immediate resolution of this contamination problem and future contamination problems.

The company Geosyntec previously approached the problem in multiple ways. First, they attempted to solve this issue through purge logs tests on the site and their second attempt was retrieving air quality samples in residential homes. The issue with the purge logs was it did not collect enough tests to determine the correct remediation technique in order to clean all pollutants in the soil and groundwater. The issue with the air quality samples was most residents becoming noncompliant with employees doing air quality tests in their homes. Both routes resulted in a lack of solving the issue and cleaning the site efficiently.

Before designing ways to find a solution to the contamination problem, it is important to find out what kinds of contaminants are in the groundwater and the extent to which they have affected the system. From this observation, the team will then proceed to a diagnosis phase. Once the diagnosis is complete, our team will select one of the three main remediation methods: biological remediation, chemical remediation, and physical remediation. Biological remediation techniques include using microorganisms, organic matter, and plants to clean the contaminated groundwater (Dessau, 2006) . Chemical remediation is achieved through chemical precipitation, oxidation, ion exchange, and carbon absorption (Atoc, 2023). This method is the only option when it comes to certain groundwater contaminants. Physical remediation includes a pump and treat system that physically removes the groundwater from the aquifer and then treats it at the surface (Burton, 2021).

In order to proceed with these remediation techniques, the team will develop a remediation matrix where it is suitable for soil type, levels of contaminant, permeability, etc that will expose all chemicals in the soil, air, and water and how much of these toxins are present. Developing this matrix will help determine which of the various remediation techniques are viable for the Jackson Cleaners spill. This matrix will be able to be used to solve future spills and provide an effective way to clean spills in a timely and cost efficient manner.

With the matrix, a soil map of the area and groundwater and river interaction will then be identified in order to create a conceptual site model (CSM). This CSM will use the data collected to develop a visual representation of the contaminant source, affected areas, potential fate and transport. The solution to the Jackson Cleaners spill will cover the technical aspect of current and future contamination issues through the engineering principle of being efficient but thorough and provides a design that improves their current contamination spill techniques.

## **STS Project Proposal**

Jackson, Mississippi, a predominantly black city with a high poverty rate, has been struggling with a water crisis for years due to a combination of factors including underfunding, aging infrastructure, and natural disasters. The city's underlying issues surfaced during the heavy rains in August 2022 that caused flooding that further damaged the city's water treatment plants and distribution systems, leaving hundreds of thousands of people without safe drinking water for months. Although this event was a tragedy, the surrounding communities have experienced multiple water related incidents regarding flooding and potable water issues beforehand. For example, in 1979, intense rainfall and flooding of the Pearl River caused over \$1 billion in damages and in February 2020, treatment pumps failed to alleviate the flood waters. Due to this crisis, the 150,000+ residents had their water shut off for a whole month (Russell, 2022).

Through the STS framework, Actor-Network Theory (ANT) I will examine the multiple actors involved in the crisis such as the lack of social groups considered, lack of the ability to modify the use of the design regardless of what the original design was, past design flexibility, and stabilization in the Jackson Mississippi water crisis. Organizations such as the National Association for the Advancement of Colored People (NAACP), support the argument of the lack of design flexibility of this case and the social aspects that the state failed to acknowledge. For example, At least five bills were introduced targeting Jackson's water system, judges, and local control of resources, but the bills made it purposefully harder for residents to pay their water bills through their new proposed matrix (NAACP, 2023).

In previous studies regarding the Jackson Mississippi water crisis, researchers did not consider the city and states lack of social construction when it came to updating outdated pipe

and water treatment functions. The stakeholders in this instance, being the state, did not prioritize updating the water systems throughout the city which ultimately shaped their design process for years after their first water quality incident. For instance, in 2020, Republican Governor Reeves vetoed a bill “aimed at addressing Jackson’s aging water infrastructure.” (Breslow, 2022). The state's lack of effort to fix the outdated and broken pipe designs eventually led to the crisis in 2022 that forced a prolonged state emergency for three months, forcing communities to boil water. With this evidence, it is seen that the consequences of not implementing the standards and regulations of the pipe designs will result in communities without clean water, and division instead of unity regarding the local government and the citizens. The extraction of the research done on the Jackson Mississippi case will further unpack the previous argument made.

Using the ANT framework, I will analyze all possible factors, human and non-human, of the Jackson Mississippi case. With this evidence, a solution will be concluded that will result in a technological design that is socially constructed to fit the needs of current and future communities living in Jackson, Mississippi. With this new solution, I encourage the current stakeholder groups such as the government to shift their past priorities, concerns, and values that wrongly shaped the previous solutions to the crisis’ resolutions. If this solution of implementing design flexibility based on the current social needs is not met, -outdated technology like old pipe designs, underrepresented communities, relaxed implementation of technological guidelines will continue to occur.

## **Conclusion**

Upon completion of the technical proposal, conceptual site model (CSM), an environmental remediation technology matrix, and possible remediation strategies will be

developed and recommended to the Geosyntec company the team and I are working with. Regarding the STS proposal, an indirectly related case from the Jackson, Mississippi water crisis will deliver the importance of future socially constructed designs that will incorporate relevant social groups, interpretive flexibility, design flexibility, closure, and stabilization when developing designs that will be directly affected by society. The STS research proposal will provide readers with a better understanding of how certain social aspects and stakeholders can prevent certain communities from avoiding contamination and spills. With understanding the importance of current and future social aspects in the process of the design, it will aid a new point of view to the current stakeholders to put in practice when developing the technical design. I hope to apply the remediation techniques for this site through research and by addressing the broader socio-technical challenge of the site through the ANT framework.



## References

- Aotc. (2023, June 9). *Types of environmental remediation: Top 25 - AOTC*. Alpha-Omega Training & Compliance, Inc. <https://a-otc.com/25-types-of-environmental-remediation/>
- Breslow, J. (2022, August 31). *The water crisis in Jackson follows years of failure to fix an aging system*. NPR. <https://www.npr.org/2022/08/31/1120166328/jackson-mississippi-water-crisis>
- Burton, R. (2021, September 21). *A comprehensive guide to groundwater remediation*. Handex Consulting & Remediation. <https://www.hcr-llc.com/blog/a-comprehensive-guide-to-groundwater-remediation#:~:text=There%20are%20two%20types%20of,and%20then%20taken%20off%20site>
- Cressman, D. (1970, January 1). *A brief overview of actor-network theory: Punctualization, Heterogeneous Engineering & Translation*. Summit Research Repository. <https://summit.sfu.ca/item/13593>
- Dessau. (2006). *Manual For Biological Remediation Techniques*. International Centre for Soil and Contamination. <https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/3283.pdf>
- Get the facts - jackson water crisis*. NAACP. (2023, April 5). <https://naacp.org/resources/get-facts-jackson-water-crisis>
- Ground water contamination G - U.S. environmental protection agency*. EPA. (n.d.). <https://www.epa.gov/sites/default/files/2015-08/documents/mgwc-gwc1.pdf>
- Indoor Air Quality | US EPA - U.S. Environmental Protection Agency*. EPA . (2023, July 14). <https://www.epa.gov/report-environment/indoor-air-quality>
- Murray, L. (2021, March 19). *Globally, 3 billion people at health risk due to scarce data on water quality*. UNEP. <https://www.unep.org/news-and-stories/story/globally-3-billion-people-health-risk-due-scarce-data-water-quality#:~:text=Researchers%20surveyed%20more%20than%2075%2C000,per%20cent%20were%20severely%20polluted.>
- Russell, C. (2022, October 19). *The infrastructure failures during the 2022 Jackson, Mississippi floods point to a larger issue*. Earth Day. <https://www.earthday.org/the-infrastructure-failures-during-the-2022-jackson-mississippi-floods-point-to-a-larger-issue/>
- U.S. Census Bureau quickfacts: Ypsilanti City, Michigan*. United States Census . (2022). <https://www.census.gov/quickfacts/fact/table/ypsilanticitymichigan/AGE295222>