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Examining Public Water Systems Servicing Schools and Childcare Facilities to Inform Policy: A Study of Lead Exposure in the Mississippi Delta

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EXAMINING PUBLIC WATER SYSTEMS SERVICING SCHOOLS AND CHILDCARE FACILITIES TO INFORM POLICY: A STUDY OF LEAD EXPOSURE IN THE MISSISSIPPI DELTA

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Abstract

This study was initiated with the intent of identifying elementary schools and childcare facilities in the Mississippi Delta with children ages 6 and under that may have public water systems (PWSs) with lead exceedances of 5 ppb. We also aimed to identify the existence, and further the availability, of information regarding which public schools and childcare facilities were serviced by which public water systems. Based on the results of this study, considerations related to Mississippi's ability to comply with the 2020 Revisions of the Lead and Copper Rule requiring testing in all public schools were determined. Seven principal counties were investigated for possible exceedances. The Mississippi Department of Health's Drinking Water Watch (DWW) and Public Water System Material Inventory (PWSMI) databases were utilized to determine details regarding each PWS and the concentrations of lead detected over a six-year period from January 1st, 2014 to January 1st, 2020. Elementary schools and childcare facilities for the seven counties were then overlaid with their accompanying PWS. Of the 87 identified PWS, 18 reported lead water concentrations matching or exceeding 5.0 ppb. Thirteen of these PWSs likely serve children ages 6 and younger through elementary schools and child care facilities. This study showed that while information regarding the presence of lead within PWSs is accessible to the public, the capability to easily match schools with their water provider was more challenging because service areas are not easily accessible. This information will be vital in the state's ability to prioritize and comply with lead in drinking water testing in childcare centers and public schools as required by the new Lead and Copper Rule Revisions.

Abbreviated Terms

AL	Action Level
CDC	Centers for Disease Control and Prevention
CWS	Community Water System
DWW	Drinking Water Watch
EBLL	Elevated Blood Lead Level
EPA	Environmental Protection Agency
LCR	Lead and Copper Rule
LCRR	Lead and Copper Rule Revisions
LSL	Lead Service Line
LSLR	Lead Service Line Replacement
MSDH	Mississippi State Department of Health
NTNCWS	Non-Transient Non-Community Water System
PE	Public Education
PPB	Parts Per Billion
PWSMI	Public Water System Materials Inventory
SDWA	Safe Drinking Water Act
TL	Trigger Level
WLL	Water Lead Level

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Chapter 1: Introduction

Lead as a Toxicant and At-risk groups

Lead is a toxicant with the potential for significant and harmful effects on human health, especially in regard to neural health. Globally, lead is abundantly distributed, yet dangerous environmental chemical. Important physical properties of lead like softness, malleability, ductility, poor conductibility and resistance to corrosion make it a popular material throughout the industrial world (Mahaffay, 1990). In the United States, the Environmental Protection Agency (EPA) estimates that drinking water contamination can make up 20 percent or more of a person's total exposure to lead (USEPA, 2021). Across all age groups in the United States, an estimated 32 million people are serviced by PWSs that use lead service lines, with more than 5.5 million people receiving water at or above the 15 ppb action level (Eyal, 2021).

Lead exposure causes damage to the brain and kidneys and can interfere with the production of red blood cells that carry oxygen to all parts of the body. Lead has acute and chronic impacts on the body. In adults, long-term exposure can lead to a lower cognitive performance and causes anemia, increased blood pressure, brain and kidney damage, and reduced fertility in males (Sokol & Berman, 1991). Across the United States children are still exposed to lead. In 2017, researchers at the Public Health Institute's California Environmental Health Tracking Program reported that the overall number of children with elevated blood lead levels as of 1999-2010 in the United States was 1.2 million, which is double the value reported by the Centers for Disease Control and Prevention (Frostenson, 2017). In addition to drinking water, sources of exposure can come from lead paint in homes and toys, and soil, but children who reside in households either at or below the federal poverty level and also those who live in housing built before 1978 are considered at the highest risk of lead exposure (CDC, 2021). Housing inequity in America plays an important part in the exposure of lead to disadvantaged groups such as low-income families and often times those from minority racial and ethnic backgrounds. Lead paint was banned in the United States in 1978, but the enforcement of its removal in residential locations is largely left up to the duty of regulators and inspectors charged with keeping buildings up to code (Spengler, 2020). For rental properties, landlords are independently tasked with meeting these standards. If these preventive measures are not enforced by the landlord, tenants often have limited options for removing lead. Further, these safeguards are more likely to fail in neighborhoods of concentrated disadvantage where low-income families often lack the power and resource to remove lead from their homes (Winter & Sampson, 2020).

Children are particularly sensitive to even low levels of lead which can cause neurotoxicity and contribute to behavioral problems, learning deficits and lowered IQ (Rubin & Strayer 2008). High susceptibility of children to lead exposure is attributed to in part to their habits (e.g. hand to mouth behaviors, time spent on the ground), and they absorb high quantities of lead through their gastrointestinal tract as their bodies continue to grow (Jusko et al., 2008). For example, children can absorb 40 percent to 50 percent of an oral dose of water-soluble lead compared with 3 percent to 10 percent for adults (Hanna-Attisha et al., 2016). A dose-response relationship exists for children aged 1 to 5 years, for every 1 ppb increase in water lead, blood lead increases by 35 percent (Hanna-Attisha et al., 2016). Even low-level lead exposure is of particular concern to children because their growing brains and nervous systems are more sensitive to the damaging effects of lead (Sanders et al., 2009). In regard to school drinking water, it has long been identified as an important point of exposure to lead for U.S. children because many schools in the United States contain aging infrastructure such as pipes with lead solder and lead-containing water fountains, or faucets (Lambrinidou et al., 2010). Lambrinidou and coauthors (2010) highlighted that compounding the effects of exposure are the facts that schools are usually only in use 8-10 hours per day and not on weekends or holidays. Thus, there can be long periods of time in which water sits in the pipes, leading to the migration of lead into drinking water.

The effects of lead exposure through drinking water will most often occur on small-scale incidences that do not receive national attention. However, since the turn of the century, there have been two major contamination events in the United States that showed the damage that can occur when regulatory measures are either not properly in-place or violated altogether.

Washington, DC Lead in Drinking Water Crisis

The Washington, DC drinking water contamination crisis occurred when a water disinfectant was switched from free chlorine to chloramine in November 2000. This switch reduced the concentration of potential carcinogens to levels below those specified by the EPA. However, chloramine altered the water chemistry and unexpectedly caused lead to leach from lead service line pipes and other plumbing materials. In turn, the contamination adversely affected water lead levels in homes throughout the city. For the time period of 2001-2004, the water lead levels (WLLs) remained higher than the EPA regulatory action level of 15 ppb (Edwards, et al., 2009). In the second half of 2001, the incidence of elevated blood lead levels (EBLLs) abruptly increased by 9.6 times versus the first half of 2001. For homes tested throughout the D.C. area in 2003, over two-thirds of 6000+ homes had WLLs greater than 15 μg/L (Roy & Edwards, 2019). The total reach of exposure in children is estimated to have been approximately 42,000 with exposure times of less than 2 years. To resolve the issue, orthophosphate, a common corrosion control treatment, was added through the Washington, DC water systems starting in August 2004.

Flint Water Crisis

In April 2014, Flint, Michigan's source of drinking water was switched from Lake Huron to the Flint River. In a cost-saving move, the transition was made without the necessary corrosion control treatment to prevent lead release from pipes and plumbing. There were many warnings and concerns voiced regarding the use of the Flint River as a community water source. Despite these concerns, the switch was still made. Shortly following the switch to Flint River, residents filed complaints about the water's color, taste, and odor, and various health concerns including skin rashes (Hanna-Attisha et al., 2016). The initial supplier, Detroit Water and Sewage Department, reported very low corrosivity for lead. In contrast, the new supplier, Flint River, had the necessary markers consistent with high corrosivity – high chloride, high chloride-to-sulfate mass ratio, and no corrosion inhibitor. In early September 2015, a research team from Virginia Tech sampled water from 252 homes and reported that the city's 90^{th} percentile lead level was 25 ppb (Torrice, 2016). A spatial analysis study published in *The American Journal of Public Health* discovered an increase in the proportion of Flint children with elevated blood lead levels (EBLL) before and after the crisis. In the pre period, 2.4% of children in Flint had an EBLL; for the post period, 4.9% of children had an EBLL (Hanna-Attisha et al., 2016).

The Flint water crisis highlighted a gap in the provision of safe drinking water to all people, especially to the most vulnerable. There is apparent blame on many fronts at the heart of this issue, but poor and unaccountable decision-making by public officials as well as deficiencies in the Safe Drinking Water Act and the Lead and Copper Rule exacerbated the issue tremendously (Olson, et al., 2016). In total, nine individuals were charged on 42 counts related series of alleged actions and inactions that created the historic injustice of the Flint Water Crisis, included the former Governor of Michigan, Richard Snyder (Watkins, 2021). While these charges, levied in January 2021, indicate that the legal dispute of this case is still in the accusatory phase, the widespread nature of both the charges and the range of individuals involved shows a largescale administrative and legislative failure.

While Flint portrayed a lead in drinking water crisis on a national level, it does not represent the widespread violations of the Lead and Copper Rule on a national level. In 2015 alone, over 18 million people were served by 5,363 community water systems that violated the Lead and Copper Rule (Olson, et al., 2016).

History of Lead Water Contamination and Legislative Action

Lead exposure has affected humans since the earliest incorporation of the element into our daily lives. The first notable description of lead toxicity dates back to second century BC when physician Nicander of Colophon was able to identify the acute effects found in high-dose exposure, namely paralysis (Riva et al., 2012). An article from the EPA shows that Roman society was enamored with lead due to its diverse uses despite possessing the knowledge that it could lead to serious health problems. Consequently, the Romans adopted the same mentality that Americans believed for many years: limited exposure correlates to limited risk. Not unlike United States policy regarding lead for many years, the Romans were unable to realize that everyday low-level exposure led to chronic lead poisoning. As is noted by the Environmental and Energy Study Institute, this negligence towards the potential health risks with lead in early United States policy and regulation was highlighted by the introduction of tetraethyl lead in motor engines to prevent engine knock. For nearly fifty years, leaded gasoline was the primary form of fuel in the United States until the formation of the EPA under the *Clean Air Act* in 1970 allowed for the regulation of compounds that endanger human health (Stolark, 2016). The formation of the EPA led to a number of regulatory practices and laws regarding lead. The 1971 signing of the *Lead-Based Paint Poisoning Prevention Act*, aimed to control and restrict the lead content in paint used in federally funded housing (Reid & Eitland, 2017).

The *Safe Drinking Water Act* (SDWA) in 1974 was enacted to help protect the quality of water provided by public water systems (Environmental Protection Agency, 2017). The initial act, and substantial amendments in 1986 and 1996, is administered through programs that establish standards and treatment requirements for public water systems (PWSs), promotes compliance of PWSs, provides assistance to small water systems, and protects sources of drinking water amongst other actions (Weinmeyer et al., 2017). Further, the 1988 addition of the *Lead Contamination Control Act* aimed to reduce exposure to lead contaminated water in schools (Environmental Protection Agency, 2017). The EPA first devised maximum contaminant level goals (MCLGs) and national primary drinking water regulations (NPDWRs) for lead and copper in 1991 with the *Lead and Copper Rule* (LCR) (Environmental Protection Agency, 2017).

Lead and Copper Rule

Initially drafted in 1991, the purpose of the LCR was to protect public health by minimizing lead and copper levels in drinking water, primarily by reducing a water source's corrosiveness (USEPA, 2021). All community water systems (CWSs) and non-transient non-community water systems (NTNCWSs) are covered by the Lead and Copper Rule. However, private wells are not regulated by the SDWA and therefore are not subject to the current standards of the rule. The rule requires systems to monitor drinking water at customer taps. If lead concentrations exceed an action level of 15 parts per billion (ppb) in more than 10 percent of customer taps sampled, the system must undertake a number of additional actions to control corrosion. Additionally, the system must also inform the public about steps they should take to protect their health and may have to replace lead service lines under their control (USEPA, 2021). Since implementation of the LCR, drinking water exposures have declined significantly, resulting in major improvements in public health. Notably, the number of nation's large drinking water systems that have exceeded the LCR action level of 15 ppb has decreased by over 90 percent (USEPA, 2019). Between 2017 and 2019, fewer than 5 percent of all water systems reported an action level exceedance (USEPA, 2019). The LCR works by utilizing a tiering system for prioritizing sampling sites. The EPA describes in detail the qualification for each tier site on their website for drinking water requirements (USEPA, 2021). **Table 1** shows the tiering classification as described by the EPA in the Lead and Copper Rule Monitoring and Reporting Guidance for Public Water Systems (USEPA, 2010).

Table 1: Tiering Qualifications for Community Water Systems and Non-Transient Non-Community Water Systems

<table>
<tr><th colspan="2">Tiering Classification for Sampling Sites</th></tr>
<tr><th>Tiering for CWS</th><th>Tiering for NTNCWS</th></tr>
<tr><td>Tier 1 sampling sites are single family structures:
Copper pipes with lead solder installed after 1982 or have lead pipes; and/or are served by a lead service line</td><td>Tier 1 sampling sites consist of buildings:
Copper pipes with lead solder installed after 1982 or have lead pipes; and/or are served by a lead service line</td></tr>
<tr><td>Tier 2 sampling sites consist of buildings, including multiple-family residences (MFRs)*
Copper pipes with lead solder installed after 1982 or have lead pipes; and/or served by a lead service line</td><td>Tier 2 sampling sites consist of buildings with copper pipes with lead solder installed before 1983.</td></tr>
<tr><td>Tier 3 sampling sites are single family structures with copper pipes having lead solder installed before 1983</td><td>Tier 3: Not applicable.</td></tr>
</table>

*Note: When MFRs comprise at least 20% of the structures served by a water system, the system may count them as Tier 1 sites (USEPA).

Tap monitoring results equate to the primary factor determining monitoring requirements and whether any action towards treatment is needed i.e., corrosion control treatment, source water treatment, public education, and/or lead service line replacement. When recording testing results for a particular system, the 90th percentile method is utilized. Within this method, the samples are arranged from lowest to highest value. The number of samples taken is multiplied by .90 to give you the sample that is the 90th percentile and further the value for the system (MSDH, 2021). If 90th percentile monitoring results are higher than the action level of 0.015 mg/L (15 ppb) for lead, corrosion control treatment (CCT) is required. Standard monitoring is conducted at six-month intervals. Both initial monitoring, which is required of all systems, and follow-up monitoring (the two consecutive six-months after a system completes the installation of corrosion control and is only required for systems that install treatment) are types of standard monitoring practices. If a system completes two consecutive six-month standard monitoring periods in which the 90th percentile levels do not exceed 15 ppb, the system can move to reduced monitoring and the frequency at which it is sampled moves to once every three years (USEPA, 2021). The minimum number of samples required to be tested for a system is dependent on the population served by the particular system. **Table 2** shows the breakdown of the sample numbers required relative to the population served.

Table 2: Minimum Number of Lead and Copper Tap Samples for Systems on Standard Monitoring

System Size	Number of Samples
10,001 – 100,000	60
3,301 – 10,000	40
501 – 3,300	20
101 – 500	10
≤ 100	5

(Federal Register Vol. 86, No. 10)

As the CDC has identified no safe blood lead level in children, it is imperative that actions are continued to mitigate the opportunity for exposure to occur (CDC, 2019). Further, despite the action level for lead being set at 15 ppb, the maximum contaminant level goal is 0 ppb (EPA). Therefore, we must be vigilant in creating new regulation and enforcing previous ones to help eliminate lead exposure whenever possible. Although progress still needs to be made, there has been some reassurance over the years that lead exposure has been taken as a serious public health matter. Since the 1970s, we have seen a noticeable drop in lead exposure to people living in the United States. In children, the median concentration of lead in the blood of children ages 1 to 5 years decreased from 15 micrograms per deciliter (µg/dL) in 1976 - 1980 to just 0.7 µg/dL in 2015-2016. This accounts for a total decrease in blood lead concentration in children of 95 percent (USEPA, 2020). Further, the concentration of lead in blood at the 95th percentile in children dropped from 19 µg/dL to 2.8 µg/dL, a decrease of 90 percent, over the same time period (USEPA, 2020). While childhood blood lead levels have shown significant improvement as a result of the initial implementation of this rule and previous regulatory measures such as the removal of leaded gasoline/paint, exposure to lead remains a serious concern, especially for children.

EPA's 3Ts For Reducing Lead in Drinking Water

The EPA's "3Ts" aims to help schools and childcare facilities establish and operate a voluntary program to reduce the lead content in drinking water. The three T's - training, testing, and taking action – all take different approaches to achieving the desired result of less lead in water. The training aspect works to teach childcare facility officials to increase awareness about the possible occurrences, causes, and health effects of lead in drinking water and develop program plans. Secondly, the EPA aims to test drinking water in childcare facilities to identify potential problems. Lastly, and the most prominent aim, is to overall take the necessary action to reduce lead in drinking water. Provided on the EPA's website is a 3T toolkit that communicates all the necessary information required to ensure a successful program (USEPA, 2021). The toolkit explains why lead testing is important, how to get started, knowing the facts about the program overall, and finally how to make a plan and take action.

December 2020 Revisions to the Lead and Copper Rule

The December 2020 Federal Register Rules and Regulations released by the EPA lists a number of major differences between the previous Lead and Copper Rule – including the initial release in 1991 and numerous smaller revisions in previous years – and the 2019 proposed Lead and Copper Rule Revisions (LCRR) and the final rule requirements. The Action Level (AL) and Trigger Level (TL) have seen some additions to their requirements with the new revisions defining a trigger level of 10 μg/L. The initial lead service line (LSL) program activities required that systems complete a materials evaluation by the time of initial sampling. No requirement to update materials evaluation was set, and no lead service line replacement (LSLR) plan was required. The new LSL program activities require all systems to develop an LSL inventory or demonstrate absence of LSLs within 3 years of final rule publication. LSL inventory must be updated annually or tri-annually according to their tap sampling frequency. Additionally, all systems with known or possible LSLs must develop a LSLR plan. Perhaps the most essential component of the new mandates pertains to testing for lead in drinking water at schools and childcare facilities.

The first draft of the LCR did not include separate testing and educational programs for community water systems at schools and childcare facilities. The only schools initially required to sample were those that belonged to non-transient non-community water systems. The final LCRR states that community water systems must conduct sampling at 20% of elementary schools and 20% of childcare facilities per year and conduct sampling at secondary schools on request for 1 testing cycle (5 years) and conduct sampling on request of all schools and childcare facilities. Additionally, sample results and public education (PE) must be provided to each sampled school/childcare, primacy agency and local or state health department. The EPA's revisions to the Lead and Copper Rule will better identify high concentrations of lead, improve the reliability of lead tap sampling results, strengthen corrosion control treatment requirements, expand consumer awareness and improve risk communication. This rule requires, for the first time, community water systems to conduct lead-in-drinking-water testing and public education in schools and childcare facilities (Federal Register, Vol. 86, No. 10, pg. 4198).

Within the revisions, one of the target points is to systematically replace lead service lines (LSL). The final Lead and Copper Rule revision (LCRR) will require the PWSs with high lead levels to initiate LSL removal, thereby permanently reducing a significant source of lead in many communities. Further, all water systems with LSLs or lines with "lead status unknown" must create an LSLR plan by the rule compliance date of January 16, 2024 (Federal Register, Vol. 86, No. 10, pg. 4199). The final rule requires all water systems to create a publicly accessible LSL inventory. The initial inventory must be available within three years and updated over time to reflect changes, such as verification of lead status unknown service line material compositions or LSLs that have been replaced altogether. All water systems must create an inventory, regardless of size or other water system characteristics, and the inventory must include all service lines in the distribution system, without exclusions. Water systems with only non-LSLs are required to conduct an initial inventory, but they are not required to provide inventory updates to the state or the public and they may fulfill the requirement to make the inventory publicly accessible with a statement that there are no LSLs, along with a general description of the methods used to make that determination (Federal Register, Vol 86, No. 10, pg. 4213).

The EPA estimates that exposure to lead in drinking water could account for as much as one fifth of a person's total lead exposure (USEPA, 2018). Since children are at most risk of harm from lead exposure, EPA is requiring that community water systems (CWS) test for lead in drinking water in schools and childcare facilities. The Biden administration recently announced a slight delay for the effective date of the LCRR, which now is set for June 17th, 2021. This however does not change the compliance date which is still set for January 16th, 2024 (Federal Register, 2021). When the ruling does go into effect, systems must conduct drinking water sampling at each elementary school and each childcare facility that they serve over no more than five years, testing 20 percent of the facilities that they serve each year. The system will be required to provide sampling results to the school or childcare facility and information on actions that can be taken by the school or childcare facility to reduce lead in the drinking water. The system will also be required to provide information to the school or childcare facility on methods to communicate results to users of the facility and parents. CWSs are also required to provide testing to secondary schools on request during the 5 years of mandatory elementary and childcare facility testing, and also to elementary schools and childcare facilities on request after the first round of mandatory testing. These requirements will provide schools and childcare facilities with an understanding of how to create and manage a drinking water testing program that is customizable to their needs and an appreciation of the benefits of such a program (Federal Register, Vol. 86, No. 10, pg. 4201). After all elementary schools and childcare facilities are tested once, the CWS will be required to conduct sampling at all the schools and childcare facilities they serve when requested by a facility (Federal Register, Vol. 86, No. 10, pg. 4234).

The EPA is requiring that each state retain all record keeping requirements from the current LCR. In addition, EPA is requiring the state to maintain a record of all public water system's LSL inventories and annual updates. This information is necessary for the state to calculate goal and mandatory LSLR rates, as well as verify correct tap sample site selection tiering. EPA is also requiring the state to maintain a record of the state's decision and approval related to water system changes to source water or treatment (Federal Register, Vol 86, No. 10, pg. 4242).

Lead Drinking Water in Mississippi

The risk of lead contamination in drinking water does not escape Mississippi. The *Jackson Free Press* reported that in January of 2016, the Mississippi State Department of Health (MSDH) identified Hinds County, which encompasses a large portion of the Jackson metro area, as one of 16 counties in Mississippi at high risk for lead contamination. Additionally, the health department reported high concentrations of lead in the city's drinking water systems. This announcement came a full seven months after Jackson city officials first became aware of the problem, however. The MSDH notified the city that 22% of samples from June 2015 exceeded

15 ppb, and thirteen homes out of the 58 sampled had elevated levels of lead (Otts, 2017). The city had persistent issues with stabilizing the pH, alkalinity, and hardness within the city's OB Curtis Water Treatment Plant, which is likely the main culprit of the elevated levels of lead (Otts, 2017). For the testing period January 1, 2017 to June 30, 2017, the level fell with only a measure of 7 ppb for the 90^{th} percentile. Discouragingly, however, the monitoring period July 1, 2017 to September 31, 2017 reported a 90^{th} percentile measure of 14.8 ppb, nearly double the previous measure. As of the publication of the report by the National Sea Grant Law Center in December of 2017, city of Jackson residents remained at risk of lead exposure through the drinking water. Fortunately, the most recent lead testing results from the City of Jackson PWS read 90^{th} percentile levels of 3.7 ppb (MSDH).

In regard to testing for lead in public schools and childcare facilities, Mississippi has no established laws or regulations requiring for testing in these facilities (MSDH, 2021). While this reality is not optimal to determine the prevalence of lead in public schools, the State of Mississippi cannot be faulted on a national level as until the most recent revisions to the LCR, no testing in public schools was required. Despite this, strong evidence exists showing that a significant number of children in Mississippi are still being exposed to lead. According to data retrieved from the Mississippi Lead Poisoning Prevention and Healthy Homes Program, 263,541 children were tested for elevated blood lead levels (BLLs) from 2010-2015. Out of these children tested, 2,303 had BLLs at or above 5 µg/dL and 285 had BLLs greater than or equal to 15 µg/dL (MSLPPHHP STELLAR Database, 2015). Because we know that lead pipes or copper plumbing connected with lead solder may contaminate water supplies, school drinking water cannot be overlooked as a source for children's exposure (Mayo Clinic, 2019) (MSDH, 2015).

The State of Public Water Systems in the Mississippi Delta

The "Mississippi Delta" is a common misnomer as the area referenced does not refer to the Mississippi River Delta, which can be found in the wetlands of Louisiana where the river meets the Gulf of Mexico (Helferich, 2014). The Delta referenced here is an extensive alluvial plain in the State of Mississippi following the entirety of the state from just south of Memphis, Tennessee all the way to roughly Natchez, Mississippi (Encyclopedia of Arkansas, 2020). Historically, the Delta has long been an incredibly impoverished region for both the State of Mississippi and the United States as a whole (Cummins, 2017). The populace is spread sparingly across the entire region and is represented by predominant black communities largely encapsulated by generational impoverishment (ArcGIS, 2021).

As aforementioned, the Mississippi Delta incorporates a relatively large land area yet services a relatively small, dispersed population. This leads to a network of water systems that are incredibly fragmented and individually operated. For the seven counties studied in this report, five of them have more than ten public water systems. A number of the systems service populations less than one thousand residents, as is reported by Drinking Water Watch and all of the systems observed in this study represent populations less than 50,000. As outlined by the Lead and Copper Rule, this means each of these systems are required to conduct a minimum of one, six-month round of initial monitoring. The number of samples taken ranges from 60 samples for systems serving greater than 10,000 all the way to merely 5 samples for systems servicing a population less than 100. Thus, depending on the chosen samples, an accurate depiction of the state of lead in the system's drinking water may or may not be able to be reached. Further, in Mississippi, the sampling plan is supposed to include houses that are served by lead service lines, if any are known/present. If houses serviced by lead service lines are not known, then it is possible that testing will not reveal the severity of the lead dispersion within the system. While it is important to observe these samples to identify systems at-risk of lead exposure, the possibility of gaps in knowledge regarding the presence of lead service lines for a system as well as possible disparity in the number of samples tested can lead to underestimation of specific areas at risk of lead exposure.

Questions and Goals of this Project

This project's overall intent is to result in constructive and impactful information regarding the servicing of public water systems to children, primarily ages 6 and under, through elementary schools and childcare facilities. The information found in this study will hopefully benefit future efforts to identify and remove sources of lead exposure to young children in the Mississippi Delta. Initial expectations of the work were that the fractured state of public water systems in the Mississippi Delta would result in difficulties with identifying which schools are supplied by what public water systems. Moreover, the possibility of incomplete or inaccurate reporting about the state of lead service lines and other lead materials within each distribution system could lead to legitimate issues when trying to identify areas of high risk to lead exposure. The accessibility, and further the accuracy, of the information compiled from this project will inform the State of Mississippi's ability to comply with the new regulations regarding testing in schools for lead as described in the Lead and Copper Rule 2020 new mandates.

Chapter 2: Methods

Disruptions Due to Sars-CoV-2

The initial goal for this project was to send out water sampling test kits to have filled with first-draw water samples that would be returned to analyze the residential lead concentrations primarily in the Mississippi Delta (Green et al., 2021). Based on the results obtained, notices were to be sent out to households that contained exceedances in lead. Community engagement events were to be held with the aim of educating the public on the importance of monitoring for lead in their drinking water supplies. Following the analysis of the most susceptible areas to lead contamination from drinking water, public policy recommendations were to be made regarding the implementation of better testing in at-risk communities. Unfortunately, progress was not able to be sufficiently made before nationwide quarantine efforts begun. With Covid-19 beginning to ravish our communities in the spring of 2020, a new course of action had to be taken. The new course of work allowed for social distancing and virtual analysis to be performed as we learned and adapted to the unfolding pandemic.

New Data Analysis and Public Policy Recommendation Initiative

With the ability to visit communities and households unequivocally removed from the project, the direction shifted from community engagement and analytical determinations to data analysis and policy recommendations regarding testing for lead in schools and childcare facilities operating in seven counties in the Mississippi Delta. This new course was optimal for a number of reasons. First, with the MSDH providing a number of publicly accessible databases regarding lead in public water systems, work could be done in identifying water systems that presented high-risk of exposure to its community members. Secondly, based on the data found, a number of policy recommendations could be contributed to serve the communities studied in this project.

Finally, based on the revisions to the Lead and Copper Rule, the State of Mississippi's ability to comply with the new mandates could be determined.

Sources and Standards for Collecting Data

The seven principal counties investigated were as follows: Coahoma, Issaquena, Leflore, Quitman, Sunflower, Warren, and Washington. These counties were selected as they were all listed to be high risk counties by the MSDH for lead exposure, and all are counties in the Mississippi Delta. To get a firm understanding of which public water systems displayed a risk of exposure to lead in schools and childcare facilities, the MSDH's Lead and Copper Rule Public Water System Materials Inventory (PWSMI) was utilized in conjunction with Drinking Water Watch (DWW). The respective URLs for PWSMI and DWW are as follows: https://msdh.ms.gov/msdhsite/index.cfm/30,21403,76,837,html ; https://msdh.ms.gov/msdhsite/_static/30,0,76,793.html. PWSMI contains information regarding the water system name and ID, whether lead is present within service lines or other materials, and the date reported. DWW reports the number of samples and measured values for lead and copper levels in public water. The measurement follows the 90th percentile method. In this method, samples for a system are ordered from lowest to highest. The sample that reads the 90th percentile highest is your reading for the system. For example, if there were 20 samples in a system, multiplying 20 by .90 would give you 18. Therefore, the 18th highest sample is your 90th percentile for the system. The EPA's action level for lead in drinking water is 15 ppb (µg/L). However, because there is no safe lead exposure level for children (World Health Organization), we chose to note all systems with exceedance levels of 5 µg/L into our systems of interest because 5 ppb is the FDA limit for lead in bottled water. This lowered exceedance level allowed for us to broaden our search for systems that may pose a threat. The testing period monitored was established as a 6-year window from January 1st, 2014 to January 1st, 2020. The 6-year monitoring period was used to hopefully gauge how the system has been reporting their lead concentrations for at least 2 three-year periods, because all public water systems are supposed to follow at minimum a 3-year testing cycle as is required by the Lead and Copper Rule.

Conjunction of Data from DWW and PWSMI

As mentioned previously, initial efforts required the use of Drinking Water Watch and Public Water System Materials Inventory to gather the information of interest. Both the PWSMI and DWW applications are accessible from the MSDH's public website. For each water system, an in-depth description of the details of the system was produced in order to identify not only exceedances, but also irregularities in the reporting of public information. If followed correctly, the PWSMI should serve as a catalog for public water systems to provide a report to both the MSDH as well as the general public regarding the presence of lead in service lines or a number of other materials, indexed in **Table 11a**.

The presence or absence of lead within the water system report should serve as an initial marker as to the likelihood that exceedances will be present. The PWSMI main page has a simple search bar in which the public water systems details can be accessed by a number of different searches. Because of the multiple possible ways to access the same information, the standard practice of searching consisted of searching the name of each county individually and observing the systems listed. Once a county was selected, all of the water system names and ID numbers for the county were listed as well as lead in service lines and other materials and the date reported. Clicking on any of the water system names pulls up a continuous-scroll PDF page with the Lead & Copper Sample Plans for each system in that county. The details of each system were acquired and placed onto a Microsoft Excel sheet to later be used in conjunction with

Drinking Water Watch. In addition to the details of the system being noted, any irregularities or discrepancies in reports were cataloged. The details of these irregularities will be further evaluated in the discussion portion of this study.

After the information provided by PWSMI was captured, Drinking Water Watch was used to revisit the listed systems to determine if exceedances were present at any point in the 6-year window. The Drinking Water Watch application allows for the systems to be discovered by a number of unique pathways, but to ensure continuity in the method of gathering data, a simple, standard investigative system was used. Once on the homepage of the Drinking Water Watch link, the standard for searching for all 86 public water systems was to use the “Principal County Served” tab and visit each system within that particular county. Once a county was selected, a list of the public water systems for the county can be observed as well as the type of system (CWS or NTNCWS), the status (Active or Inactive), and the primary source water type. By clicking on a singular water system number to the left of the system name, more details of that system can be found. Listed on this page includes, but is not limited to, primary points of contact for the system, the population served, and links to more specified details. One of the links provided is “Lead and Copper Sample Summary Results.” This page provides information such as the monitoring period beginning and ending dates, number of samples taken, measurements in mg/L, and the type of analyte (Lead or Copper).

From this point, we were able to personalize the desired monitoring period for information displayed which was as previously mentioned to be January 1st, 2014 to January 1st, 2020. Once the period was entered, all testing cycles within that window could be observed. All systems are required to operate on at least a 3-year testing cycle but depending on the levels of lead in the water, the frequency of testing may increase. The frequencies of testing were noted as well as irregularities within the testing cycle such as a missed testing period or seemingly random testing windows. The most valuable information provided was the measure of lead for each monitoring period. Because the values are reported in mg/L and our desired unit of measurement is µg/L, or parts per billion, a simple conversation was performed.

Identification of Public Water Systems of Interest

In all, data were collected for 86 water systems across seven counties. The individual number of systems per county can be found in **Table 3**. From the 86 water systems, initial priority was given to those that displayed any number of exceedances equaling or exceeding 5.0 ppb over the 6-year monitoring period. From the systems that displayed any exceedance, we were able to then finetune our efforts to the systems that likely or certainly serviced schools and childcare facilities. Those that in all likelihood did not service children ages 6 and under in schools and childcare facilities were ultimately redacted from the study and listed in **Table 12**. **Figure 1** depicts the process of elimination and identifying our final systems of interest.

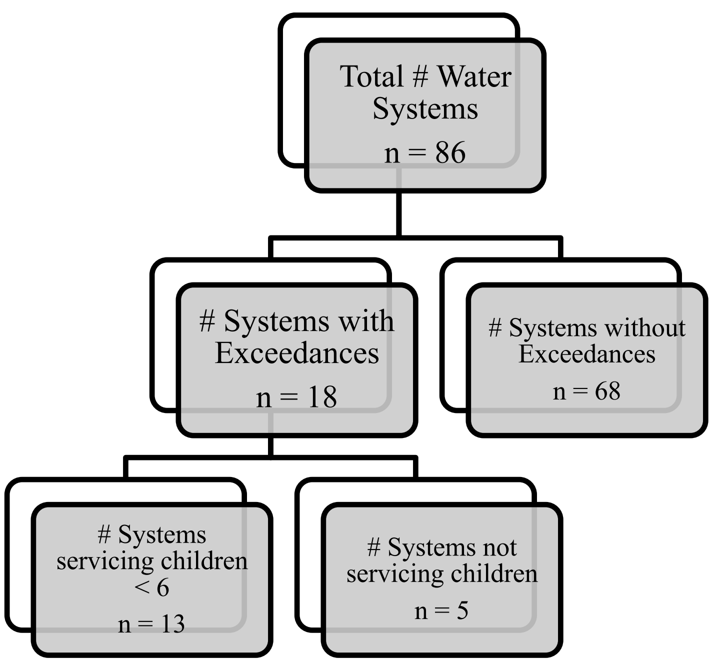

Figure 1: Flow Chart describing the selection of PWSs of interest.

Integration and Mapping of Elementary Schools and Childcare Facilities

A detailed list from a team working under the WIIN Grant at Mississippi State University was produced containing the name, address, type of facility (childcare or school), and the county in which the facility resides. The WIIN Grant, begun in 2019, is a program run at Mississippi State University that works with schools and childcare centers in the state to test for lead (MWRRI, 2020). In total, the Excel sheet contained comprehensive data for schools and childcare facilities for 13 counties, including the seven studied for this project. The schools and childcare facilities residing in our counties of interest were extrapolated from the Excel sheet. Efforts then began to accurately map the boundaries of PWSs in the counties in order to superimpose the location of childcare facilities and elementary schools within their respective PWSs. Initial attempts to deduce which systems serviced the individual facilities resulted in a number of inconclusive results. Searching the internet for publicly accessible details of PWS boundaries for these counties proved to be ineffective as no definitive results were produced to confirm either the existence or absence of these PWS boundaries.

Efforts were then focused on contacting MSDH to discover if any maps containing details of schools and childcare facility water systems were available and accessible. Dr. William "Bill" Moody in the Department of Water Supply was approached via an email inquiry about the status of the information we aimed to find. An initial request for information was sent to Dr. Moody on February 10th, 2021. After waiting approximately two weeks for a response, a follow-up message was sent on February 25th, 2021. While a response from Dr. Moody was anticipated, work began on identifying which systems may service childcare facilities and elementary schools using past data collected by Dr. Jamiko Deleveaux with the Center for Population Studies at The

University of Mississippi. Dr. Deleveaux had previously worked to accomplish this goal and had discovered a few facilities that likely were serviced by a particular PWS.

Chapter 3: Results

The breakdown of the number of public water systems as well as exceedances per county is demonstrated in **Table 3**. Several systems that reported exceedances over the monitoring period reported more than one test that resulted in an exceedance of 5 µg/L. Thus, a column was created to demonstrate the total number of reported exceedances over the monitoring period. Some of the systems operated on standard monitoring (6-month intervals) due to one or more of the qualifications listed for standard monitoring in the introduction. Other systems were able to operate on reduced monitoring. This difference in frequency of testing could have attributed to a higher or lower number of total exceedances over the monitoring period but does not alter the most significant detail in whether or not the system had greater than or equal to 5.0 ppb testing values. In total, there were 33 readings over the monitoring period that met or exceeded the 5.0 ppb cut-off value.

Table 3: County Public Water Systems Overview

NUMBER OF PUBLIC WATER SYSTEMS PER COUNTY & EXCEEDANCES REPORTED

COUNTY SERVED	# of Public Water Systems	# of PWSs with an exceedance ≥ 5.0 ppb	Total # of exceedances 2014 - 2020
QUITMAN	12	4	6
COAHOMA	18	2	8
LEFLORE	16	3	3
SUNFLOWER	14	3	4
WASHINGTON	16	5	11
ISSAQUENA	3	1	1
WARREN	7	0	0
TOTAL	86	18	33

With the exception of Warren, each county investigated through Drinking Water Watch reported at minimum one exceedance of 5 ppb or higher from the 6-year window. Further, many of the systems exceeded the 15 ppb action level established by the EPA. **Tables 4-10** elaborate on the system details for Quitman, Coahoma, Leflore, Sunflower, Washington, Issaquena, and Warren counties, respectively. In each of these tables, the population for each system served, type of public water system, and value/number of exceedances are noted. **Table 4** shows a total of four Quitman County systems – Town of Crowder, City of Marks, West Lambert Water Association, and Town of Sledge – all reported exceedances greater than or equal to 5 ppb at least on one occurrence between January 1st, 2014 – January 1st, 2020. The highest value reported was 29.3 ppb in the Town of Crowder water system. **Table 5** shows that while only two systems reported values greater than or equal to the 5 ppb exceedance, Coahoma Community College accounted for seven of the eight total values recorded greater than or equal to 5 ppb. **Table 6** reveals that Leflore County only reported three systems with exceedances, one of which was a not-transient non-community water system (NTNCWS) servicing a catfish farm. Sunflower County, **Table 7**, also reported three systems with exceedances of 5 ppb.

Washington County in **Table 8** reported the highest number of systems, five, with an exceedance. Two of the systems were NTNCWSs, including a casino. **Table 9** shows that while Issaquena County only has three active public water systems, the Town of Mayersville still reported an exceedance during the monitoring period. Lastly, **Table 10** lists the county system details for Warren County, which was the only county investigated that managed not to record any exceedances of 5 ppb over the 6-year monitoring period.

Table 4: Quitman County Exceedances ≥ 5 ppb 2014 – 2020

QUITMAN COUNTY

PUBLIC WATER SYSTEM	Population Served	Type of PWS	Exceedances Reported (µg/l)
BIG FIELD WATER ASSN.	599	CWS	None
TOWN OF CROWDER	700	CWS	29.3, 29.1
BIRDIE WATER ASSN. *	148	*	*
CITY OF MARKS	1738	CWS	9.7
DARLING WATER ASSOCIATION	240	CWS	None
TOWN OF FALCON	167	CWS	None
TOWN OF LAMBERT	1638	CWS	None
S. QUITMAN – S. LAMBERT	520	CWS	None
S. QUITMAN – W. CROWDER	182	CWS	None
W. LAMBERT WATER ASSN.	124	CWS	15.7, 15.7
TOWN OF SLEDGE	540	CWS	6.1
SOUTH LAKE WATER ASSN.	560	CWS	None

* Birdie Water Association was not able to be found on The MSDH's Drinking Water Watch, despite it being a listed system on the Water System Materials Inventory for Quitman County. Thus, information regarding potential exceedances over the monitoring periods investigated were unable to be determined as the Drinking Water Watch application is the primary source for the distribution of exceedance details.

Table 5: Coahoma County Exceedances ≥ 5 ppb 2014 – 2020

COAHOMA COUNTY

PUBLIC WATER SYSTEM	Population Served	Type of PWS	Exceedances Reported (µg/l)
CLARKSDALE PUBLIC UTIL	17962	CWS	8.9
TOWN OF FRIARS POINT	1200	CWS	None
COAHOMA COMMUNITY COLLEGE	2000	CWS	7.5, 8.4, 5.8, 5.8, 7.0, 5.0, 8.6
PINE GROVE COM. WATER ASSN.	433	CWS	None
COAHOMA UTIL DISTRICT #2	539	CWS	None
GREEN ACRES W/A – N	237	CWS	None
GREEN ACRES W/A – S	351	CWS	None
IOC-LULA / ISLE OF CAPRI	950	NTNCWS	None
LU-RAND UTILITY DISTRICT	215	CWS	None
RENA LARA WATER ASSN.	412	CWS	None
MOORE BAYOU W/A	438	CWS	None
MOORE BAYOU W/A #2	420	CWS	None

MOORE BAYOU W/A #3	378	CWS	None
TOWN OF COAHOMA	325	CWS	None
TOWN OF JONESTOWN	1298	CWS	None
TOWN OF LULA	319	CWS	None
TOWN OF LYON	382	CWS	None
WATER ASSN OF MOON LAKE	500	CWS	None

Table 6: Leflore County Exceedances ≥ 5 ppb 2014 – 2020

LEFLORE COUNTY

PUBLIC WATER SYSTEM	Population Served	Type of PWS	Exceedances Reported (µg/l)
AMERICA'S CATCH CATFISH PLANT	300	NTNCWS	None
AMERICA'S CATCH THE FARM	185	NTNCWS	14.0
BLUE LAKE WATER ASSN.	270	CWS	None
CITY OF GREENWOOD	16000	CWS	None
CITY OF ITTA BENA	2049	CWS	None
CITY OF SCHLATER	322	CWS	5.0
CITY OF SCHLATER – (P D PLANT)	108	CWS	5.1
E. LEFLORE WATER AND SEWER DISTRICT	5279	CWS	None
HEARTLAND CATFISH	400	NTNCWS	None
MINTER CITY WATER AND SEWER	555	CWS	None
MORGAN CITY WATER AND SEWER	300	CWS	None
MS VALLEY STATE UNIV.	2250	CWS	None
PHILLIPSTON WATER ASSN.	94	CWS	None
T J BEALL CO.	50	NTNCWS	None
TOWN OF SIDON	500	CWS	None
VIKING SPECIALTY PRODUCTS	45	NTNCWS	None

Table 7: Sunflower County Exceedances ≥ 5 ppb 2014 – 2020

SUNFLOWER COUNTY

PUBLIC WATER SYSTEM	Population Served	Type of PWS	Exceedances Reported (µg/l)
BIG YEAGER WATER ASSN.	270	CWS	None
CITY OF DREW	2349	CWS	None
CITY OF INDIANOLA	10683	CWS	None
CITY OF RULEVILLE	3000	CWS	None
FMH WATER ASSN. #1	2778	CWS	None
MS STATE PENITENTIARY	3000	CWS	18.2
ROME WATER SYSTEM	204	CWS	None
S. SUNFLOWER W/A – INDIANOLA	245	CWS	None
S. SUNFLOWER W/A – INVERNESS	887	CWS	None
SUNFLOWER WATER ASSN.	468	CWS	23.4, 23.4
TOWN OF DODDSVILLE	215	CWS	None
TOWN OF INVERNESS	1019	CWS	None
TOWN OF MOORHEAD	2300	CWS	None
TOWN OF SUNFLOWER	1007	CWS	5.4

Table 8: Washington County Exceedances ≥ 5 ppb 2014 – 2020

WASHINGTON COUNTY

PUBLIC WATER SYSTEM	Population Served	Type of PWS	Exceedances Reported (µg/l)
BLACK BAYOU WATER ASSN.	4493	CWS	None
CITY OF GREENVILLE	31517	CWS	None
CITY OF GREENVILLE (AIRBASE)	25	CWS	5.81, 5.81
CITY OF HOLLANDALE	2702	CWS	None
CITY OF LELAND	4500	CWS	None
DELTA BRANCH EXPERIMENT STA	225	NTNCWS	5.84
GLEN ALLAN WATER ASSN	603	CWS	None
GOLDING ACRES WATER ASSN.	87	CWS	20.0, 10.0, 10.4, 22.2, 69.2
HARLOWS CASINO	420	NTNCWS	11.5, 7.5
JAMIE WHITTEN DELTA STATES RESEARCH CENT	300	NTNCWS	None
RASKIN ENTERPRISES LLC	580	CWS	None
SWIFTWATER DEVELOPMENT ASSN.	734	CWS	None
TOWN OF ARCOLA	546	CWS	None

TOWN OF METCALFE	1067	CWS	None
WAYSIDE WATER ASSN.	1674	CWS	5.0
WINTERVILLE WATER ASSN.	90	CWS	None

Table 9: Issaquena County Exceedances ≥ 5 ppb 2014 – 2020

ISSAQUENA COUNTY

PUBLIC WATER SYSTEM	Population Served	Type of PWS	Exceedances Reported (µg/l)
TALLULA UTILITY DISTRICT	280	CWS	None
TOWN OF MAYERSVILLE	725	CWS	9.1
VALLEY PARK W/A	559	CWS	None

Table 10: Warren County Exceedances ≥ 5 ppb 2014 – 2020

WARREN COUNTY

PUBLIC WATER SYSTEM	Population Served	Type of PWS	Exceedances Reported (µg/l)
CITY OF VICKSBURG	29430	CWS	None
CULKIN WATER DISTRICT	11135	CWS	None
EAGLE LAKE WATER DISTRICT	1663	CWS	None
FISHER FERRY WATER DISTRICT	5190	CWS	None
HILLDALE WATER DISTRICT	5403	CWS	None
INTERNATIONAL PAPER CO.	292	NTNCWS	None
YOKENA - WATER DEPT	2800	CWS	None

Table 11 displays the systems with exceedances of 5.0 ppb across all seven counties, with the exception of Warren County which had no exceedances. **Table 11a** provides a legend for the details reported by the individual water systems describing the distribution piping. This particular portion of information allows for us to deduce a possible correlation between lead in specific parts of the piping distribution and exceedance levels. Many of the systems' Lead & Copper Sample Plans were not submitted to The Mississippi State Department of Health's Public Water System Materials Inventory database. Thus, those particular systems without a report submitted were identified as "Did Not Report." In all, 18 out of 86 (20.9%) public water systems

investigated displayed exceedances equaling or surpassing the 5.0 ppb mark. Golding Acres Water Association [MS0760034] in Washington County recorded the highest value at 69.2 ppb over the 6-year monitoring period. Clarksdale Public Utilities reported the highest population serviced by a water system, 17962, to list an exceedance found, 8.9 ppb.

Table 11: Condensed Table of Reported Exceedances across Seven counties: Highest to Lowest

REPORTED EXCEEDANCES ACROSS 7 COUNTIES: HIGHEST TO LOWEST VALUES

COUNTY	Water System No.	Water System Name	Details of The System Piping*	Estimated Amount (miles, feet, or connections)	Population Served	Exceedances Reported (µg/l)
WASHINGTON	[MS0760034]	Golding Acres Water Assn	Did Not Report	Did Not Report	87	69.2, 22.2, 20.0, 10.4,10.0
QUITMAN	[MS0600003]	Town of Crowder	Did Not Report	Did Not Report	700	29.3, 29.1
SUNFLOWER	[MS0670038]	Sunflower Water Assn.	D, D1, D2, E	D – Did not Report, D1 – 40 connections, D2 – 50 connections, E – 60 connections	468	23.4, 23.4
SUNFLOWER	[MS0670014]	MS State Penitentiary – MN LN	Did Not Report	Did Not Report	3000	18.2
QUITMAN	[MS0600016]	West Lambert Water Assn	Did Not Report	Did Not Report	124	15.7, 15.7
LEFLORE	[MS0420045]	America's Catch The Farm	E	E – 300 feet	185	14.0
WASHINGTON	[MS0670078]	Harlow Casino	Did Not Report	Did Not Report	420	11.5, 7.5
QUITMAN	[MS0600007]	City of Marks	A, B, C, D	A – 5 miles, B – 28 connections, C – 28 connections, E – 20 connections	1738	9.7
ISSAQUENA	[MS0280001]	Town of Mayersville	D, D1, D2, E	Did Not Report	725	9.1
COAHOMA	[MS0140002]	Clarksdale Public Utilities	A, D, D1, D2	Did Not Report	17962	8.9
COAHOMA	[MS0140033]	Coahoma Community College	Did Not Report	Did Not Report	2000	8.6, 8.4, 7.5, 5.8, 5.8, 5.0
QUITMAN	[MS0600008]	Town of Sledge	Did Not Report	Did Not Report	540	6.1
WASHINGTON	[MS0760044]	Delta Branch Experiment STA	D, D1, D2, E	D1 – 4 connections, D2 – 5 connections, E – 4 connections	225	5.84
WASHINGTON	[MS0760014]	City of Greenville (Airbase)	D, D1, D2	D1 – 4 connections, D2 – 2 connections	25	5.81, 5.81

SUNFLOWER	[MS0670012]	Town of Sunflower	Did Not Report	Did Not Report	1007	5.4
LEFLORE	[MS0420022]	City of Schlater – (P D Plant)	D, D1	Did Not Report	108	5.1
LEFLORE	[MS0420005]	City of Schlater	D, D1	Did Not Report	322	5.0
WASHINGTON	[MS0760026]	Wayside Water Assn.	D, D1, D2, E	Did Not Report	1674	5.0

Table: 11a

LEGEND

A	Lead pipe, piping with lead-lined interior, or lead joint pipe in the distribution mains
B	Lead service lines on either side of meter
C	Lead goosenecks/ pigtails
D	Lead from solder, caulking, alloys and home plumbing
D1	Constructed AFTER 1982
D2	Constructed BEFORE 1983
E	Copper from piping and allow

Out of the 18 systems found with exceedances, five were deemed not of relevance to the premise of this project. Despite these systems operating with exceedances reported greater than or equal to 5 ppb in our monitoring window, the likelihood that children ages six and under are being serviced by them is negligible. **Table 12** highlights which systems were excluded and an explanation validation their removal. After this adjustment, the final 13 systems were chosen to continue the study.

Table 12: Systems eliminated from the study and reason for removal

REMOVED PUBLIC WATER SYSTEMS	
SYSTEM NAME	DESCRIPTION OF REMOVAL
AMERICA'S CATCH THE FARM	America's Catch The Farm does not serve the wider community (NTNCWS). Childcare and elementary schools are unaffected by its lead exceedances.
COAHOMA COMMUNITY COLLEGE	Coahoma Community College does not serve the wider community. Childcare and elementary schools are unaffected by its lead exceedances.
CITY OF GREENVILLE (AIRBASE)	City of Greenville (Airbase) does not serve the wider community. Childcare and elementary schools are unaffected by its lead exceedances.
DELTA BRANCH EXPERIMENT STATION	Delta Branch Experiment Station does not serve the wider community (NTNCWS). Childcare and elementary schools are unaffected by its lead exceedances.
HARLOW'S CASINO	Harlow's Casino does not serve the wider community (NTNCWS). Childcare and elementary schools are unaffected by its lead exceedances.
MS STATE PENITENTIARY	MS State Penitentiary does not serve the wider community. Childcare and elementary schools are unaffected by its lead exceedances.

Table 13 lists a number of schools across the seven counties and the utility system that likely services them. This list was included in this study to create a better understanding of where the boundaries for each PWS may ultimately exist. It includes systems that largely did not report exceedances of 5 ppb over the six-year monitoring period, with the exception of Wayside Water Association. This information was retrieved through collaboration with Dr. Jamiko Deleveaux. Confirmation that these systems are in fact the correct utility servicing the individual school could not be confirmed by any known database available to the public.

Table 13: Potential PWSs servicing schools with children ages 6 and under

FACILITIES WITH CHILDREN AGES 6 AND UNDER OVERLAY WITH PUBLIC WATER SYSTEMS

COUNTY	Name	Childcare/School	City	Address	Utility
COAHOMA	Jonestown Elementary	School	Jonestown	330 Matagorda Road	Moore Bayou Water Assn., Inc.
LEFLORE	Leflore County Elementary	School	Itta Bena	401 Lakeside Drive	Blue Lake Water Assn., Inc.
SUNFLOWER	East Sunflower	School	Sunflower	212 E. Claiborne St.	FMH Water Assn. #1
WASHINGTON	Akin Elementary	School	Greenville	361 Bowman Blvd	Swiftwater Dev. Assn.
WASHINGTON	Armstrong Elementary	School	Greenville	528 Redbud Street	Swiftwater Dev. Assn.
WASHINGTON	Mc Bride Elementary	School	Greenville	438 N Poplar Street	Swiftwater Dev. Assn.
WASHINGTON	Solomon Magnet	School	Greenville	556 Bowman Blvd	Swiftwater Dev. Assn.
WASHINGTON	Stern Elementary	School	Greenville	522 McAllister Street	Swiftwater Dev. Assn.
WASHINGTON	Webb Elementary	School	Greenville	600 S Harvey Street	Swiftwater Dev. Assn.
WASHINGTON	Weddington Elem.	School	Greenville	668 Sampson Road	Swiftwater Dev. Assn.
WASHINGTON	Riverside Elementary	School	Avon	939 Riverside Road	Wayside Water Assn.
WASHINGTON	Leland Elementary	School	Leland	404 E Third Street	Black Bayou Water Assn.
WASHINGTON	Leland School Park	School	Leland	200 Milam Street	Black Bayou Water Assn.
ISSAQUENA	O'Bannon Elementary	School	Greenville	1203 S Raceway Rd	Glen Allan Utility District
WARREN	Bowmar Avenue	School	Vicksburg	912 Bowmar Avenue	City of Vicksburg
WARREN	Dana Road Elementary	School	Vicksburg	1247 Dana Road	Fisher Ferry Water District
WARREN	South Park Elementary	School	Vicksburg	6530 Nailor Road	Fisher Ferry Water District
WARREN	Beechwood Elem.	School	Vicksburg	999 Highway 27 S	Culkin Water District
WARREN	Bovina Elementary	School	Vicksburg	5 Willow Creek Dr	Culkin Water District
WARREN	Sherman Ave Elem.	School	Vicksburg	2145 Sherman Ave	Culkin Water District
WARREN	Warrenton Elementary	School	Vicksburg	09 Belva Drive	Warrenton Heights Utility Co

Table 14 displays childcare facilities and elementary schools believed to be serviced by PWSs reporting an exceedance. Some of these facilities house children that are older than six years of age, but all include at least some students that are six years and younger. There were multiple methods used to reach the determination of the PWS that services each of these schools. For Riverside Elementary, the data provided by Jamiko Deleveaux revealed that Wayside Water Association was the likely supplier for the school. Other schools were deduced to be serviced by

a PWS through a simple google search to reveal the town in which the school resides. For instance, Ripley/Blackwell Headstart Center is located in Mayersville, Mississippi; therefore, it was concluded that the Town of Mayersville PWS was the probable source for the school. For the schools and childcare facilities assumed to be serviced by Clarksdale Public Utilities, the facilities list provided by team with the WIIN Grant at Mississippi State University was resourceful as it stated that these schools all reside in Clarksdale. **Table 15** shows an abbreviated breakdown of the number of schools and childcare facilities per county.

Table 14: Exceedances in PWSs believed to service schools in target counties

EXCEEDANCES IN PWS POTENTIALLY SERVICING SCHOOLS IN TARGET COUNTIES

NAME	Childcare/School	County	Address	PWS	Exceedances (µg/l)	# of Students (2021)
RIVERSIDE ELEMENTARY	School	Washington	939 Riverside Road	Wayside Water Assn.	5.0	592
RIPLEY/BLACKWELL HEADSTART CNT.	Childcare	Issaquena	Highway 14 West	Town of Mayersville	9.1	48
THE GOLDEN CONNECTION	Childcare	Quitman	680 3rd Street	City of Marks	9.7	32
AARON E. HENRY HEAD START CNT.	Childcare	Coahoma	810 Sasse St	Clarksdale Public Utl	8.9	417
BEST FRIENDS II	Childcare	Coahoma	160 Catalpa St	Clarksdale Public Utl	8.9	64
BERTHA BLACKBURN HEAD START	Childcare	Coahoma	709 Highway 322	Clarksdale Public Utl	8.9	60
COI HEAD START/ CCC BABY TIGER	Childcare	Coahoma	3240 Friars Point Rd	Clarksdale Public Utl	8.9	30
CREATIVE CHILDREN CHILD CARE CENTER	Childcare	Coahoma	423 Mississippi Ave	Clarksdale Public Utl	8.9	52
HOME AWAY FROM HOME DAY CARE CENTER	Childcare	Coahoma	748 Cherry St	Clarksdale Public Utl	8.9	56
LORETTA'S LITTLE ANGEL CHILD CARE CENTER	Childcare	Coahoma	340 Mississippi Ave	Clarksdale Public Utl	8.9	65
MITCHELL'S DAY CARE CENTER	Childcare	Coahoma	527 Indiana Ave	Clarksdale Public Utl	8.9	13

MOVING FORWARD LEARNING CENTER	Childcare	Coahoma	1300 Martin Luther King Blvd	Clarksdale Public Utl	8.9	50
NEIGHBORHOOD CHILD CARE SERVICE	Childcare	Coahoma	716 Martin Luther King Blvd	Clarksdale Public Utl	8.9	15
RENE'S ALL IN ONE RESOURCE CENTER	Childcare	Coahoma	126 Jefferson Ave	Clarksdale Public Utl	8.9	54
STEPPING STONES CHRISTIAN DAYCARE	Childcare	Coahoma	415 Lee Dr	Clarksdale Public Utl	8.9	50
TOTS FOR TIME II	Childcare	Coahoma	1206 Desoto Ave	Clarksdale Public Utl	8.9	89
SHERARD ELEMENTARY	School	Coahoma	3105 Bobo-Sherard Rd	Clarksdale Public Utl	8.9	171
MYRTLE HALL IV. LANG IMMERSON	School	Coahoma	700 5th St	Clarksdale Public Utl	8.9	211
HEIDELBERG SCHOOL MATH & SCIENCE	School	Coahoma	801 Maple Ave	Clarksdale Public Utl	8.9	286
KIRKPATRICK HEALTH/WELLNESS	School	Coahoma	1101 Smith St	Clarksdale Public Utl	8.9	273
GEO H OLIVER VISUAL/PERF. ARTS	School	Coahoma	871 Ritchie Ave	Clarksdale Public Utl	8.9	246
BOOKER T. WASHINGTON INTERN. STUDIES	School	Coahoma	1806 Sunflower Ave Ext.	Clarksdale Public Utl	8.9	204

(https://www.publicschoolreview.com/) (https://childcarecenter.us/)

Table 15: Summarization of Childcare Facilities/Schools by County

SCHOOLS & DAYCARES PER COUNTY

COUNTY	Childcare Facilities/Schools
QUITMAN	3
COAHOMA	27
LEFLORE	29
SUNFLOWER	27
WASHINGTON	71
ISSAQUENA	2
WARREN	40

Chapter 4: Discussion

Data Analysis through MSDH Resources

One of the goals of this project was to evaluate the accessibility of information regarding PWSs servicing the seven principal counties in the Mississippi Delta. Overall, the DWW and PWSMI sites largely are helpful in determining information regarding a particular public water system. Most systems had up-to-date testing completed and system distribution details reports submitted to MSDH. Through DWW and PWSMI, details regarding individual systems were determined; however, there were a number of difficulties when trying to access data. Most notably, having to use two databases instead of one central location made efforts to compile information tedious. The decentralized nature of MSDH resources mimics that of the water systems servicing the Mississippi Delta in that information is spread out and fractured. For the average person searching for this information, it would be rather difficult to discern where to start when searching for details about a certain water system.

Secondly, there are a number of discrepancies between DWW and PWSMI. Some of the differences are rather minor, such as the name of a system (ex. For DWW, Water System Number [MS0600010] is South Quitman – South Lambert Utilities, while PWSMI has it listed as South Quitman County Utilities). However, in terms of collecting and determining the details of a particular distribution, there are some discrepancies that are more important. For instance, the standard for identifying PWSs on PWSMI was to search for systems by entering the county of interest into the search bar and list the systems present, yet it was frequently noted that many of the systems servicing the county did not show up when the search was conducted. In Leflore County alone, Heartland Catfish [MS0420042], Minter City [MS0420035], Morgan City [MS0420004], MS Valley State University [MS0420003], Phillipston Water Association

[MS0420040], T J Beall Co [MS0420046], and Town of Sidon [MS0420006] all failed to appear when “Leflore” was keyed into the search bar. This lack of appearance could potentially lead to someone trying to access information about a particular system to believe no information was present.

On the basis of determining the sources of lead within a given system, there did not seem to be consistent reporting across all systems. In fact, 20 systems of 86 total (except for TJ Beall Company which is a new system) did not submit a report on the distribution details of the system. These details are instrumental to determining the sources of lead, indexed in **Table 11a**, in a distribution. This is particularly troublesome for systems that reported greater than 5 ppb over the monitoring period as they would not be able to identify the source of lead in the system. In **Table 4**, the Town of Sledge had a lead water concentration of 6.1 ppb for a testing period, yet the system does not have a report submitted through the PWSMI database. In another instance of inconsistency, Birdie Water Association from Quitman County in **Table 4** cannot be found on the DWW site entirely. After search attempts by entering Quitman County, the water system number, and the water system name were completed, no results were able to be found for Birdie.

It is also troublesome that some of the systems reported in **Table 11** that the details of the distribution system did have materials that contain lead, the PWSMI database may have had the system listed as “No” for “Lead in Service Lines” and “Lead in Other Materials.” This exact discrepancy in reporting occurred in at least one PWS in every county investigated. Of the 86 studied systems, over a third of the systems (33, 38.4%) reported “No” for “Lead in Service Lines” and “Lead in Other Materials,” yet provided details of the where the distribution actually did contain lead in the Lead & Copper Sample Plan for that particular system. Even more concerning is that 5 of the 33 systems that had these discrepancies were systems that met or exceeded the 5 ppb value. On the surface, this is problematic because it shows that there are systems within the Delta that may have lead in the distribution system despite reporting that they do not. This will make it very challenging to locate where Mississippi's PWSs have lead and will certainly not make efforts to mitigate exposure in elementary schools and childcare facilities any easier. However, the most concerning revelation found here is the uncertainty behind fixing these issues. It is unclear based on first analysis whether the fault for the differences in reporting is due to administrative error, lack of communication on how to report the details of these systems, or potentially negligence of the information at hand.

Testing for lead in Public Schools: A National Glance and Application to Mississippi

With the newest revisions to the LCR officially in effect on June 17th, 2021, public water systems have until January 16th, 2024 to reach compliance with the new mandates. The question regarding whether Mississippi could comply with the new mandates requiring testing in public schools was examined in this study. As described in aforementioned literature, Mississippi currently does not have any regulations or laws in place for lead testing in public schools. Nonetheless, there are some states that have required testing in public schools for some years prior to the newest LCRRs.

In particular, a study was performed in New Jersey to investigate compliance with mandated testing for lead in drinking water in school districts. In 2016, Governor Chris Christie ordered the New Jersey Department of Education to mandate that school districts test all drinking water outlets for lead within one year and that results be publicly posted for parents and students to view (Sullivan & Lopez, 2019). The study by Sullivan & Lopez (2019) revealed several requirements enumerated by the New Jersey Department of Education. Some requirements included for samples to be first draw, water must have sat in pipes for 8 – 48 hours prior to testing, and signage was posted indicating not to use the water for 8 hours prior to testing. Results revealed promising suggestions that a state can comply with school lead water testing. Of the 581 operational New Jersey school districts in 2016, 520 (90%) tested their water either immediately prior to or within the 1-year period. New Jersey chose to use the same action level as the EPA recommends at 15 ppb. Of the districts tested 76% had at least one outlet that exceeded the 15 ppb action level (Sullivan & Lopez, 2019). While the Sullivan & Lopez study provides optimistic view on Mississippi's ability to comply the new regulations, the differences between New Jersey and Mississippi are far-reaching. The most glaring difference is the land area to population ratios. New Jersey has a population of nearly nine million dispersed over an area of roughly 8,700 square miles, while Mississippi has a population of just under three million and a land area of 47,000 square miles (U.S. Census Bureau). Being able to translate methods used in a small, densely populated region of this country to that of a region like Mississippi, particularly the Mississippi Delta, has yet to be seen whether or not it is effective.

A collaborative study performed by scientists from Harvard University and the University of California in 2019 investigated which states had testing for lead mandated or even simply suggested in public schools. As of January 2019, only 24 states and the District of Columbia had any kind of regulations regarding testing for lead in public schools. The states with some form of testing recommendations or requirements were Alabama, Arizona, California, Colorado, Idaho, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nevada, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oregon, Rhode Island, Utah, Vermont, Virginia, Washington, and the District of Columbia. A mere seven of those states and the District of Columbia required testing to take place in public schools. For the other 17 states, program participation was voluntary (Vock, 2019). Across the 24 states and the

District of Columbia, there seemed to be no apparent standard for the states' action levels, protocols to test school drinking water for lead and to share their findings, recommendations for school responses to testing, or organization and maintenance of water quality data (Cradock, 2019). The Harvard study was able to provide data from 12 of the states regarding the lead content found in drinking water in schools. Factoring for each state's independent action levels, 12% of all water samples tested had a lead concentration at or above the state's action level, while 44% of the schools tested had one or more water samples with a lead concentration at or above the state's action level (Cradock, 2019).

While the study, and moreover the testing methods, performed in New Jersey may present too many variances in population, socioeconomics, and land area to adequately be applied to Mississippi, the testing done in Alabama likely represents the most accurate comparison to efforts that could be performed in Mississippi. Alabama is Mississippi's mirror state with similar land area, demographics, characteristics, economics, and overall population. Alabama initiated its school drinking water lead testing program in April 2017 (Cradock, 2019). The Harvard and University of California study listed details of Alabama's testing program. Unlike the program in New Jersey, the testing in Alabama was voluntary for public schools. Targeted groups ranged from Pre-Kindergarten "Pre-K" to 12th grade students. Samples taken were first-draw samples after letting water stagnate in the desired collection faucet for at least eight hours (Alabama Department of Environmental Management). The action level for Alabama was designated to be 20 ppb, 5 greater than the EPA's current action level. Public schools (n = 232) serving grades Pre-K to 12th grade provided drinking water lead testing results. Five schools (2%) reported one or more sample at or above the 20 ppb action level (Alabama Department of Environmental Management). Of those schools, three of them were primary education schools.

The data provided by the state of Alabama looks promising in terms of the very few action level exceedances reported; however, a further examination of the state's testing program reveals how the data could be misleading. First, because testing was only voluntary, it is plausible that a number of schools did not participate in the program. Perhaps the schools that did not conduct testing would have exceeded the 20 ppb action level, showing a greater presence in the schools than originally believed. Additionally, because Alabama's action level is 5 ppb greater than that of both the EPA and New Jersey's program, there is the possibility that samples could have fallen between 15 and 20 ppb, which had the action level been lower, it would have increased the total number of exceedances across the testing pool. Ultimately, these claims are entirely speculation into what could occur within the state if the testing was performed differently. Perhaps lowering the action level to 15 ppb and requiring all schools in Alabama to perform testing would have little to no effect on the results, but the data as it stands for the state is incomplete and fails to identify many significant areas at risk to exposure in public schools. Despite the inherit flaws in the methods performed, the testing done in Alabama does show that large-scale efforts can be performed in a state very similar to Mississippi.

Recommendations on the state of lead in PWSs and LCCR compliance in Mississippi

The data collected within this study highlights areas in the Mississippi Delta region that should be considered of priority interest when testing in public schools under the new LCRRs are fully implemented. While the State of Mississippi likely has the ability to perform statewide testing in public schools for lead exceedances, prioritization of locations to begin testing will be difficult to identify. The information we obtained from DWW and PWSMI shows that despite there being undeniable flaws in the system currently in place, there is for the most part up-to-date testing for lead and Lead & Copper Sample Plans available for access to the public and the state to identify systems with higher exceedances of lead. However, without knowledge of what public schools are serviced by particular public water systems, testing within the schools that would be considered priority due to exceedances in their PWS will be nearly impossible. Additionally, inaccurate reporting regarding the existence of lead in distribution systems will make the replacement of these system components difficult to find. Based on these facts, a few recommendations can be made regarding Mississippi's approach to mitigating the effects of lead in drinking water and complying with the Lead and Copper Rule Revisions.

First, the State of Mississippi must prioritize mapping the boundaries of the PWSs and the facilities serviced by these systems. To the best of the knowledge of this study, no such maps exist for the state's public water systems. Our efforts to reach out to MSDH to inquire about such information or anything in existence similar to what we were looking for did not result in any answers. Upon their creation, these maps should be publicly accessible, similar to the DWW and PWSMI databases, so the general public can be aware of where high-risk areas to lead exceedances may exist. This is a public health issue that should be taken with extreme consideration, especially with the knowledge of the damage that can be done to the children of this state. Secondly, Mississippi must make considerations to improving on the current state of discrepancies in reporting found on the PWSMI database. Having an area on the MSDH website explicitly states that there is no lead in service line or in other materials and then providing information that states there are details in the distribution system with lead present on the Lead & Copper Sampling Plan is troublesome. The most glaring issue with this is the possibility that systems may be overlooked when reviewing which distributions need replacing simply because of an error in reporting. It is recommended that the State of Mississippi find a way to incentivize accurate reporting. Perhaps one of the easiest solutions to this problem would be to increase public education efforts regarding the dangers of lead exposure, with emphasis to the effects on our children. Another area that could lead to improvements amongst the discrepancies seen would be for better technical assistance provided to accurately report the data for PWSs. Lastly, it is recommended that Mississippi make plans not only to comply with the new mandates, but the state should go beyond the requirements set forth and take the lead on a national level to tackle this issue. Once the issue is resolved of locating where within distribution systems lead materials and pipes are located, the state should prepare to apply for federal grants for the replacement of these materials. There are a number of criteria under the Drinking Water State Revolving Fund that Mississippi would meet to apply for this grant such as infrastructure replacement, corrosion control optimization, and lead testing and education (USEPA, 2020). Funding for these projects can be appropriated through Congress where the EPA would then award capitalization grants to the state. The state is required to provide a 20% match for the project (USEPA, 2020). In other instances, funding is provided in the form of a loan in which the state may have a number of payment options with low interest rates and extensive repayment periods (USEPA, 2020). The potential cost and scope of these projects would have to be evaluated upon prioritization of highest risk to human health, but Mississippi would have the opportunity to be the standard others follow. With Mississippi currently being at the bottom of many public health categories such as diabetes and obesity rates (CDC), the chance to lead the way in combating a major public health issue like lead exposure should not be taken lightly.

Chapter 5: Conclusion

This project aimed to compile data regarding the state of lead in the Mississippi Delta's public water systems. We hoped through identifying systems with higher values of lead that we would be able to identify public school systems and childcare facilities that were most at-risk to lead in drinking water exposure. Additionally, we sought out the existence of maps containing the boundaries of the studied public water systems in order to superimpose the location of schools within their particular system. While we were able to identify systems of interest and a few schools and childcare facilities that may be serviced by those systems, the data largely contained gaps regarding what PWSs serviced each school and the existence of maps containing PWS boundaries could never be confirmed. The study also analyzed the state's ability to comply with the new Lead and Copper Rule Revisions which took effect on March 16th, 2021. It was determined through this study that the state likely has the necessary resources and sufficient enough data to perform the tasks required to test for lead in public schools, yet Mississippi lacks the ability to identify priority schools for testing due to an absence of knowledge regarding which schools are serviced by what public water systems. Based on these findings, a number of recommendations were made to improve on the current state of lead in public water systems in Mississippi. This study will hopefully represent the foundation towards further research into this subject and more extensive policy suggestions can be produced to benefit the health of all Mississippians.

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Appendix

A. Breakdown of known elementary schools and childcare facility in the seven counties. Provided by the WIIN Grant at Mississippi State University.

NAME	CHILDCARE/SCHOOL	COUNTY	CITY	ADDRESS
AARON E. HENRY HEAD START CENTER	Childcare	Coahoma	Clarksdale	810 SASSE ST
BERTHA BLACKBURN HEAD START CENTER	Childcare	Coahoma	Clarksdale	709 HIGHWAY 322
BEST FRIENDS II	Childcare	Coahoma	Clarksdale	160 CATALPA ST
COI HEAD START/CCC BABY TIGER	Childcare	Coahoma	Clarksdale	3240 FRIARS POINT RD
CREATIVE CHILDREN CHILD CARE CENTER	Childcare	Coahoma	Clarksdale	423 MISSISSIPPI AVE
FRIARS POINT HEAD START CENTER	Childcare	Coahoma	Friars Point	340 JAMES A SHELBY DRIVE
HOME AWAY FROM HOME DAY CARE	Childcare	Coahoma	Clarksdale	748 CHERRY ST
HOPE RESOURCE & ACTIVITY CTR.	Childcare	Coahoma	Jonestown	379 RANDALL ST
JFC MONTESSORI SCHOOL	Childcare	Coahoma	Jonestown	401 MAIN STREET
JONESTOWN HEAD START	Childcare	Coahoma	Jonestown	270 MATAGORDA ROAD
LITTLE SUNSHINE CHILDCARE CENTER	Childcare	Coahoma	Clarksdale	1040 W 2ND ST
LORETTA'S LITTLE ANGEL CHILD CARE	Childcare	Coahoma	Clarksdale	340 MISSISSIPPI AVE
MITCHELL'S DAY CARE CENTER	Childcare	Coahoma	Clarksdale	527 INDIANA AVE
MOVING FORWARD LEARNING CENTER	Childcare	Coahoma	Clarksdale	1300 MARTIN LUTHER KING BLVD
NEIGHBORHOOD CHILD CARE SERVICE	Childcare	Coahoma	Clarksdale	716 MARTIN LUTHER KING BLVD
RENE'S ALL IN ONE RESOURCE CENTER	Childcare	Coahoma	Clarksdale	126 JEFFERSON AVE
STEPPING STONES CHRISTIAN DAYCARE	Childcare	Coahoma	Clarksdale	415 LEE DR
TOTS FOR TIME II	Childcare	Coahoma	Clarksdale	1206 DESOTO AVE
FRIARS POINT ELEMENTARY SCHOOL	Childcare	Coahoma	Friars Point	350 South Street
JONESTOWN ELEMENTARY SCHOOL	Childcare	Coahoma	Jonestown	330 Matagorda Road
LYON ELEMENTARY SCHOOL	Childcare	Coahoma	Lyon	2020 Roberson Road
SHERARD ELEMENTARY SCHOOL	Childcare	Coahoma	Clarksdale	3105 Bobo-Sherard Road
MYRTLE HALL IV LANG. IMMERSION	Childcare	Coahoma	Clarksdale	700 5Th Street
HEIDELBERG SCHOOL MATH & SCIENCE	Childcare	Coahoma	Clarksdale	801 Maple Ave
KIRKPATRICK HEALTH /WELLNESS	Childcare	Coahoma	Clarksdale	1101 Smith Street
GEO H OLIVER VISUAL/PERF. ARTS	Childcare	Coahoma	Clarksdale	871 Ritchie Avenue
BOOKER T WASHINGTON INTERN. STUDIES	Childcare	Coahoma	Clarksdale	1806 Sunflower Ave Extension
RIPLEY/BLACKWELL HEAD START CENTER	Childcare	Issaquena	Mayersville	HIGHWAY 14 WEST
SOUTH DELTA ELEMENTARY SCHOOL	School	Issaquena	Rolling Fork	138 Weathers Avenue
ABC LEARNING CENTER #1 AFTERSCHOOL PROGRAM	Childcare	Leflore	Greenwood	803 HENDERSON ST
ABC LEARNING CENTER #2	Childcare	Leflore	Greenwood	619 W JOHNSON ST
AGAPE LOVE LEARNING & DEVELOPMENTAL CENTER	Childcare	Leflore	Greenwood	705 BOWIE LN
BRIGHT BEGINNINGS DAYCARE	Childcare	Leflore	Greenwood	2204 PORTWOOD ST
BRIGHT BEGINNINGS DAYCARE 3	Childcare	Leflore	Greenwood	900 W CLAIBORNE AVE
BRIGHT BEGINNINGS DAYCARE II	Childcare	Leflore	Greenwood	1629 CARROLLTON AVE
CHURCH OF THE NATIVITY	Childcare	Leflore	Greenwood	400 HOWARD ST
FIRST PRESBYTERIAN KINDERGARTEN	Childcare	Leflore	Greenwood	301 MAIN ST

G0D'S LITTLE ANGEL'S LEARNING CENTER	Childcare	Leflore	Greenwood	1509 LEFLORE AVE
GILLIAM HEAD START CENTER	Childcare	Leflore	Greenwood	100 E MARTIN LUTHER KING JR DR
GOD'S HELPING HANDS LEARNING ACADEMY	Childcare	Leflore	Greenwood	401 MCLEMORE ST
GWEN'S KINDERGARTEN & DAY CARE, INC.	Childcare	Leflore	Greenwood	515 MONTGOMERY ST
HIS KIDS CHILD CARE CENTER	Childcare	Leflore	Greenwood	615 GRAND BLVD
HPCOC CHILD DEVELOPMENT DAY CARE CENTER #2	Childcare	Leflore	Greenwood	1308 STRONG AVE
JUDYS KIDS NURSERY& EDUCATION CENTER INC DBA JKN INC	Childcare	Leflore	Greenwood	PO BOX 1114, 1313 CARROLLTON AVENUE
KLASSY KIDS LEARNING CENTER	Childcare	Leflore	Greenwood	127 MCGEHEE ST
LEARNING TREE, INC.	Childcare	Leflore	Greenwood	211 W PRESIDENT AVE
MVSU DEVELOPMENT CENTER	Childcare	Leflore	Itta Bena	ROBERT CLARK JR LANE
PRECIOUS MOMENTS LEARNING DEVELOPMENT ACADEMY	Childcare	Leflore	Greenwood	202 MARTIN ST
RAINBOW KIDS DAYCARE LLC	Childcare	Leflore	Greenwood	700 E MARTIN LUT KING
SCHOOL OF CHAMPIONS DEVELOPMENT & LEARNING ACADEMY LLC	Childcare	Leflore	Itta Bena	200 GREER ST, P.O. BOX 1025
ST. JOHN'S PRESCHOOL & WDM	Childcare	Leflore	Greenwood	1001 GRAND BLVD
EAST ELEMENTARY SCHOOL	School	Leflore	Greenwood	208 Meadowbrook Road
LEFLORE COUNTY ELEMENTARY SCHOOL	School	Leflore	Itta Bena	401 Lakeside Drive
CLAUDINE F BROWN ELEMENTARY SCHOOL	School	Leflore	Greenwood	Highway 49 S
BANKSTON ELEMENTARY SCHOOL	School	Leflore	Greenwood	1312 Grand Boulevard
DAVIS ELEMENTARY SCHOOL	School	Leflore	Greenwood	400 Cotton Street
THREADGILL ELEMENTARY SCHOOL	School	Leflore	Greenwood	1001 Broad Street
W C WILLIAMS ELEMENTARY SCHOOL	School	Leflore	Greenwood	1300 Carrollton Avenue
QUITMAN COUNTY HEAD START	Childcare	Quitman	Lambert	648 MCDAVID STREET
THE GOLDEN CONNECTION	Childcare	Quitman	Marks	680 3RD ST
QUITMAN COUNTY ELEMENTARY SCHOOL	School	Quitman	Lambert	Hwy 3 South
BE BE KIDS LEARNING CENTER	Childcare	Sunflower	Indianola	413 SECOND ST
BUCK-A-ROO LEARNING CENTER	Childcare	Sunflower	Indianola	805 HOOVER ST
COLOR ME A RAINBOW CHILD DEVELOPMENTAL CTR	Childcare	Sunflower	Indianola	106 CURTIS ST
DREW HEADSTART/EARLY HEADSTART	Childcare	Sunflower	Drew	120 S CHURCH ST
ELISE'S PLACE	Childcare	Sunflower	Indianola	924 BROADMOOR DR
FUMC DAY SCHOOL AND KINDERGARTEN	Childcare	Sunflower	Indianola	205 SECOND ST
HUTCHINS YOUNGLAND DAYCARE CENTER	Childcare	Sunflower	Indianola	416 OAK ST
IMAGINARIUM LEARNING CENTER I	Childcare	Sunflower	Drew	160 E BROADWAY AVE
INDIANOLA HEADSTART/EARLY HEADSTART	Childcare	Sunflower	Indianola	702 ROOSEVELT ST
INDIANOLA KIDS UNIVERSITY, INC.	Childcare	Sunflower	Indianola	307 CURTIS ST
LADONNA'S LITTLE ANGEL'S LEARNING CENTER	Childcare	Sunflower	Drew	181 W PARK AVE
LITTLE ANGELS DAY CARE	Childcare	Sunflower	Moorhead	1012 ROY ST
LITTLE HUMBLE HEARTS CHRISTIAN ACADEMY	Childcare	Sunflower	Ruleville	114 S CHESTER AVE
MADEARS KIDZ	Childcare	Sunflower	Ruleville	120 S RUBY AVE
MOORHEAD HEADSTART/EARLY HEADSTART	Childcare	Sunflower	Moorhead	1307 E DELTA AVENUE
POOH BEAR DAYCARE #2	Childcare	Sunflower	Indianola	302 MIMOSA DR
RULEVILLE HEADSTART	Childcare	Sunflower	Ruleville	710 BYRON ST
SPONGE BOB CHILD CARE LEARNING CENTER	Childcare	Sunflower	Indianola	125 GALAXIE RD
SUNFLOWER HEADSTART/EARLY HEADSTART	Childcare	Sunflower	Sunflower	225 E CLAIBORNE ST
CARVER ELEMENTARY SCHOOL	School	Sunflower	Indianola	404 Jefferson Street
EAST SUNFLOWER SCHOOL	School	Sunflower	Sunflower	212 East Claiborne Street
A W JAMES ELEMENTARY SCHOOL	School	Sunflower	Drew	400 South Blvd
INVERNESS SCHOOL	School	Sunflower	Inverness	1101 Oak Street
JAMES ROSSER ELEMENTARY SCHOOL	School	Sunflower	Moorhead	601 Ingram Street
RULEVILLE CENTRAL ELEMENTARY SCHOOL	School	Sunflower	Ruleville	410 L F Packer Drive

LOCKARD ELEMENTARY SCHOOL	School	Sunflower	Indianola	302 College Avenue
INDIANOLA ACADEMIC ACHIEVEMENT	School	Sunflower	Indianola	300 Jefferson Street
ALL MY CHILDREN	Childcare	Warren	Vicksburg	722 BELMONT ST
ALL MY CHILDREN 2 LLC	Childcare	Warren	Vicksburg	914 FARMER ST
BINAH ACADEMY	Childcare	Warren	Vicksburg	6889 PAXTON RD
BLESSINGS LEARNING CENTER	Childcare	Warren	Vicksburg	4216 HALLS FERRY RD
CEDARS HEAD START	Childcare	Warren	Vicksburg	235 CEDARS SCHOOL CIR
CHILDREN LEARNING CENTER OF VICKSBURG, LLC	Childcare	Warren	Vicksburg	920 FARMER ST
CHILDRENS EDUCATION STATION DAYCARE & LEARNING CENTER	Childcare	Warren	Vicksburg	2362 GROVE ST
CHILDREN'S LEARNING CENTER AFTERSCHOOL	Childcare	Warren	Vicksburg	2121 CLAY ST STE G
CRAWFORD ST. PLAY SCHOOL	Childcare	Warren	Vicksburg	900 CRAWFORD ST
CROSS POINT DAYCARE	Childcare	Warren	Vicksburg	510 PORTERS CHAPEL RD
CUTLER'S GROW-N-LEARN	Childcare	Warren	Vicksburg	5305 INDIANA AVE
FIRST PRESBYTERIAN CHURCH KINDERGARTEN AND PRESCHOOL	Childcare	Warren	Vicksburg	1501 CHERRY ST
GOOD SHEPHERD PRESCHOOL	Childcare	Warren	Vicksburg	629 CHERRY ST
H & H KIDZ ZONE	Childcare	Warren	Vicksburg	2734 WASHINGTON ST
HAWKINS UMC PRESCHOOL	Childcare	Warren	Vicksburg	3736 HALLS FERRY RD
KIDDIE CITY CHILD CARE/LEARNING CENTER	Childcare	Warren	Vicksburg	1783 M L KING BLVD
KIDDIE KOLLEGE	Childcare	Warren	Vicksburg	1222 GROVE ST
KID'S COTTAGE	Childcare	Warren	Vicksburg	437 RIDGEWOOD ST
KIDS PRESCHOOL 1	Childcare	Warren	Vicksburg	1902 WASHINGTON ST
KIDS PRESCHOOL 2	Childcare	Warren	Vicksburg	1002 BELMONT ST
KING'S HEAD START CENTER	Childcare	Warren	Vicksburg	200 R L CHASE CIR
KJ'S ACADEMY, INC	Childcare	Warren	Vicksburg	1306 HOPE ST
LIL' WONDERS DAY CARE	Childcare	Warren	Vicksburg	712 DABNEY ST
LITTLE PEOPLE LEARNING CENTER LLC	Childcare	Warren	Vicksburg	718 BRIDGE ST
LOVING HEARTS LEARNING CENTER	Childcare	Warren	Vicksburg	3211 WISCONSIN AVE STE B
PEACEFUL PLACE DAYCARE	Childcare	Warren	Vicksburg	1301 HOLLY ST
PIED PIPER PRESCHOOL	Childcare	Warren	Vicksburg	1417 FAYETTE ST
PORTER'S CHAPEL ACADEMY DAYCARE	Childcare	Warren	Vicksburg	3470 PORTERS CHAPEL RD
PRECIOUS MOMENTS LEARNING CENTER	Childcare	Warren	Vicksburg	1411 CHERRY ST
PURKS YMCA	Childcare	Warren	Vicksburg	267 YMCA PL
TREASURES LEARNING CENTER	Childcare	Warren	Vicksburg	1091 OAK RIDGE RD
VER BECK YMCA	Childcare	Warren	Vicksburg	1884 OAK RIDGE RD
BOVINA ELEMENTARY SCHOOL	School	Warren	Vicksburg	5 Willow Creek Drive
BOWMAR AVENUE SCHOOL	School	Warren	Vicksburg	912 Bowmar Avenue
BEECHWOOD ELEMENTARY SCHOOL	School	Warren	Vicksburg	999 Highway 27 S
DANA ROAD ELEMENTARY	School	Warren	Vicksburg	1247 Dana Road
REDWOOD ELEMENTARY SCHOOL	School	Warren	Redwood	100 Redwood Road
SHERMAN AVE ELEMENTARY	School	Warren	Vicksburg	2145 Sherman Ave
SOUTH PARK ELEMENTARY SCHOOL	School	Warren	Vicksburg	6530 Nailor Road
WARRENTON ELEMENTARY SCHOOL	School	Warren	Vicksburg	809 Belva Drive
ANEW ACADEMY & LEARNING CENTER	Childcare	Washington	Greenville	560 N 7TH ST
ARCOLA HEAD START CENTER	Childcare	Washington	Arcola	202 GUM STREET
ARMS OF LOVE LEARNING CENTER AND DAYCARE	Childcare	Washington	Greenville	1428 LEWIS ST
CARE BEARS CHILD DEVELOPMENT CENTER	Childcare	Washington	Leland	303 HUDDLESTON ST
CHARLIE BROWN DAY CARE	Childcare	Washington	Greenville	414 MILL RD
EDUCATION STATION	Childcare	Washington	Greenville	1544 OLD LELAND RD
EVERLASTING LOVE	Childcare	Washington	Greenville	334 FAIRVIEW AVE
F.U.T.U.R.E, INC	Childcare	Washington	Greenville	1600 E REED RD
FIRST PRESBYTERIAN PRE-SCHOOL	Childcare	Washington	Greenville	1 JOHN CALVIN CIR

FLORIDA STREET DAY CARE & LEARNING CENTER	Childcare	Washington	Greenville	445 S FLORIDA ST
FULWILER HEADSTART/EARLY HEAD START	Childcare	Washington	Greenville	699 DUBLIN ST
FUN-SHINE DAYCARE CENTER	Childcare	Washington	Leland	604 E 3RD ST
GARRETT HALL HEAD START	Childcare	Washington	Greenville	415 N THEOBALD ST
GRACE OUTREACH CHILD DEVELOPMENT CENTER	Childcare	Washington	Greenville	1633 BROADWAY EXT N
GRACE TEMPLE AFTERSCHOOL CARE	Childcare	Washington	Greenville	2034 OLD LELAND RD
GUILLORY'S GROUP DAY CARE HOME	Childcare	Washington	Greenville	213 N HYMAN ST
HAPPY SMILES DAY CARE	Childcare	Washington	Greenville	861 N THEOBALD ST
HAPPY SMILES SUMMER CAMP	Childcare	Washington	Greenville	1141 S DELESSEPS ST
HODDING CARTER MEMORIAL YMCA	Childcare	Washington	Greenville	1688 FAIRGROUNDS RD
HYMAN STREET LEARNING CENTER	Childcare	Washington	Greenville	229 N HYMAN ST
JACK & JILL DAYCARE AND LEARNING CENTER	Childcare	Washington	Greenville	1091 HIGHWAY 1 S
KANGAROO DAY CARE	Childcare	Washington	Greenville	1033 S DELESSEPS ST
KITTY'S LEARNING CENTER	Childcare	Washington	Greenville	1636 HOSPITAL ST
LA LA'S LEARNING ACADEMY	Childcare	Washington	Greenville	522 KENTUCKY ST
LIL DARLINGS LEARNING CENTER	Childcare	Washington	Leland	714 7TH ST
LISA'S LITTLE RASCALS CHILDCARE, LLC	Childcare	Washington	Greenville	405 S BEAUCHAMP AVE
LITTLE EINSTEIN'S DAYCARE AND LEARNING CENTER	Childcare	Washington	Greenville	712 S BROADWAY ST
LITTLE LAMBS NURSERY & LEARNING CENTER	Childcare	Washington	Metcalfe	124 JUNCTION STREET
LOVING HANDS DAYCARE & LEARNING CENTER	Childcare	Washington	Greenville	853 W. PERCY ST.
MAJESTY LEARNING AND DAYCARE CENTER	Childcare	Washington	Greenville	738 W UNION ST
MCLEMORE-WARD HEAD START/ EARLY HEAD START	Childcare	Washington	Greenville	546 GAMARI RD
MINI R CHOSEN LEARNING CENTER	Childcare	Washington	Greenville	214 SOUTH MARTIN LUTHER KING
MINOR EXCELLENCE CHILD CARE CENTER	Childcare	Washington	Arcola	306 BROADWAY ST
MISS LILLIE'S DAYCARE	Childcare	Washington	Greenville	1623 DUNCAN DR
MOTHER GOOSE LEARNING CENTER SITE II	Childcare	Washington	Leland	708 7TH ST
NEW BEGINNINGS DAYCARE	Childcare	Washington	Greenville	449 S 6TH ST
ONCE UPON A LIFETIME DAYCARE AND LEARNING CENTER	Childcare	Washington	Greenville	2196 HWY 82 EAST
ONCE UPON A LIFETIME DAYCARE II	Childcare	Washington	Greenville	1379 E REED RD
OPEN ARMS DAYCARE & LEARNING CENTER	Childcare	Washington	Greenville	424 ARNOLD AVE
OPTIMUM CARE DAY CENTER	Childcare	Washington	Greenville	1421 MARY ST
PAGE MOORE HEAD START/EARLY HEAD START	Childcare	Washington	Leland	1301 NORTH MAIN STREET
PATRICK 'S LITTLE SMURFS	Childcare	Washington	Greenville	429 E CLAY ST
PEACE-SANDERS HEAD START/EH	Childcare	Washington	Hollandale	505 W WASHINGTON ST
PICKETT STREET LEARNING CENTER	Childcare	Washington	Greenville	821 PICKETT ST
PLAY-N-LEARN	Childcare	Washington	Greenville	106 - 114 N BEAUCHAMP
PLAY-N-LEARN II	Childcare	Washington	Greenville	1705 E REED RD
RAINBOW LEARNING CENTER	Childcare	Washington	Leland	310 BAKER BLVD
REDBUD LITTLE LEARNERS	Childcare	Washington	Greenville	620 DEATON ST
ROSE HILL NORTH CHRISTIAN DAY CARE CENTER	Childcare	Washington	Greenville	808 HAMPGREEN ST
ST. JAMES EPISCOPAL DAY SCHOOL	Childcare	Washington	Greenville	1026 S WASHINGTON AVE
SUNSHINE DAY CARE & LEARNING CENTER	Childcare	Washington	Greenville	544 E GLOSTER ST
TENDER AGES LEARNING CENTER	Childcare	Washington	Greenville	646 LESTER ST
TENDER AGES LEARNING CENTER ACADEMY	Childcare	Washington	Greenville	766 MOBILE ST
THE CHILDREN'S ACADEMY	Childcare	Washington	Greenville	2205 HIGHWAY 1 S
TLC ACADEMY & LEARNING CENTER, LLC	Childcare	Washington	Greenville	1600 E REED RD
TODDLER TOWN INC.	Childcare	Washington	Greenville	524 TENNESSEE GAS RD
TRUE VINE CHRISTIAN LEARNING CENTER	Childcare	Washington	Greenville	1531 E ALEXANDER ST
T'STINE'S DAYCARE & LEARNING CENTER	Childcare	Washington	Greenville	301 CALIFORNIA ST
SANDERS ELEMENTARY SCHOOL	School	Washington	Hollandale	502 West Washington Street
LELAND ELEMENTARY SCHOOL	School	Washington	Leland	404 E Third Street

LELAND SCHOOL PARK	School	Washington	Leland	200 Milam Street
O'BANNON ELEMENTARY SCHOOL	School	Washington	Greenville	1203 S. Raceway Road
RIVERSIDE ELEMENTARY SCHOOL	School	Washington	Avon	939 Riverside Road
AKIN ELEMENTARY SCHOOL	School	Washington	Greenville	361 Bowman Blvd
SOLOMON MAGNET SCHOOL	School	Washington	Greenville	556 Bowman Blvd
ARMSTRONG ELEMENTARY SCHOOL	School	Washington	Greenville	528 Redbud Street
BOYD ELEMENTARY SCHOOL	School	Washington	Greenville	1021 South Colorado
MC BRIDE ELEMENTARY SCHOOL	School	Washington	Greenville	438 N Poplar Street
STERN ELEMENTARY SCHOOL	School	Washington	Greenville	522 Mcallister Street
WEBB ELEMENTARY SCHOOL	School	Washington	Greenville	600 S Harvey Street
WEDDINGTON ELEMENTARY SCHOOL	School	Washington	Greenville	668 Sampson Road