EXHIBIT

15

Exhibit No.:	
Issue(s):	Lead Line Replacement
Witness/Type of Exhibit:	Marke/Rebuttal
Sponsoring Party:	Public Counsel
Case No.:	WU-2017-0296

REBUTTAL TESTIMONY

OF

GEOFF MARKE

Submitted on Behalf of the Office of the Public Counsel

MISSOURI-AMERICAN WATER COMPANY

CASE NO. WU-2017-0296

August 23, 2017

OPC Exhibit No. 15
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MISSOURI-AMERICAN WATER COMPANY

CASE NO. WU-2017-0296

I. INTRODUCTION

Q. Please state your name, title and business address.

A. Geoffrey Marke, PhD, Economist, Office of the Public Counsel ("OPC or "Public Counsel"), P.O. Box 2230, Jefferson City, Missouri 65102.

Q. Are you the same Dr. Marke that filed direct testimony in WU-2017-0296?

A. Yes.

Q. What is the purpose of your rebuttal testimony?

A. The purpose of this testimony is to respond to direct testimony regarding:

- Overview of lead and federal lead regulation
  - Missouri American Water Company ("MAWC" or the Company) witness Gary A. Naumick
- MAWC's lead line replacement proposal
  - MAWC witness Bruce W. Aiton, Brian LaGrand and Gary A. Naumick

Q. Please state OPC's position.

A. OPC continues to recommend that the Commission reject the Company's current application and, if the Company seeks relief within the pending rate case, consider OPC's alternative for a two-year pilot study in which no more than $4 million annually (or $8 million in total can be spent on planned full lead service line replacement and third-party administrative costs associated with the collaborative research efforts. The pilot study will explore the feasibility, legality and associated policy implications of full lead service line replacement across MAWC's entire territory and the state of Missouri with the results

presented to the Missouri Public Service Commission, the Missouri Legislature and the Missouri Governor's Office for consideration. Finally, it is OPC's hope that a byproduct of the pilot study may help substantiate selection of future "shovel ready" infrastructure funding from the federal government to help offset cost considerations.

The issue of lead line replacements cuts across public health, scientific, technical, and legal arenas and should not be viewed as a linear engineering exercise alone. Given the complexities, uncertainties, and costs in ensuring safe drinking water, it is important that necessary planning and dialogue among stakeholders occurs both before and during a program of this kind. OPC recognizes that in this instance, imperfect knowledge should not be an excuse for inaction, but we are also acutely cognizant that eradicating lead within a water distribution system must be grounded in evidence-based research with recognition of the interdependent challenges that are necessarily created. OPC's proposed pilot study from its direct testimony provides the framework to facilitate the substantive research, planning and communication to mitigate known risks and to anticipate and plan for the otherwise unintended consequences that are undoubtedly linked to this complex, decade(s)-long policy reform.

II. OVERVIEW OF LEAD AND FEDERAL LEAD REGULATION

Q. Do you agree with Mr. Naumick's overview of lead hazards?

A. In part. Context matters when considering interventions and informing substantive policy directives; and though I have no reason to doubt his specific factual statements, I do not believe his overview provides the appropriate context for informing the Commission of the likely sources of lead hazards nor of the historical drop in detected blood lead levels ("BLLs") as a result of lead prevention policies to date.

Q. What should the Commission know about lead?

A. In its raw form, lead is one of the softest, most versatile metals found on earth and been utilized in a variety of commercial products and processes. Lead is also a designated

pollutant regulated by many laws administered by EPA, including the Toxic Substances Control Act (TSCA), Residential Lead-Based Paint Hazard Reduction Act of 1992 (Title X), Clean Air Act (CAA), Clean Water Act (CWA), Safe Drinking Water Act (SDWA), Resource Conservation and Recovery Act (RCRA), and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) among others.

There is a voluminous amount of research substantiating the link between the deleterious effects of high BLLs and human health including impairments to brain,[1] kidneys,[2] cardiovascular system,[3] and the blood[4] being some of the most susceptible to breakdown from high dosage or prolonged lead exposure. Children, pregnant mothers, international adoptees and refugees in particular have all been classified as "at-risk" populations by the Centers for Disease Control. ("CDC")[5]

Health-related concerns from lead exposure are not new; there are even documented instances of lead-linked-health-impairments associated with the use of lead service lines that date over two-thousand years ago. For example, the Roman author/architect Marcus Vitruvius Pollio ("Vitruvius") noted in his seminal work, *De architectura* (estimated to be written between 30 and 15 BC) that:

> "Water conducted through earthen pipes is more wholesome than that through lead; indeed that conveyed in lead must be injurious, because from it white lead [PbCO3, lead carbonate] is obtained, and this is said to be injurious to the human system. Hence, if what is generated from it is pernicious, there can be no doubt

[1] Mazumadr. M. et. al (2011) Low-level environmental lead exposure in childhood and adult intellectual function: a follow-up study. *Environmental Health*. 10.24. https://ehjournal.biomedcentral.com/track/pdf/10.1186/1476-069X-10-24?site=ehjournal.biomedcentral.com

[2] Payton, M., Payton, M., Hu, H., Hu, H., Sparrow, D., et al., 1994. Low-level lead exposure and renal function in the normative aging study. *American Journal of Epidemiology*. 140 (9), 821–829. https://academic.oup.com/aje/article-abstract/140/9/821/76785/Low-level-Lead-Exposure-and-Renal-Function-in-the

[3] Hu, H., Aro, A., Payton, M., Korrick, S., Sparrow, D., et al., 1996. The relationship of bone and blood lead to hypertension: the normative aging study. *JAMA* 275 (15): 1171–1176. http://dx.doi.org/10.1001/jama.1996.03530390037031.

[4] Roels, H., Lauwerys, R., 1987. Evaluation of dose-effect and dose-response relationships for lead exposure in different Belgian population groups (fetus, child, adult men and women). *Trace Elements in Medicine*. 4 (2), 80–87. https://dial.uclouvain.be/pr/boreal/object/boreal:53768

[5] CDC (2015) Lead: At-Risk Populations. https://www.cdc.gov/nceh/lead/tips/populations.htm

> that itself cannot be a wholesome body. This may be verified by observing the workers in lead, who are of a pallid colour; for in casting lead, the fumes from it fixing on the different members, and daily burning them, destroy the vigour of the blood; water should therefore on no account be conducted in leaden pipes if we are desirous that it should be wholesome." (VIII.6.10-11)[6]

This sentiment was ultimately abandoned. In fact, as late as 1917, most engineers believed the benefits of using lead mains outweighed the potential costs. The New England Water Works Association argued:

> The most serious objection to the use of lead pipe for services is the possibility that the water may dissolve enough lead from the pipe to cause lead poisoning. It is certain that many cases of lead poisoning have been caused by the use of lead services. On the other hand, lead has always been used for services in most of the large places without any unfavorable effects.[7]

In the United States, by the 1920s, lead was an essential part of the middle-class home. Lead was used in: telephones, ice boxes, vacuums, irons, and washing machines; dolls, painted toys, bean bags, baseballs, and fishing lures.[8] It would be the inclusion of lead in gasoline, paint, and pipes, the building blocks of urbanization and a growing housing stock that would have largest health impact. That legacy remains, in part, with us today. The US Department of Health and Human Services ("HHS") has estimated that

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[6] *Vitruvius: Ten Books on Architecture* (2001) edited by Ingrid D. Rowland and Thomas Noble Howe qtd. From Lead Poisoning and Rome. http://penelope.uchicago.edu/~grout/encyclopaedia_romana/wine/leadpoisoning.html

[7] Journal of the New England Water Works Association (1917). 31, 1 March 1917 https://books.google.com/books?id=sGAZAQAAIAAJ&pg=PR1&dqJournal+of+the+New+England+Water+Works+1917+March+Volume+31+%60&hl=en&sa=X&ved=0ahUKEwiZkLT98LPVAhUp2IMKHex_C4IQ6AEIKTAA#v=onepage&q=Journal%20of%20the%20New%20England%20Water%20Works%201917%20March%20Volume%2031%20%60&f=false

[8] Bliss, L. (2016) An American history of lead poisoning. *The Atlantic*. https://www.theatlantic.com/health/archive/2016/02/an-american-history-of-lead-poisoning/462576/

environmental lead levels have increased >1000 fold over the last 300 years due largely to human activities, with the greatest increase occurring between 1950 and 2000.[9]

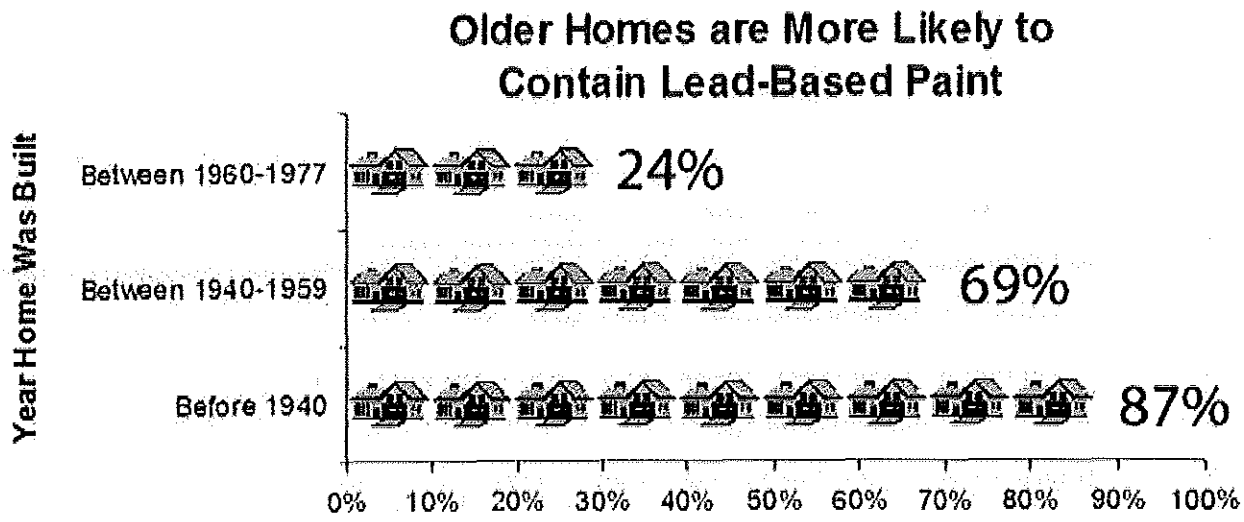
Q. What has been the primary source of lead exposure in the United States?

A. Engine exhaust. Before it was banned, fuel exhaust from the use of tetraethyl lead and tetra methyl lead, as gasoline additives to increase octane rating, resulted in the largest concentrations of lead released into the U.S. environment. In 1979, cars released 94.6 million kilograms (208.1 million pounds) of lead into the air in the United States. In 1989, when the use of lead was limited but not banned, cars released only 2.2 million kg (4.8 million pounds) to the air.[10] Leaded gasoline was phased out in the United States in the 1980s, and lead was banned for use in gasoline for motor vehicles beginning January 1, 1996. However, it is still used in a number of developing countries.[11]

Today, the most common hazardous source of lead exposure for most U.S. citizens is in the form of lead-contaminated dust from deteriorated lead-based paint largely found in older homes as estimated in Figure 2.

[9] United States Agency for Toxic Substances and Disease Registry, (2007). Toxicological Profile for Lead. U.S. Dept. of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Atlanta, Ga Retrieved from: https://www.atsdr.cdc.gov/toxprofiles/tp13.pdf.
[10] Ibid.
[11] Ibid.

Figure 2: EPA estimates of lead-based paint based on year of homes construction[12]



Concern centering on lead-based paint are especially relevant for Missouri citizens. According to the Missouri Department of Health and Senior Services ("MO DHSS"), the primary lead hazard to children in Missouri is deteriorated lead-based paint.[13] Although lead-based paint was banned for residential use nationwide in 1978, according to MO DHSS, more than 21 percent of the current housing stock in Missouri was built before 1950. Not surprisingly, the concentration of old housing stock varies considerably between both zip codes and counties as shown in Figure 3 and Figure 4.

[12] US EPA (2017) Protecting your family from exposures to lead. https://www.epa.gov/lead/protect-your-family-exposures-lead

[13] Missouri Department of Health and Senior Services (2016) Missouri Childhood Lead Poisoning prevention program. Annual Report for Fiscal Year 2015. http://health.mo.gov/living/environment/lead/pdf/AnnualReportFY2015.pdf

Figure 3: Percent of Missouri Pre-1950 Housing by Zip Code[14]

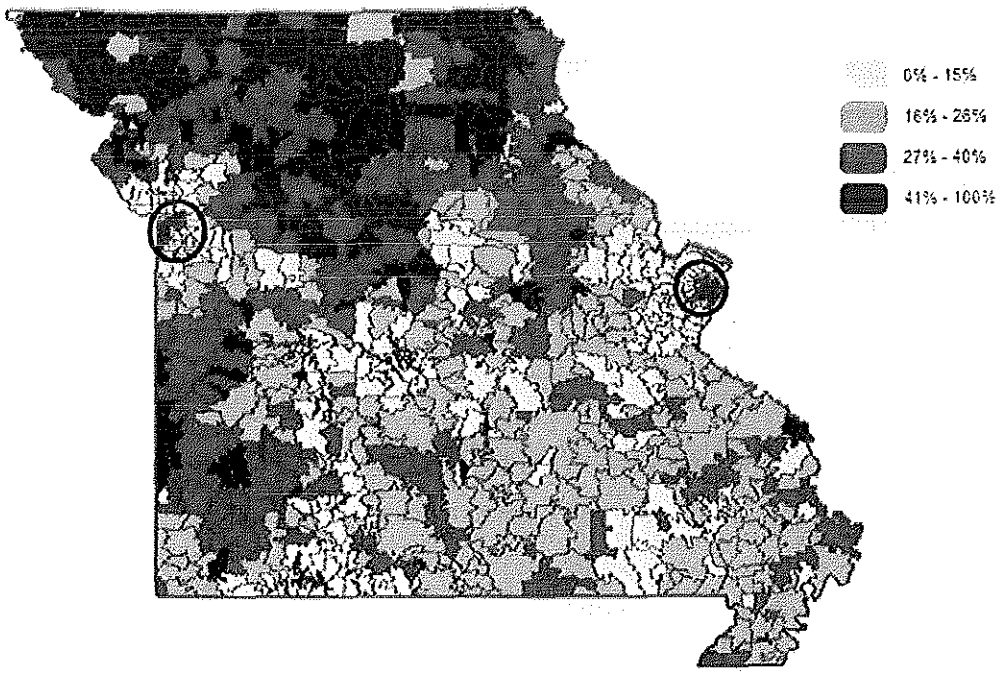
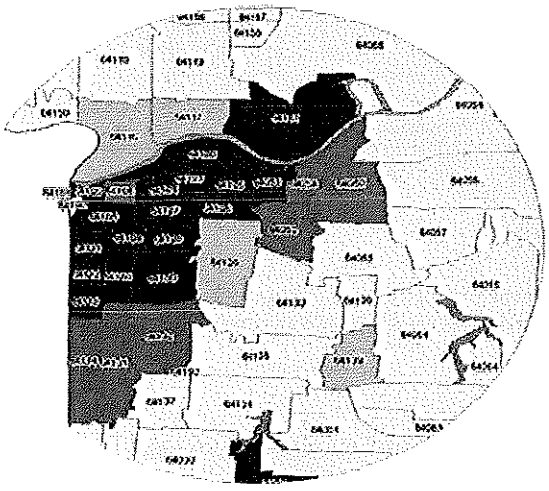
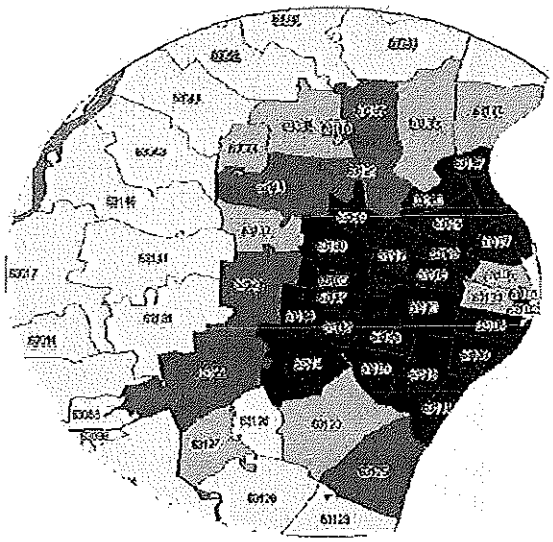


Figure 4: Percent of Missouri Pre-1950 Housing within Kansas City and St. Louis[15]

Kansas City



St. Louis



[14] Ibid.
[15] Ibid.

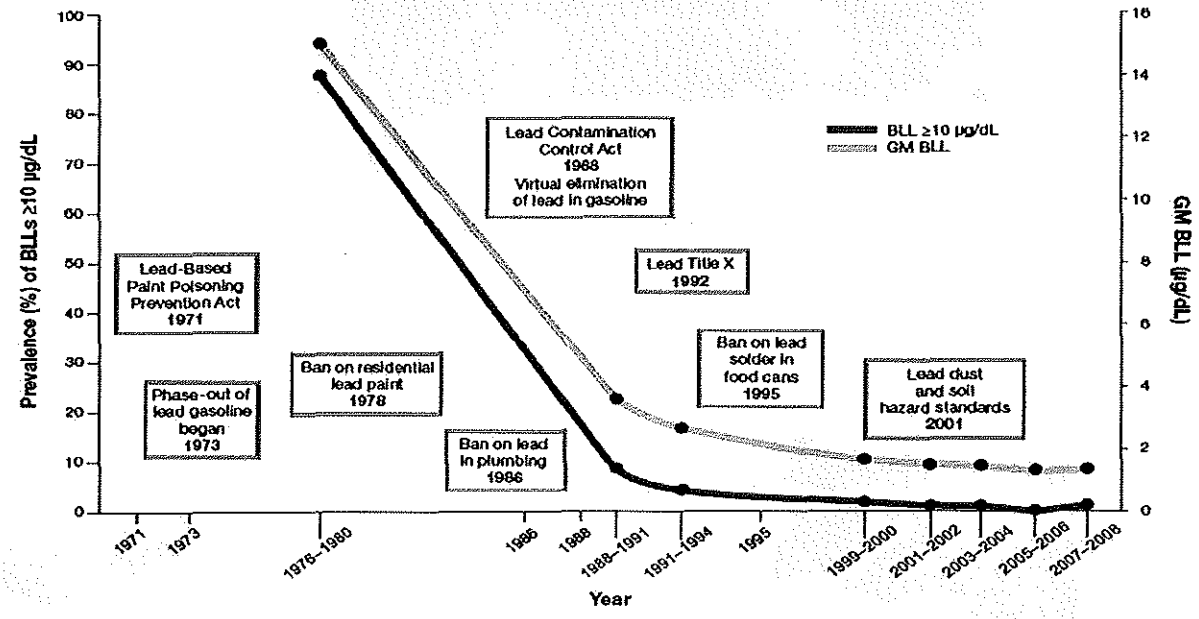
Q. Has exposure to hazardous lead levels decreased?

A. Yes, considerably. In the 1970's, over 70% of children tested nationwide had BLLs over 10 µg/dL;[16] by 2001, it was <1%. For comparison purposes, according to MO DHSS:

> Missouri blood lead testing data for July 1, 2015, through June 30, 2016, there were 600 children under the age of six identified with elevated blood levels of at least 10 µg/dL or 0.69% (0.69 percent of the 86,864 children tested that year).[17]

These decreases, both nationwide and in Missouri (which is the #1 lead producing state in the US[18]), coincide with the phasing out of leaded gasoline and paints.[19] The drop in reported BLLs can be seen Figure 3 along with the relevant passage of U.S. lead prevention policies.

Figure 3: Lead prevention policies and BLLs in children aged 1-5[20]



[16] Mahaffey, K.R., et. al. (1982) National estimates of blood lead levels: United States, 1976–1980: association with selected demographic and socioeconomic factors. *New England Journal of Medicine* 307 (10):573–579. http://dx.doi.org/10.1056/NEJM198209023071001.

[17] See GM-1.

[18] Ibid.

[19] United States Agency for Toxic Substances and Disease Registry (2007) Toxicological Profile for Lead. U.S. Dept. of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Atlanta, Ga Retrieved from: https://www.atsdr.cdc.gov/toxprofiles/tp13.pdf.

[20] Policy Statement from the American Academy of Pediatrics. (2016) Prevention of Childhood Toxicity *Pediatrics* . http://pediatrics.aappublications.org/content/early/2016/06/16/peds.2016-1493

Q. What amount of lead in drinking water poses an urgent health risk—the kind of threat that should cause consumers to immediately stop their home's water for drinking and cooking?

A. It is not clear there is an amount, as this question was posed by reporters at USA TODAY to the EPA with its response as follows:

> At this time, EPA has not provided a broader guidance regarding a lead concentration that would trigger a do-not-drink order.[21]

Today, if a given water system is found to be in violation of the LCR there is no requirement for notification to customers to stop drinking the water, only advice on ways to reduce exposures. Both the EPA and the CDC have said that no amount of lead in water is safe for children, but neither agency supported that statement with a regulatory action. Presently, both the EPA and CDC still recommend that water utilities and public health officials disregard sampling in the homes if one-time tap water sampling results are lower than the EPA 15 ppb ("parts-per-billion") lead action level and there is no known source of lead in the home.[22] Short of a water system being declared a federal emergency (see Flint) it is unclear what the threshold is. This is, in part, because some estimates of complete lead removal from the nation's building and water infrastructure exceed $1 trillion and will likely take decades to complete.[23]

[21] Young. A. (2016) How much lead in water poses an imminent threat? *USA Today*. https://www.usatoday.com/story/news/nation/2016/03/16/what-lead-levels-in-water-mean/81534336/

[22] U.S. Centers for Disease Control and Prevention (CDC). 2002. Managing elevated blood lead levels among young children: Recommendations from the Advisory Committee on Childhood Lead Poisoning Prevention. Atlanta, GA: CDC. Accessed: August 22, 2017, http://www.cdc.gov/nceh/lead/CaseManagement/caseManage_main.htm. In listing "Common Sources of Lead Exposure to Consider in an Environmental Investigation," (Table 2.3), that document recommends only that investigators consider drinking water samples of 15 ppb or higher. See also CDC, Lead Prevention Tips for water, https://www.cdc.gov/nceh/lead/tips/water.htm (accessed August 22, 2017) (stating: "You should begin by asking your water authority these questions: 1. Does my water have lead in it above EPA's action level of 15 parts per billion (ppb)? If the answer is no, no action is needed. . . ."). qtd. from Katner et. al. (2017) Public Comments on EPA's draft report titled "Proposed modeling approaches for a health based benchmark for lead in drinking water. http://www.circleofblue.org/wp-content/uploads/2017/08/Katner_LeadModelingComment.pdf

[23] Bliss, L. (2016) An American history of lead poisoning. *The Atlantic*. https://www.theatlantic.com/health/archive/2016/02/an-american-history-of-lead-poisoning/462576/

Lead and Copper Rule

Q. Do you agree with Mr. Naumick's overview of the issue of lead exposure in water?

A. Again, in part. Although I have no reason to doubt any of his specific factual statements, I do not believe his overview provides the appropriate context for informing the Commission of the uncertainty surrounding compliance, enforcement and future status of the Lead and Copper Rule ("LCR").

Q. Please provide some background regarding the LCR.

A. Promulgated in 1991 to protect public health by minimizing lead and copper levels in drinking water, the LCR was designed to determine the health of a water system, not to identify individual portions of distribution system at high risk.[24] Since lead and copper are generally absent from water as it leaves the treatment facility, the way that lead enters the water in the distribution system is through the corrosion of lead bearing premised plumbing material such as lead service lines, lead solder or leaded brass faucets. Lead particulate can also accumulate on the internal walls of corroded galvanized steel pipes or be lodged within a faucet aerator. The LCR is unique in requiring utilities to collect one liter, first draw water samples at high risk consumers' taps. The rule mandates that only 100 homes in a large city need to be tested in order to be compliant with the LCR, thus resulting in <1 in 1000 homes being tested. Additional breakdown in system size and number of sample sites can be seen in Table 1.

[24] Triantafyllidou, S., Edwards, M., (2012) Lead (Pb) in tap water and in blood: implications for lead exposure in the United States. Critical Review in Environmental Science and Technology. 42 (13), 1297–1352. http://www.tandfonline.com/doi/abs/10.1080/10643389.2011.556556

Table 1: Lead and Copper tap and Water Quality Parameter ("WQP") tap monitoring [25]

Size category	System size	Number of Pb/Cu tap sample sites[a]		Number of WQP tap sample sites[b]	
		Standard	Reduced	Standard	Reduced
Large	>100 K	100	50	25	10
	50,001 - 100 K	60	30	10	7
Medium	10,001 - 50 K	60	30	10	7
	3301 - 10 K	40	20	3	3
Small	501 - 3300	20	10	2	2
	101 - 500	10	5	1	1
	≤100	5	5	1	1

The LCR action level of 10 µg/dL applies to the 90th percentile of the sample set, but not to the individual measurements.[26] Inherent sample variability in: water use patterns, the presence or absence of protective coatings in the pipes, the age of the water in the distribution system, water chemistry, mineral types, temperature, and sampling techniques of the LCR at the customer tap pose considerable challenges in accurately assessing the presence of lead-contaminated water. As such, the LCR has been a source of considerable debate within the industry since its inception with the EPA continuing to work on "long-term" revisions for more than a decade now.[27]

Q. What is the current status of the LCR?

A. According to the recently updated US Office of Management and Budget notice:

> Beginning in 2004, EPA conducted a wide-ranging review of the Lead and Copper Rule (LCR) to determine if there is a national problem related to elevated lead levels. EPA's comprehensive review consisted of several elements, including a series of workshops designed to solicit issues, comments, and suggestions from stakeholders

[25] US EPA (2008) Lead and Copper Rule: A quick reference guide. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=60001N8P.txt

[26] Powell, M., (2005) The 1991 Lead/Copper drinking water rule and the 1995 decision not to revise the arsenic drinking water rule: two case studies in EPA's use of science. Discussion Paper 97-05 http://ageconsearch.umn.edu/bitstream/10454/1/dp970005.pdf

[27] Parents for nontoxic alternatives. (2015) Statement of Dissent to the EPA National Drinking Water Advisory Council (NDWAC) https://www.epa.gov/sites/production/files/2015-11/documents/ndwaclerstatementofdissent.pdf

> on particular issues; a review of the monitoring data to evaluate the effectiveness of the LCR; and a review of the LCR implementation by States and water utilities. As a result of this multi-part review, EPA identified seven targeted rules changes and EPA promulgated a set of short-term regulatory revisions and clarifications on October 10, 2007, to strengthen implementation of the existing Lead and Copper Rule. In developing the short-term revisions, EPA identified several regulatory changes to be considered as part of the identifying more comprehensive changes to the rule. These considerations are longer-term in nature as they require additional data collection, research, analysis, and stakeholder involvement to support decisions.[28]

The EPA now expects a draft rule to be published in January of 2018, or six months later than what was announced a year ago. Assuming no additional setbacks and under the most favorable timeline, the final rules, according to the EPA will not be ready until July 2019.

It is important to note that under this timeline the revised LCR rules would also coincide roughly with the conclusion of OPC's proposed lead service line replacement pilot project. This would position MAWC and ratepayers in the ideal situation for compliance with potential federal regulatory changes.

Q. How are lead service line replacements on the customer-side treated by the LCR?

A. They are the responsibility of the customer not the utility. Initially, the LCR required the replacement of the entire lead pipe, both the utility-owned and privately-owned sections. But requiring water utilities to remove privately-owned lead service lines raised constitutional and legal issues in terms of private property and eminent domain. A 1994 challenge in the DC Circuit Court by the American Water Works Association ("AWWA") limited the EPA's jurisdiction to just the public portion of the service line. The Court opinion stated:

> The AWWA (American Water Works Association) challenges. . . . the EPA's inclusion of water lines owned by others in the definition of distribution facilities

[28] Office of Management and Budget (2017) View Rule: National primary drinking water regulations for lead and copper: regulatory revisions. https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201704&RIN=2040-AF15

> under the 'control' of a public water system, and thus subject to the lead line replacement regulations. . . . We grant the AWWA's petition because the EPA failed to provide adequate notice that it might adopt a broad definition of control.

As a result the LCR was revised in 2000 to allow for partial service line replacement, although utilities could offer homeowners the option of replacing their portion of the line at the homeowner's cost.

Q. Can you cite to a water system that replaced all of its lead service lines?

A. Yes. Madison, Wisconsin is often held up as a best practice case study. In 1994 Madison Water Utility was faced with a situation where it was in violation of the LCR and its most standard chemical corrosion treatments were ineffective. Seven-years later, there were approximately 6,000 lead service lines on the utility-owned portion and 5,000 on the homeowner side. The state set a goal of replacing all service lines by 2011. In 2000 the city passed an ordinance that prioritized replacements in schools and day care facilities but disagreements regarding cost allocation soon followed. The utility initially attempted to add a surcharge but this was rejected by the Wisconsin Public Service Commission. Ultimately, costs were subsidized in part from an added surcharge from a sewer authority and revenue collected from water tower-based cell antenna fees. The Utility used that money to reimburse individual customers up to $1,000 the cost of the replacement. Madison Water also provided low-income customers a loan with repayment deferred until the property sold.[29]

Q. What should the Commission note from the Madison example?

A. As successful and innovative as Madison's example is, it is worth noting that it took seventeen-years to complete 6,000 lead service lines on the utility-side and 5,000 service lines on the homeowner side. Cost causation principles were also not entirely abandoned by the Madison utility as individual homeowners paid at least half the costs.

[29] Renner. R. (2010). Reaction to the solution: Lead exposure following partial service line replacement. *Environmental Health Perspectives* 118.5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866705/pdf/ehp-118-a202.pdf

III. MAWC'S LEAD LINE REPLACEMENT PROPOSAL

Estimated Number of Lead Service Lines

Q. Do you agree with Mr. LaGrands 30,000 lead service line replacement estimate?

A. No. In MAWC's initial application two numbers are cited and reprinted here:

> Nationwide, old lead service lines connect an estimated **6.1 million or more** homes and businesses to community drinking water mains. MAWC currently estimates that there are approximately **30,000 service lines** containing lead belonging to customers that are connected to MAWC's systems. (emphasis added)[30]

MAWC's application included a footnote to the 6.1 million estimate that directed readers to the Lead Service Line Replacement Collaborative. Although a review of the website failed to produce a citation for the nationwide estimate, a Google search for "6.1 million lead service lines" immediately cited to a 2016 AWWA journal article titled, "National Survey of Lead Service Line Occurrence."[31]

Table 2 includes the results of that study highlighting the largest estimated number of lead service lines by state, water system size and % of population based on 2016 US Census data.

[30] Missouri American Water (2017) WU-2017-0296. Application and Motion for Waiver. p. 3.
[31] Cornwell, D.A. et al. (2016) National Survey of Lead Service Line Occurrence. Journal of American Water Works Association April. http://media.mlive.com/news_impact/other/jaw201604cornwell_pr.pdf

Table 2: AWWA's top ten estimated states with the most lead service lines as percentage of its total 2016 US Census population

	Water System Size (small, medium, large and total)[32]				% of LSL per population	
	< 10,000	10,000 – 50,000	>50,000	All Systems	Total Population[33]	% of Total Population[34]
1. Illinois	76,000	240,000	410,000	730,000	12,801,539	5.70%
2. Ohio	52,000	170,000	430,000	650,000	11,614,373	5.60%
3. Missouri	**68,000**	**65,000**	**200,000**	**330,000**	**6,093,000**	**5.42%**
4. Minnesota	32,000	83,000	140,000	260,000	5,519,952	4.71%
5. Michigan	52,000	140,000	270,000	460,000	9,928,300	4.63%
6. Indiana	40,000	75,000	180,000	290,000	6,633,053	4.37%
7. Wisconsin	36,000	70,000	130,000	240,000	5,778,708	4.15%
8. New Jersey	1,100	320,000	31,000	350,000	8,944,469	3.91%
9. New York	2,900	280,000	84,000	360,000	19,746,289	1.82%
10. Texas	46,000	210,000	17,000	270,000	27,862,596	0.97%

The Commission should note that Missouri is estimated as having the third highest percentage of lead service lines and the 6th most estimated lead service lines in total in the United States.

MAWC's footprint extends over several of the most populated areas in the state including St. Louis and St. Charles Counties, the City of Joplin, the City of St. Joseph as well as many smaller systems. To be clear, if the Company is to be believed that the two numbers cited in its application are accurate then we should assume that only 9% of all of the estimated lead service lines in Missouri are in a MAWC designated service territory.

Based on the foregoing information it is reasonable to conclude that the Company's estimate for the number of lead service lines in its service territory is likely understated.

[32] Cornwell, D.A. et al. (2016) National Survey of Lead Service Line Occurrence. Journal of American Water Works Association April. http://media.mlive.com/news_impact/other/jaw201604cornwell_pr.pdf
[33] United States Census Bureau (2016) July 2016 Annual Estimates of the Residential population for the United States. https://www.census.gov/data/tables/2016/demo/popest/nation-total.html
[34] Represents a conservative percentage estimates as it assumes one lead service line for 1 person. In reality, one lead service line is likely servicing more than one person within a household.

Q. Can you provide other support to suggest that MAWC's numbers are understated?

A. Yes. Flint, Michigan provides an illustrative example of how company "tap records" and GIS estimates can be grossly inaccurate. In February of 2016 Mayor Karen Weaver of Flint, Michigan publicly estimated that 15,000 lead service lines would need to be replaced. By December of 2016, Mayor Weaver announced that initial estimates were grossly understated, and that an exploratory investigation by the University of Michigan estimated that as many as 29,100 Flint residences have lead or galvanized steel service lines that need to be replaced.[35] In eight-months the estimated number had approximately doubled.

The Company's response to OPC DR-2006 also gives me pause as to the soundness of its lead service line estimates. OPC DR-2006 states:

> Referencing the direct testimony of Bruce W. Aiton p. 3, 12-13, please provide the source/reference to substantiate the following statement:
>
> *Until around 1950, it was common practice for water utilities in Missouri to install lead service lines.*

The Company responded:

> The precise date is not readily available. The use of "around 1950" was pulled from articles related to Flint, MI. "New lead service lines have been banned since the 1950s."
> http://www.freep.com/story/news/local/michigan/flint-water-crisis/2016/02/27/lead-water-lines-lurk-unknown-many-cities/80551724/

To be clear, when asked about specific dates cited in their direct testimony regarding Missouri lead service line installation practices, the Company provided a response from a Detroit newspaper titled, "Where are the lead pipes? In many cities, we just don't know".

[35] City of Flint, Michigan (2016) FAST Start Initiative. https://www.cityofflint.com/fast-start/

With that said, I would agree with sentiments expressed in that headline and apparently MAWC acknowledges this fact as well. Notably, an integral part of OPC's proposed pilot would include a scoping analysis to identify the size and scale of the number of lead service lines.

Costs of Replacing Lead Service Lines

Q. Do you agree with Mr. LaGrand's $3,000 to $5,500 cost per replacement estimate?

A. No. Due primarily to unreliable, opaque and piece-meal records, water utilities often do not know what they will discover in the excavation process. Rarely is it as simple as digging a hole, replacing the line, and filling the hole. Consequently, excavating the ground of an older city may be more akin to performing surgery in the 19th century and this has made the cost of line replacement difficult to accurately estimate. Although still a small sample size, initial spent costs to date have exceeded the Company's estimated range with many individual sites hovering around the $10,000 spend.

Additionally, citing Flint, Michigan again as a reference, the Rowe Professional Services Company Water Service Inventory and Pilot Replacement Report[36] estimated the Flint, Michigan lead line replacement extraction process at $7,500 per household with additional cost considerations including (but not limited to):

- Permits and fees
  - Total about $2,400 per site, or about 25% of the costs of the "average" replacement
- Inspections
- Finished basements
- Garbage days
- Water and sewer service in the same trench
- Fixture repairs
- Large pipe or odd-fittings
- Trees & contaminated soil
- Dust
- Worker identification

[36] Rowe Professional Services Company Water Service Inventory and Pilot Report (2017) City of Flint, Michigan http://docs.house.gov/meetings/IF/IF14/20160413/104765/HHRG-114-IF14-Wstate-CreaghK-20160413-SD006.pdf

Cost estimates will no doubt fluctuate based on what is prioritized. For example, removing 3,000 service lines a year (the Company's proposed estimate) would appear to be an ambitious number under the most favorable of conditions (i.e., perfect weather, perfect information and no confounding variables). It would also be reasonable to assume that these large removal estimates would be married to either increased costs or substandard quality of work. Expeditious removal may be a priority if individually impacted ratepayers want immediate action and the quality of work may be a concern if it is perceived that the contract selection will be based on the "lowest bidder" for what amounts to a highly sensitive excavation process.

There are no doubt other trade-offs that need to be vetted. For example, should lead line service projects prioritize "economically constrained populations," or prioritize work in conjunction with other main replacements that were already scheduled to take place? This question was posed in OPC DR-2017 which stated:

> Referencing the direct testimony of Bruce W. Aiton p. 10, 15-17 which states:
>
> > *Many customers, particularly those in older neighborhoods with populations that face economic constraints that make it difficult or impossible for them to pay for replacement, will have a difficult time replacing their lead service lines on their own.*
>
> - Has MAWC's full lead line replacements to date specifically targeted neighborhoods whose populations face economic constraints? Additionally, Does MAWC plan on targeting neighborhoods whose populations face economic constraints?

The Company responded:

> To date MAWC has replaced lead service lines found on mains that had been prioritized for replacement during our 2016 planning cycle which did not include LSLR in the prioritization. MAWC's approach to replacing lead service lines is to give priority to the lead service lines that exist along the route of water main renewal projects and those found during emergency work.

The Company is currently updating its prioritization criteria for selecting water mains for renewal. The Company plans to consider the replacement of lead service lines without restriction on home owner economic constraints as part of its prioritization of main renewal projects.

Further discovery responses confirm that the Company does not appear to have been targeting "economically constrained neighborhoods" as the response to OPC DR-2005 includes the zip codes in which water testing samples were taken (see GM-2). I have adapted that table from the Company's response to include the name of the city/county in which the lead service line was excavated. Those results are in Table 3 below:

Table 3: Locations of lead service line replacements to date and flushing sample results

	Zip Code	Sample 1 - Post Flush	Sample 2 - Still	Sample 3 - Post Flush	Sample 4 - Still
Clayton	63105	74	72	8	3
Webster Groves	63119	9	9	2	
Mehlville	63125	1	1		
Spanish Lake	63138	1	1		
Brentwood	63144	3	4	1	
St. Joseph	64501	10	8		
Buchanan County	64503	3	2		
Buchanan County	64504	1	1		
Buchanan County	64505	5	4		
Buchanan County	64506	1	1		
Buchanan County	64507	12	9	1	
	Grand Total	120	112	12	3

A brief review of US Census data shows that the median value of owner-occupied housing units, 2011-2015 in Clayton is listed at $597,700[37] which is contrasted against the Missouri median value of $138,400.[38] Stated differently, homes in Clayton, where the vast majority of lead line replacements have occurred to date, are worth more than four times the median

[37] US Census (2016) QuickFacts: Clayton, Missouri https://www.census.gov/quickfacts/fact/table/claytoncitymissouri/PST045216
[38] US Census (2016) QuickFacts: Missouri https://www.census.gov/quickfacts/MO

average in Missouri. Although a small sample size, these preliminary results raise equity concerns and at the very least call attention to the issue of prioritization.

It is also important to note that the Company's direct testimony omits the total estimated "all-in" costs based on MAWC's numbers to date. For comparative purposes, Table 4 includes the cost estimates referenced in the Company's application broken down by number of estimated service lines and the Company's low/high cost estimate per unit compared a long with AWWA's Missouri-specific estimates with MAWC's low/high cost estimate.

Table 4: Projected Lead Service Line Replacement Costs in Company Application

Source	# of service lines	MAWC low/high Estimated cost	Total costs
MAWC territory estimate	30,000	$3,000 per unit	$90,000,000
MAWC territory estimate	30,000	$5,500 per unit	$165,000,000
AWWA Missouri estimate	330,000	$3,000 per unit	$990,000,000
AWWA Missouri estimate	330,000	$5,500 per unit	$1,815,000,000

Both the $90 million and (especially) the $1.815 billion price tags should give the Commission and other stakeholders pause.

Q. Why should the Commission concern itself with Missouri estimates?

A. First, as explained above, the total Missouri estimates cast doubt on the Company's estimates for its service area. Second, the total Missouri estimates should concern the Commission because MAWC is presently requesting to move to single-tariff pricing and abandon the regulatory principle of cost causation in its entirety. If the Company continues to seek further consolidation and socialization of costs, an incentive is created for water systems with otherwise cost-prohibitive projects (such as lead service line replacement) to sell their system to MAWC and socialize those site-specific costs on to existing MAWC customers. As it relates to lead service line replacement, if the AWWA report is accurate this would represent an enormous cost shifting burden to existing customers. It would also represent an unprecedented regulatory action by a state regulatory Commission.

Putting aside cost allocation issues for a moment to focus on the magnitude of the cost, it bears repeating that even under the most conservative of estimated costs and most conservative of estimated lead services lines in operation—the absolute floor for customers is at $90 million. This is not a trivial amount of money especially when the same Company is currently requesting a 45% rate increase to its quarterly billed St. Louis customers. The Commission should be mindful of the concept of opportunity costs and consider any and all opportunities to minimize excessive costs. OPC's pilot study recognizes this by including a policy track to address ancillary considerations including supplementing future costs from the federal government. As it stands, no such plan is being proposed by the Company.

Q. Do you believe MAWC's communications, testing and prioritization plan is correct?

A. No. There are a number of deficiencies with the company's plan. Many of OPC's concerns have already been raised as questions to explore in the proposed pilot study. These include, but are clearly not limited to the following:

- Which customers should get priority?
- Should work be spread out or concentrated in one area at a time?
- Should vacant or substandard housing be included?
- Will low-income property owners with mass meters pass the costs along to low-income tenants?
- What about inactive accounts?
- Should efforts be focused on mirroring future planned replacement or should previously identified "partial" replacements be the priority?
- How will customers be notified?
- In situations where lead lines have already been identified by the utility, were customers notified? If not, why?
- How should costs be allocated?
- What are the testing parameters and should results be disclosed to the public?
- Should filters be utilized?
- What about lead particulate in the homes internal pipes or faucets?

- When will customers be notified that lead is in contact with their water supply moving forward?

I look forward to other parties' feedback in rebuttal and will expound accordingly on this topic in surrebuttal.

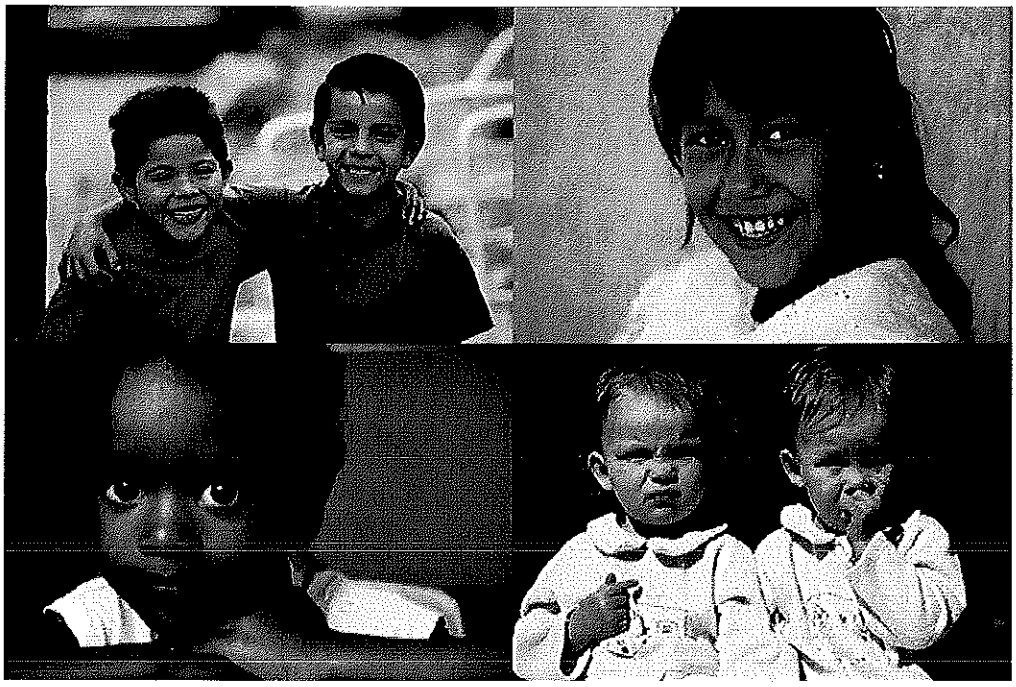
Q. Do you have any concluding statements?

A. Yes. When, and how, to address lead service line replacements are questions with no clear answers at this point. The ever present question of "who pays" further compounds the questions especially as it relate to customer-owned service lines. Ultimately, given the indeterminate size and scope of the Company's proposal, the regulatory uncertainty surrounding the LCR, the public health implications and the potential for public confusion or panic OPC ask the Commission to reject the Company's application and approve OPC's pilot study. Doing so will support the continued course of action (full lead line removal), engage diverse stakeholders in a complex topic, support evidence-based research, and explore ways to mitigate costs. OPC's pilot also allows the Commission and stakeholders the ability to review and determine their positions based on the feedback and results of rigorous pilot study.

Missouri Childhood Lead Poisoning Prevention Program

Annual Report for Fiscal Year 2016

July 1, 2015 – June 30, 2016



Missouri Department of Health and Senior Services

http://health.mo.gov/living/environment/lead/index.php

573-751-6102 or 866-628-9891

Missouri Childhood Lead Poisoning Prevention Program (CLPPP)

Annual Report for Fiscal Year 2016

July 1, 2015 – June 30, 2016

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This report meets the statutory mandate for an annual report per §701.343, RSMo.

About Our Program

PROGRAM MISSION

The Missouri Department of Health and Senior Services (DHSS) Childhood Lead Poisoning Prevention Program's (CLPPP) mission is to assure the children of Missouri a safe and healthy environment through primary prevention and the identification of lead exposures that may cause illness or death.

The DHSS' CLPPP was established in 1993 and continues to assure that health care providers have current information and tools available to screen patients less than six years of age for lead and provide primary prevention education.

The CLPPP is staffed by the following positions: a Program Manager, an Environmental Supervisor, a Research Analyst, two Data Entry Personnel, 6.5 Environmental Specialists, and a Public Health Consultant Nurse. State guidelines describe appropriate follow-up of children with elevated blood lead levels (EBL) of at least 10 micrograms per deciliter (10 µg/dL). Based on the 97.5th percentile of the blood lead level distribution among children one to five years old in the United States, the current Centers for Disease Control and Prevention (CDC) reference level is set at $\geq$ 5 µg/dL. CLPPP has been working to identify ways to provide services based on CDC's reference level. DHSS staff currently notifies all Local Public Health Agencies (LPHAs) and health plans when a blood lead level is received regardless of the level. This ensures LPHAs and health plans are aware of all the children's blood lead level results and can discuss what actions will follow if any.

Follow-up activities and case management are generally provided for children six years and younger with an EBL $\geq$ 10 µg/dL. These activities help the family understand the causes and health effects of childhood lead poisoning. Environmental risk assessments are required per statute to be performed to identify potential sources of lead exposure for children with an EBL $\geq$ 15 µg/dL. While not required by statute, CLPPP also offers environmental risk assessments for children with an EBL $\geq$ 10 µg/dL. These risk assessments provide the family with information about where lead hazards exist in and around their home. A work plan is developed to reduce these hazards and the risks associated with them. By reducing or eliminating exposures to the environmental sources of lead, the child's blood lead level should decrease and repeated elevations should be prevented. A Department of Health and Senior Services produced Lead Fact Sheet and CDC's "Protect Your Family From Lead" booklet are mailed to families of children who have been identified with having a lead level of 5 µg/dL to 9.9 µg/dL to provide information on lead poisoning and prevention.

Lead poisoning prevention educational materials are developed and provided to Missouri citizens at various community venues. DHSS works with LPHAs, the medical community, other state agencies, businesses, schools, and community organizations to prevent childhood lead poisoning. The Missouri CLPPP created a mascot to promote lead poisoning prevention messages. The costume may be loaned to any organization in Missouri wanting to increase lead poisoning prevention education and blood lead testing.

The program currently uses the Missouri Health Strategic Architectures and Information Cooperative (MOHSAIC) database to collect lead-specific data from medical and lead program activities. This database is part of an electronic health records system to provide documentation of medical testing, case management, and environmental risk assessments statewide. The data is

used to provide comprehensive lead case management services and for statistical information. All child and adult lead test information is tracked in MOHSAIC.

Lead Poisoning in Missouri

Lead poisoning is one of the most common and preventable environmental health problems today. Almost a quarter million children in the United States are estimated to have an EBL level of at least a 10 µg/dL. According to Missouri blood lead testing data for July 1, 2015, through June 30, 2016, there were 600 children under the age of six identified with EBL levels of at least 10 µg/dL (0.69 percent of the 86,864 children tested that year).

The primary lead hazard to children in Missouri is deteriorated lead-based paint. Lead-based paint was banned for residential use nationwide in 1978. Any home built before 1978 may contain lead-based paint. The highest risk of lead exposure for children is found in homes built before 1950, when most paint contained a high percentage of lead. More than 21 percent of the housing stock in Missouri was built before 1950 (see page 5).

Lead mining and smelting are an important part of Missouri's history. Lead in Missouri was first discovered along the Meramec River by French explorers in the 1700s while searching for gold and silver. Missouri became the dominant lead-producing state in the nation in 1907. It has remained so ever since. Most early lead production came from the Old Lead Belt district of southeast Missouri in the Park Hills-Bonne Terre area, and in the Tri-State Zinc-Lead district in southwest Missouri around Joplin. Today, all of the state's lead production comes from the New Lead Belt, also known as the Viburnum Trend district. This district is a very narrow, 35-mile-long ore area extending southward from the small town of Viburnum, Iron County, in southeast Missouri. Mining waste products in these areas often end up on driveways, in yards, or even in children's play areas. Dust, air, and soil around mining activity have consistently shown elevated levels of lead contamination.

Lead is a shiny, silver-colored metal found naturally in the earth's crust. Lead has historically been used in a variety of ways including in paints, gasoline, batteries, bullets, keys, and some vinyl products such as mini-blinds. Fine particles of processed or recycled lead and/or lead dust become a health hazard when they are taken into the body through inhalation (breathing) and/or ingestion (swallowing).

Lead affects almost every organ and system in the body. The effects of lead are the same whether it is inhaled or ingested and can damage the brain, central nervous system, kidneys, and immune system. Lead in the human body is most harmful to young children under six years of age, and is especially detrimental to children less than three years of age because their systems are developing rapidly.

A blood test is used to determine lead levels. Lead can be measured in blood drawn from a vein or capillary (finger stick). Blood lead levels are measured and reported as micrograms of lead per deciliter of whole blood (µg/dL).

Statewide Screening Plan

Legislation passed in 2001 required DHSS to promulgate rules and regulations to establish a statewide screening plan. The rules and regulations define criteria for establishing geographic areas in the state considered to be at higher risk for lead poisoning, outline blood lead testing requirements and protocols, and define lead testing follow-up.

In developing these regulations, CLPPP applied Missouri surveillance and census data to establish criteria for Universal Testing (high risk) and Targeted Testing (non-high risk) areas in Missouri. Based upon those criteria, and as required by state statute, the following activities shall occur in these two areas.

In **Universal Testing Areas**:

- Any child under the age of six living in or visiting for more than 10 hours per week in the Universal Testing or high risk area will be tested annually for lead.
- Childcare facilities located in Universal Testing Areas must record a "proof of lead testing" signed by the health care provider within 30 days of the child's enrollment. The statement must verify that a blood lead test was completed in the previous 12 months. If the parent/guardian does not provide proof or a written statement explaining why they do not want the child tested, the childcare facility is to offer the parent assistance in scheduling a blood lead test.

In **Targeted Testing Areas** the following activities shall occur:

- From six months to six years of age, every child will be screened annually using the Healthy Children and Youth (HCY) Lead Risk Assessment Guide to determine whether the child is at risk for lead poisoning. Responses given during the screening with the Guide may indicate the need for blood lead testing at an earlier age (six months) and/or more frequently.

  *The HCY Lead Risk Assessment Guide can be viewed at: http://health.mo.gov/living/environment/lead/pdf/HCYLeadRiskAssessmentGuide.pdf.

- Every child less than age six found to be at high risk will be blood tested for lead poisoning.
- All MO HealthNet eligible children shall be assessed by the HCY Lead Risk Assessment Guide and/or be blood lead tested at the ages stipulated by the Federal Program Guidelines (12 months of age, 24 months of age, or 12 to 72 months of age).

An updated Missouri Annual Childhood Lead Testing Area Requirements map is published every year and is available at: health.mo.gov/living/environment/lead/maps.php.

Reporting of Blood Lead Testing

Missouri's diseases and conditions reporting rule (19 CSR 20-20.020) requires reporting of all blood lead tests both elevated and non-elevated and clarifies demographic patient information required to be submitted with the report. All blood lead test results are required to be reported to the DHSS regardless of the age of the individual or the reported lead level. The data contributes to Missouri's local, regional, and statewide statistics on blood lead poisoning.

The following information is required:

- Date test was conducted
- Type of specimen (capillary or venous)
- Result of the test
- Name and address of the attending physician
- Name of the disease or condition diagnosed or suspected
- Date the test results were obtained
- Patient's complete name and home address with zip code
- Patient's date of birth
- Patient's sex and race

Health care providers should assure that the laboratory they are using is reporting to DHSS.

LeadCare Analyzers

LeadCare Analyzers are portable and easy-to-use instruments that give results of capillary blood lead samples within minutes. These devices allow the patient to receive a result immediately from the tester. LeadCare Analyzers are very convenient for physicians' offices and local health departments. These devices:

- Prevent the patient from possibly being referred to an entirely different location to have the test done.
- Save time that would be spent waiting on lab results.

The use of these instruments has increased for both providers and local public health agencies.

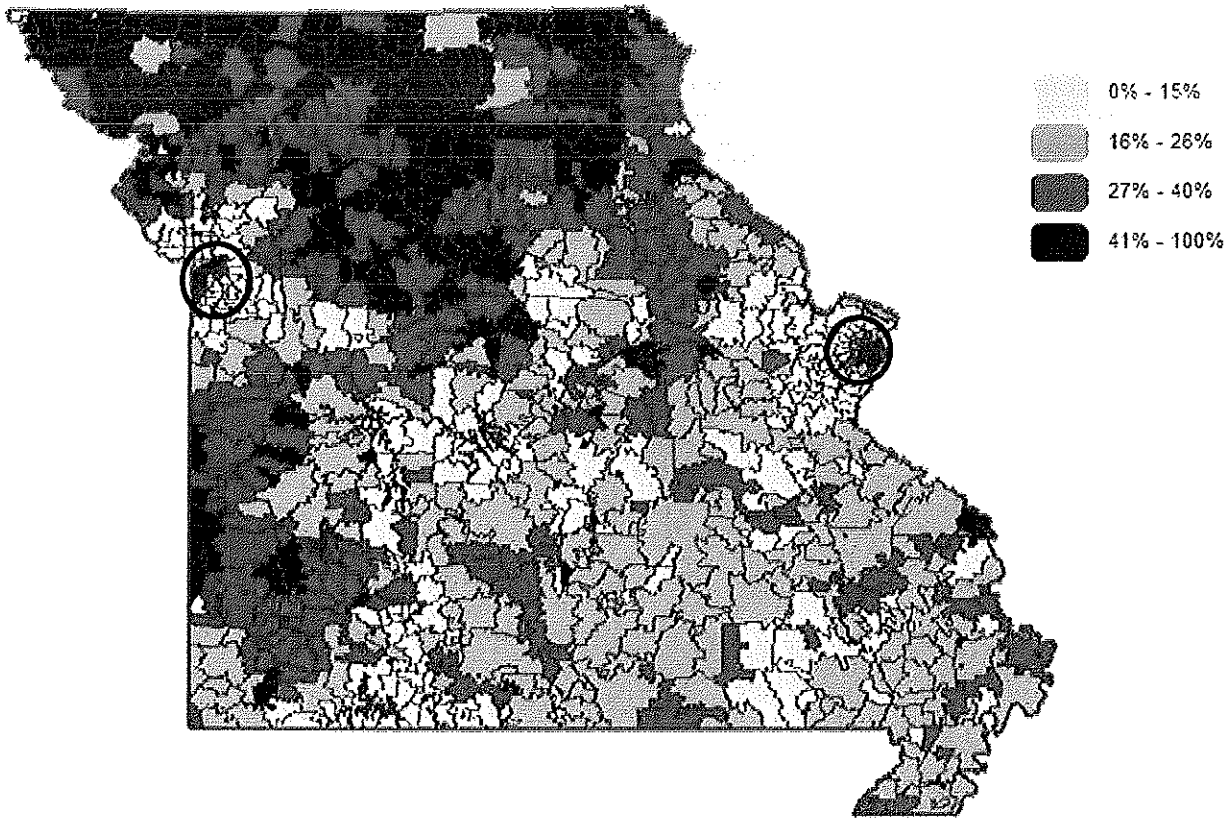
Filter Paper Blood Lead Testing

Filter Paper techniques are acceptable for blood lead testing if health care providers ensure that, as with all blood lead test methods, the chosen laboratory is participating satisfactorily in Clinical Laboratory Improvement Amendments (CLIA) certified proficiency testing (PT) program. Technical assistance is available by contacting the nurse in the DHSS Childhood Lead Poisoning Prevention Program at 573-751-6102.

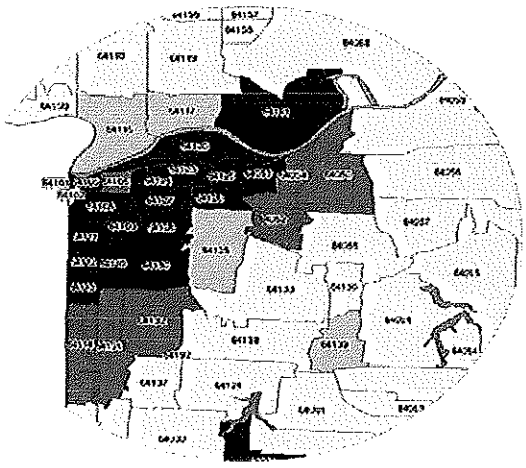
Housing Risks

Nationally, the average percentage of housing built pre-1950 decreased from 22% in 2000 to 19.6 % in 2010. Missouri is above the national average with 21% of housing units built before 1950. The map below lists the percentage of pre-1950 housing by zip code according to the 2000 census data.

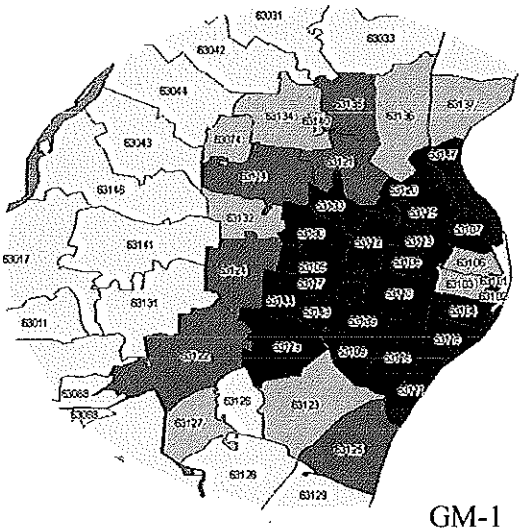
Percent of Missouri Pre-1950 Housing by Zip Code



Kansas City



St. Louis



Testing and Prevalence

The number of Missouri's children less than six years old who have been tested for lead poisoning has increased from 50,362 in 2000 to 86,864 in Fiscal Year 2016. Of the children tested, the percentage found to have elevated blood lead levels (10 µg/dL or greater) has declined from 11.1 percent in 2000 to 0.69 percent in 2016. This decrease mirrors a nationwide decrease in children's blood lead levels. In 2016, of the 86,864 children in Missouri who received a blood lead test, 600 had blood lead levels of 10 µg/dL or greater.

Highlights from the Fiscal Year 2016 testing data

- There were 86,864 children tested for lead during Fiscal Year 2016.
- Of children tested in Missouri, 600 (0.69 percent) had an elevated blood lead level of at least 10 µg/dL.
- The number of children found to have an EBL greater than or equal to 10 µg/dL decreased from 5,588 in 2000 to 600 in 2016.
- Approximately 22.3 percent of children tested resided in a Universal Testing Area in Fiscal Year 2016.
- 2,505 children tested had blood lead levels between 5 and 9.9 µg/dL (2.9 percent of the 86,864 children tested).

A summary of county level blood lead testing data for the period July 1, 2015, through June 30, 2016, is presented on the following pages.

Blood Lead Testing Data by County

For the period July 1, 2015, through June 30, 2016, for Children Less Than Six Years of Age

Jurisdiction	Blood Lead Level Test Results (µg/dL)										Total Count All Tests	2010 Census Population of Children <72 months	Percent of Total Population (<72 months) Tested	Total Elevated Count Tests >= 10	Percent Elevated Total Tested >= 10
	0-2.9	3-4.9	5-9.9	Total Count Tests <10	10-14.9	15-19.9	20-24.9	25-44.9	45-69.9	>69.9					
ADAIR	261	19	9	289	2	0	0	0	0	0	291	1,715	16.97%	2	0.69%
ANDREW	243	13	11	267	0	0	0	0	0	0	267	1,217	21.94%	0	0.00%
ATCHISON	29	17	5	51	2	0	0	0	0	0	53	362	14.64%	2	3.77%
AUDRAIN	359	33	9	401	2	4	0	1	0	0	408	2,063	19.78%	7	1.72%
BARRY	236	31	2	269	1	0	0	0	0	0	270	2,726	9.90%	1	0.37%
BARTON	103	15	1	119	0	1	1	0	0	0	121	997	12.14%	2	1.65%
BATES	157	50	21	228	2	2	1	0	0	0	233	1,369	17.02%	5	2.15%
BENTON	104	8	2	114	1	0	0	0	0	0	115	1,001	11.49%	1	0.87%
BOLLINGER	178	28	5	211	0	0	0	0	0	0	211	907	23.26%	0	0.00%
BOONE	2,347	85	18	2,450	3	0	2	0	0	0	2,455	12,126	20.25%	5	0.20%
BUCHANAN	1,200	146	117	1,463	13	7	5	3	0	0	1,491	7,321	20.37%	28	1.88%
BUTLER	688	138	15	841	1	1	0	0	0	0	843	3,369	25.02%	2	0.24%
CALDWELL	106	16	11	133	0	1	1	0	0	0	135	722	18.70%	2	1.48%
CALLAWAY	466	55	10	531	0	0	0	0	0	0	531	3,169	16.76%	0	0.00%
CAMDEN	239	16	4	259	1	0	0	0	0	0	260	2,610	9.96%	1	0.38%
CAPE GIRARDEAU	636	95	36	767	13	0	1	1	2	0	784	5,638	13.91%	17	2.17%
CARROLL	148	23	11	182	2	0	1	0	0	0	185	634	29.18%	3	1.62%
CARTER	92	8	2	102	1	0	0	0	0	0	103	515	20.00%	1	0.97%
CASS	965	64	7	1,036	4	0	0	0	0	0	1,040	8,174	12.72%	4	0.38%
CEDAR	100	19	7	126	0	0	0	0	0	0	126	1,002	12.57%	0	0.00%
CHARITON	103	16	0	119	0	1	1	0	0	0	121	575	21.04%	2	1.65%
CHRISTIAN	883	56	13	952	1	0	0	0	0	0	953	7,017	13.58%	1	0.10%
CLARK	70	14	12	96	1	0	0	0	0	0	97	577	16.81%	1	1.03%
CLAY	2,663	145	21	2,829	0	1	0	0	0	0	2,830	19,570	14.46%	1	0.04%
CLINTON	220	19	3	242	0	0	1	0	1	0	244	1,569	15.55%	2	0.82%
COLE	772	103	34	909	1	1	2	0	0	0	913	6,099	14.97%	4	0.44%
COOPER	189	31	10	230	1	0	0	0	0	0	231	1,291	17.89%	1	0.43%
CRAWFORD	335	29	10	374	2	0	0	0	0	0	376	2,000	18.80%	2	0.53%
DADE	74	22	2	98	3	0	0	0	0	0	101	494	20.45%	3	2.97%
DALLAS	147	21	4	172	1	0	0	0	0	0	173	1,368	12.65%	1	0.58%

Jurisdiction	Blood Lead Level Test Results (µg/dL)										Total Count All Tests	2010 Census Population of Children <72 months	Percent of Total Population (<72 months) Tested	Total Elevated Count Tests >= 10	Percent Elevated Total Tested >= 10
	0-2.9	3-4.9	5-9.9	Total Count Tests <10	10-14.9	15-19.9	20-24.9	25-44.9	45-69.9	>69.9					
DAVIESS	106	17	4	127	0	0	0	0	0	0	127	757	16.78%	0	0.00%
DEKALB	112	6	4	122	0	0	0	0	0	0	122	706	17.28%	0	0.00%
DENT	190	45	7	242	0	0	0	0	0	0	242	1,145	21.14%	0	0.00%
DOUGLAS	258	18	3	279	1	0	0	0	0	0	280	983	28.48%	1	0.36%
DUNKLIN	390	60	7	457	0	0	0	0	0	0	457	2,640	17.31%	0	0.00%
FRANKLIN	818	24	14	856	2	1	0	0	0	0	859	7,862	10.93%	3	0.35%
GASCONADE	172	15	7	194	3	0	0	0	0	0	197	1,009	19.52%	3	1.52%
GENTRY	117	15	5	137	0	2	0	0	0	0	139	542	25.65%	2	1.44%
GREENE	2,747	269	45	3,061	13	3	0	1	1	0	3,079	20,451	15.06%	18	0.58%
GRUNDY	134	38	11	183	3	0	3	0	0	0	189	853	22.16%	6	3.17%
HARRISON	82	10	5	97	2	0	0	0	0	0	99	781	12.68%	2	2.02%
HENRY	238	19	5	262	0	0	0	0	0	0	262	1,583	16.55%	0	0.00%
HICKORY	85	22	4	111	0	0	0	0	0	0	111	535	20.75%	0	0.00%
HOLT	77	12	1	90	2	0	0	0	0	0	92	336	27.38%	2	2.17%
HOWARD	143	7	2	152	2	0	0	0	0	0	154	732	21.04%	2	1.30%
HOWELL	293	62	4	359	0	0	0	0	0	0	359	3,389	10.59%	0	0.00%
IRON	186	48	44	278	1	0	0	0	0	0	279	742	37.60%	1	0.36%
JACKSON	8,315	3,503	261	12,079	49	14	6	7	1	0	12,156	57,177	21.26%	77	0.63%
JASPER	1,713	268	96	2,077	5	3	0	2	0	0	2,087	10,727	19.46%	10	0.48%
JEFFERSON	1,511	128	19	1,658	3	0	0	0	0	0	1,661	18,009	9.22%	3	0.18%
JOHNSON	299	46	12	357	2	3	0	0	0	0	362	4,267	8.48%	5	1.38%
KANSAS CITY	7,664	972	246	8,882	43	11	4	7	1	0	8,948	40,849	21.91%	66	0.74%
KNOX	50	8	2	60	1	0	0	0	0	0	61	323	18.89%	1	1.64%
LACLEDE	374	79	7	460	0	0	0	0	0	0	460	3,029	15.19%	0	0.00%
LAFAYETTE	180	277	0	457	1	0	0	0	0	0	458	2,511	18.24%	1	0.22%
LAWRENCE	353	55	12	420	1	0	0	0	0	0	421	3,220	13.07%	1	0.24%
LEWIS	132	8	5	145	2	0	0	0	0	0	147	762	19.29%	2	1.36%
LINCOLN	604	19	5	628	0	0	0	0	0	0	628	4,892	12.84%	0	0.00%
LINN	120	26	5	151	2	0	0	0	0	0	153	1,009	15.16%	2	1.31%
LIVINGSTON	223	15	8	246	1	0	0	0	0	0	247	1,127	21.92%	1	0.40%
MACON	174	25	10	209	2	0	0	0	0	0	211	1,266	16.67%	2	0.95%
MADISON	282	31	20	333	7	0	0	0	0	0	340	956	35.56%	7	2.06%

Jurisdiction	Blood Lead Level Test Results (µg/dL)										Total Count All Tests	2010 Census Population of Children <72 months	Percent of Total Population (<72 months) Tested	Total Elevated Count Tests >= 10	Percent Elevated Total Tested >= 10
	0-2.9	3-4.9	5-9.9	Total Count Tests <10	10-14.9	15-19.9	20-24.9	25-44.9	45-69.9	>69.9					
MARIES	63	10	0	73	0	0	0	0	0	0	73	680	10.74%	0	0.00%
MARION	419	65	32	516	5	4	0	0	0	0	525	2,373	22.12%	9	1.71%
MCDONALD	197	19	6	222	0	0	0	0	0	0	222	2,022	10.98%	0	0.00%
MERCER	23	4	3	30	0	0	0	0	0	0	30	314	9.55%	0	0.00%
MILLER	254	19	3	276	2	0	0	0	0	0	278	1,932	14.39%	2	0.72%
MISSISSIPPI	332	49	10	391	0	0	0	0	0	0	391	1,084	36.07%	0	0.00%
MONITEAU	165	17	6	188	0	0	0	0	0	0	188	1,306	14.40%	0	0.00%
MONROE	79	7	4	90	0	0	0	0	0	0	90	658	13.68%	0	0.00%
MONTGOMERY	202	36	11	249	0	0	0	0	0	0	249	920	27.07%	0	0.00%
MORGAN	160	18	2	180	1	1	0	1	0	0	183	1,503	12.18%	3	1.64%
NEW MADRID	330	57	6	393	0	1	0	0	0	0	394	1,507	26.14%	1	0.25%
NEWTON	675	92	31	798	1	1	0	0	0	0	800	4,638	17.25%	2	0.25%
NODAWAY	275	30	13	318	1	0	0	1	0	0	320	1,479	21.64%	2	0.63%
OREGON	180	38	1	219	1	0	0	0	0	0	220	736	29.89%	1	0.45%
OSAGE	138	18	8	164	0	0	0	0	0	0	164	1,095	14.98%	0	0.00%
OZARK	94	11	3	108	0	0	0	0	0	0	108	601	17.97%	0	0.00%
PEMISCOT	167	21	0	188	0	0	0	0	0	0	188	1,674	11.23%	0	0.00%
PERRY	140	4	1	145	1	0	0	0	0	0	146	1,533	9.52%	1	0.68%
PETTIS	498	64	38	600	8	3	0	0	1	0	612	3,739	16.37%	12	1.96%
PHELPS	556	73	5	634	1	1	0	0	0	0	636	3,326	19.12%	2	0.31%
PIKE	193	30	8	231	1	0	0	1	0	0	233	1,349	17.27%	2	0.86%
PLATTE	926	43	7	976	1	0	0	0	0	0	977	6,855	14.25%	1	0.10%
POLK	385	33	13	431	1	1	0	1	0	0	434	2,402	18.07%	3	0.69%
PULASKI	272	21	3	296	1	0	0	0	0	0	297	4,660	6.37%	1	0.34%
PUTNAM	46	2	0	48	0	0	0	0	0	0	48	371	12.94%	0	0.00%
RALLS	123	10	5	138	1	1	0	0	0	0	140	768	18.23%	2	1.43%
RANDOLPH	308	46	14	368	2	0	1	0	0	0	371	1,921	19.31%	3	0.81%
RAY	310	41	2	353	0	1	0	1	0	0	355	1,735	20.46%	2	0.56%
REYNOLDS	47	19	4	70	1	0	0	0	0	0	71	476	14.92%	1	1.41%
RIPLEY	201	22	6	229	1	0	1	0	0	0	231	991	23.31%	2	0.87%
SALINE	355	61	22	438	6	1	0	0	0	0	445	1,781	24.99%	7	1.57%
SCHUYLER	42	3	2	47	1	0	0	0	0	0	48	344	13.95%	1	2.08%

Jurisdiction	Blood Lead Level Test Results (µg/dL)										Total Count All Tests	2010 Census Population of Children <72 months	Percent of Total Population (<72 months) Tested	Total Elevated Count Tests >= 10	Percent Elevated Total Tested >= 10
	0-2.9	3-4.9	5-9.9	Total Count Tests <10	10-14.9	15-19.9	20-24.9	25-44.9	45-69.9	>69.9					
SCOTLAND	21	8	1	30	0	0	0	0	0	0	30	470	6.38%	0	0.00%
SCOTT	702	68	14	784	0	0	1	1	0	0	786	3,304	23.79%	2	0.25%
SHANNON	43	4	0	47	0	0	0	0	0	0	47	638	7.37%	0	0.00%
SHELBY	130	23	5	158	0	0	1	0	0	0	159	519	30.64%	1	0.63%
ST CHARLES	2,265	48	13	2,326	2	0	0	0	0	0	2,328	29,474	7.90%	2	0.09%
ST CLAIR	47	6	4	57	0	0	0	0	0	0	57	585	9.74%	0	0.00%
ST FRANCOIS	628	122	39	789	10	0	0	0	0	0	799	4,811	16.61%	10	1.25%
ST LOUIS CO	14,553	969	268	15,790	27	17	5	5	1	0	15,845	70,993	22.32%	55	0.35%
ST LOUIS CITY	8,876	1,660	758	11,294	125	36	17	17	4	0	11,493	24,645	46.63%	199	1.73%
STE GENEVIEVE	202	22	11	235	1	0	0	0	0	0	236	1,239	19.05%	1	0.42%
STODDARD	462	26	7	495	1	0	0	0	0	0	496	2,171	22.85%	1	0.20%
STONE	157	17	4	178	0	0	0	0	0	0	178	1,694	10.51%	0	0.00%
SULLIVAN	201	18	13	232	2	0	0	0	0	0	234	528	44.32%	2	0.85%
TANEY	332	10	0	342	2	0	0	0	0	0	344	3,754	9.16%	2	0.58%
TEXAS	185	19	7	211	0	0	0	0	0	0	211	1,911	11.04%	0	0.00%
VERNON	167	31	10	208	2	2	0	0	0	0	212	1,754	12.09%	4	1.89%
WARREN	410	22	1	433	0	0	0	0	0	0	433	2,746	15.77%	0	0.00%
WASHINGTON	195	39	11	245	3	1	0	0	0	0	249	1,967	12.66%	4	1.61%
WAYNE	125	15	3	143	0	0	0	0	0	0	143	858	16.67%	0	0.00%
WEBSTER	308	64	10	382	3	0	0	0	0	0	385	3,219	11.96%	3	0.78%
WORTH	30	7	2	39	0	0	0	0	0	0	39	124	31.45%	0	0.00%
WRIGHT	262	21	9	292	0	1	0	0	0	0	293	1,569	18.67%	1	0.34%
Grand Total	**73,047**	**10,712**	**2,505**	**86,264**	**378**	**117**	**51**	**43**	**11**	**0**	**86,864**	**468,264**	**18.55%**	**600**	**0.69%**

Data Notes:

-Kansas City tests are reflected in both the Kansas City row and the rows for their respective counties. These tests are counted only once in the grand totals.

Lead Poisoning Prevention Education

CLPPP develops an educational campaign and distributes materials to advocates statewide each year. The campaign goal is to provide stakeholders with the tools necessary to promote lead poisoning prevention. Themes, fact sheets, posters, and public service announcements are examples of campaign materials. The materials are used during lead poisoning prevention month to intensify the statewide effort.

Several educational brochures and fact sheets that focus on specific lead related issues such as *Pregnancy and Lead Poisoning* and *A Health Care Provider's Guide to Lead Screening and Testing Requirements* are also available and can be ordered for community-wide use.

Educational materials are also available and displayed at health fairs, home shows, blood lead testing events, and other public events when possible. Display boards provide visitors with lead poisoning prevention posters, signs, facts, and other educational materials. The display boards are helpful to capture people's attention and draw them in to learn about other healthy homes topics such as radon and mold.

Lead Poisoning Prevention Week (observed in October) campaign information, newsletters, fact sheets, booklets, and other publications are all available to the public on the CLPPP webpage. The webpage also features: upcoming events, lead testing guidelines, Missouri Annual Childhood Lead Testing Area Requirements maps, product recalls, data and statistical reports, laws, regulations, and manuals. CLPPP personnel worked with St. Joseph, St. Francois, Johnson, Audrain, and Gentry Tri-Counties testing for blood lead levels on children less than 72 months during their monthly Women, Infant, and Children (WIC) events. The team also attended a Lead Poisoning Prevention Webinar.

Collaborations

Case Management Services

Case management of children with EBL levels involves coordinating, providing, and overseeing the services required to help reduce the child's blood lead level. During fiscal year 2016, case managers strived to reduce EBL levels to less than 10 µg/dL. It is based on the efforts of an organized team and is child, physician, and family centered. Lead case management services may be provided by the child's primary care physician, LPHA, or a MO HealthNet Managed Care health plan. At times, other disciplines, such as behavioral health, are part of the case management system. In some cases, interpretive services may be indicated and these individuals will also interact with lead case managers. DHSS Childhood Lead Poisoning Prevention staff, along with MO HealthNet and LPHA staff, monitors case management for children identified with a blood lead level greater than or equal to 10 µg/dL. The MOHSAIC system is used to provide a centralized documented record of communications, results, case management interventions, and updated demographic information. This promotes the sharing of the findings and promoting unified support of suggested interventions made by the risk assessors following environmental investigation results.

Environmental Services

The CLPPP provides lead risk assessment services to detect hazardous sources of lead exposure in children's homes. This service is provided for children age six and younger who have a confirmed venous blood lead level of 15 µg/dL or greater and is offered at 10 µg/dL.

A risk assessment is conducted by a professional, trained and licensed by the DHSS Lead Licensing Program. The assessor consults with the child's family to determine areas of the home where the child may come into contact with lead. X-ray Fluorescence Analyzers (XRFs) are used to analyze painted surfaces and household objects. Dust, soil, and water samples are collected to determine if and where lead hazards exist. Upon completing the assessment and receiving the lab analysis, the risk assessor provides the property owner and/or occupant (if other than the owner) with recommendations for reducing lead hazards. The risk assessor revisits the home at an agreed-upon time to assure lead hazard reduction has been accomplished. The risk assessor collaborates with the child's parent or legal guardian, property owner, LPHA or MO HealthNet lead case manager, DHSS CLPPP staff, and the child's physician as indicated, as part of their role in case management of the elevated child. Risk assessment reports are also accessible to team members if a risk assessment was conducted on a child with a blood lead level of 10 µg/dL or greater.

Healthy Homes

Since the beginning of the "Is Your Home Healthy?" exhibit in 2007, the exhibit has been adapted for use at a variety of events throughout the state. The main exhibit focuses on the Healthy Indoor Environments unit in the Bureau of Environmental Epidemiology. The primary programs highlighted are the Childhood Lead Poisoning Prevention Program and the Indoor Air/Radon Program. Information is available on a variety of topics including lead poisoning prevention, radon and mold remediation, the fish consumption advisory, asbestos-containing vermiculite insulation, carbon monoxide poisoning prevention, heat and cold illness prevention, mercury handling and disposal, and other environmental health topics as appropriate for the event and audience. Coloring and activity books, magnets, and stickers are available to capture the interest of guardians and children. Employees from various DHSS programs work the exhibit and are available to answer questions about environmental health concerns from citizens. The exhibit also features hand washing information from the Bureau of Communicable Disease Control and Prevention along with tick and mosquito repellant information from the Vector Borne Disease Program.

Between July 1, 2015, and June 30, 2016, "Is Your Home Healthy?" was displayed at 40 different venues across the state and provided 11,898 handouts. These included the new Local Public Health Administrators training; St. Louis, Kansas City, and Jefferson City Home Builders Association Home Shows; Missouri School Nurse Conference; Missouri Environmental Educator Conference; and school and community health fairs.

The "Is Your Home Healthy?" exhibit is an ongoing collaborative effort between the Bureau of Environmental Epidemiology programs, the Bureau of Communicable Disease Control and Prevention, the Vector Borne Disease Program, and the local health departments. This outreach effort continues to help build partnerships with outside organizations such as Parents as Teachers, child advocates, school nurses, contractors, environmental health professionals, senior citizen groups, and parents. At the same time, it provides valuable information to and helps educate the citizens of Missouri about environmental hazards in their homes.

Agency for Toxic Substance and Disease Registry (ATSDR)/Environmental Protection Agency (EPA)/Missouri Department of Natural Resources (MDNR)

Lead mining, milling, and smelting have occurred throughout the lower half of Missouri. Missouri ranks as the top lead-producing state in the nation. Across the state, there are 60 counties that are potentially impacted by lead mining-related activities.

Historical lead mining, milling, and processing have resulted in innumerable tons and acres of waste products, such as tailings and chat. Over time, tailings and chat have migrated into the surrounding communities. The migration has been caused by wind or water erosion, as well as human activities, such as using the lead waste as fill material in yards, driveways, and sandboxes or using the chat for traction along roads in winter. Because of the lead mine waste and the resulting contamination into nearby communities, Missouri has many sites placed on the Environmental Protection Agency (EPA) National Priorities List (NPL) for remediation. In St. Francois County, six large mine tailings and chat piles from past mining and milling operations are located near residential areas. Other major lead mining sites that have been placed on the NPL due to residential contamination include Madison and Jefferson counties; sites in Newton, Jasper, and Iron counties; and four sites in Washington County. The active lead smelter in Herculaneum, Missouri, ceased operation on December 31, 2013. The smelter processed lead concentrate from active mining and milling operations in nearby counties into lead ingots for use in consumer products like batteries and computers. Lead contamination resulting from the smelter operations is also being addressed in the community of Herculaneum.

DHSS, along with other state, local and federal agencies (including ATSDR, EPA, and MDNR), is addressing these sites to protect public health. Multiple actions have been taken to reduce human exposure and prevent lead poisoning, especially to children less than six years old. Some of the actions taken by partnering agencies at the various sites to reduce exposure include monitoring of air, sampling of soil, water, and dust, stabilization of the tailings piles, yard soil removals, street cleanings, interior home cleaning, reduction in smelter air emissions, and special blood lead testing events. Additional activities conducted by DHSS include health studies, health consultations, public health assessments, and ongoing educational activities.

Brownfield Project

Vast areas of Missouri may have high levels of lead in soil and/or groundwater due to naturally occurring lead deposits and from past and present lead mining and production. Given the recent rapid expansion of urban sprawl, many previously undeveloped properties are now being looked at by developers for residential housing and other types of increased land use. Development of this nature on mining-impacted lands potentially exposes new populations to lead and other heavy metal contaminants.

Under a grant from ATSDR, DHSS acted to increase testing for lead in drinking water by working with the State Public Health Laboratory to add lead to its list of analytes included in the New Well Series for private drinking water supplies and by recommending actions that local public health agencies can take to increase testing. DHSS also developed health education materials to promote water testing for lead. To assist in responding to homeowner concerns for those identified with lead impacts to their drinking water system, a lead in drinking water fact sheet was developed that can be provided along with test results with recommendations for reducing exposure. These health education materials can be found at the following DHSS web site: http://health.mo.gov/living/environment/lead/publications.php#gov.

DHSS Lead Licensing Program

The Lead Licensing Program is responsible for licensing individuals to conduct lead abatement, inspections, and risk assessments. Employees of this section may make unannounced site visits to check that all individuals have the proper current license and that lead abatement is being conducted correctly and safely. This is to ensure the safety of the residents who may not know the harmful effects of improper lead abatement work practices. Like CLPPP, the Lead Licensing Program plays an important role in keeping people healthy and safe from lead poisoning. All risk assessors that are a part of CLPPP are licensed and overseen by the Lead Licensing Program.

Missouri Department of Social Services (MDSS), MO HealthNet Division (MHD)

Poverty is one major risk factor for lead poisoning. DHSS and MHD have had a cooperative agreement in place since 1998. This agreement outlines the agencies' mutual objectives regarding childhood lead poisoning to: 1) assure that MO HealthNet eligible children are screened/tested according to the Statewide Lead Testing Plan; and 2) assure that medically necessary services are provided for MO HealthNet eligible children whether by a MO HealthNet enrolled provider or a MO HealthNet Managed Care health plan for the correction or amelioration of lead poisoning related conditions identified through a full or partial Early Periodic Screening Diagnosis and Treatment. During FY2016, MO HealthNet staff assessed the current MO HealthNet status of all Missouri children with confirmed blood lead levels 10 µg/dL or greater. MO HealthNet staff generates a health plan specific report of elevated health plan members that is forwarded to each health plan lead case manager for case management of the elevation. Lead case management activities for these elevated health plan children are documented by the health plan lead case managers, directly into the MOHSAIC Lead Case Management Application. This documentation helps to facilitate greater and timelier communication regarding follow-up of elevated children among the MO HealthNet Managed Care health plans, MHD, DHSS, and the LPHAs. DHSS staff representation on the Central Area Headstart Advisory Committee provides opportunities for education and outreach regarding lead poisoning awareness and prevention activities in the community.

Women, Infant, and Children (WIC) Program

High blood lead levels that affect intelligence, behavior, and the development of children less than six years of age disproportionately affect minority and poor children. The Special Supplemental Nutrition Program for WIC is an important partner in efforts to combat the health risks of lead poisoning. By identifying high-risk children through a screening process during WIC clinic visits, referring children to their primary care provider for testing, or making blood lead testing available on-site, the likelihood that more children will be blood lead tested is improved. This practice also helps to identify elevated children, as well as initiate timely and appropriate follow-up care.

Missouri Department of Economic Development (DED)

The Missouri Department of Economic Development FY 2013-2017 Consolidated Plan produced by DED includes Targeted and Universal Testing Area maps, blood lead testing data by county, and percentage of pre-1950 housing data for the state. The document also contains the Missouri Housing Development Commission's lead-based paint policies and procedures and the HOME Repair (HERO) Program's and HOME Rental Production Program's lead-based paint reference guide.

Missouri Local Public Health Agencies (LPHAs)

Many LPHAs offer blood lead testing within their counties. Some agencies offer free blood lead testing or referrals to providers that offer testing. Most of these agencies have a nurse that assists with case management for children who have elevated lead levels; however, this nurse works in collaboration with the child's primary care physician, parent or guardian, managed health care plan, if the child is enrolled, and environmental risk assessors. DHSS' CLPPP staff collaborates with LPHA staff on elevated lead cases to provide initial and ongoing technical assistance regarding lead case management activities, as well as environmental risk assessment. Lead poisoning education and outreach is often offered at the LPHA level at health fairs, through physician offices, childcare facilities, and upon request. LPHAs utilize lead poisoning prevention campaigns to assist in raising community awareness regarding lead poisoning and its health effects. LPHAs are often a primary contact for parents of children attending childcare facilities where proof of lead testing is required. This is typically a convenient access point for lead testing and opportunity for provision of educational lead information to families. The Childhood Lead Poisoning Prevention Program also provides these agencies with educational materials and technical assistance for other related issues such as the use of the MOHSAIC application, lead case management training, and current program and regulatory requirements. The support and ongoing efforts of the LPHAs regarding childhood lead poisoning and its prevention play a key role in the primary goal to eliminate childhood lead poisoning.

St. Louis City, St. Louis County, and Kansas City are Missouri's three largest metropolitan areas. According to 2016 surveillance data, these three areas combined contain 53 percent of Missouri's children with elevated blood lead levels (320 of 600). These three areas along with Jasper County, Greene County, and Jefferson County have lead poisoning prevention programs that are managed by the LPHAs. To decrease the prevalence of EBLs in these areas, DHSS collaborates with these LPHAs, who provide lead poisoning prevention educational activities, assure case management, and environmental risk assessments.

DHSS collaboration efforts include loaning department-owned XRFs to three LPHAs for lead-related work activities. Jefferson County and Jasper County each have lead poisoning prevention programs where the XRFs are utilized. Madison County has an ongoing project using the XRF to measure lead levels in soil. The department was able to loan an XRF to each of these counties, as they were not able to purchase their own XRFs for their programs. The loaning of the XRFs to these lead programs provides a fast, accurate alternative for those programs to identify lead hazards and promote the remediation of those hazards.

For more information on lead poisoning prevention contact:

Missouri Department of Health and Senior Services
Bureau of Environmental Epidemiology
930 Wildwood Drive
Jefferson City, MO 65109
Phone: (573) 751-6102 or (866) 628-9891

Or visit our website at:
http://health.mo.gov/living/environment/lead/index.php

DATA INFORMATION REQUEST
Missouri-American Water Company
WU-2017-0296

Requested From: Tim Luft
Date Requested: 8/9/17

Information Requested:

Referencing OPC DR-2001, please provide the zip codes for each and every 189 samples and indicate whether or not the line was connected to a residential, commercial, industrial or other unit.

Requested By: Geoff Marke – Office of Public Counsel – geoff.marke@ded.mo.gov

Information Provided:

The samples were taken at premises of residential customers.

Zip Code	Sample 1 - Post Flush	Sample 2 - Still	Sample 3 - Post Flush	Sample 4 - Still
63105	74	72	8	3
63119	9	9	2	
63125	1	1		
63138	1	1		
63144	3	4	1	
64501	10	8		
64503	3	2		
64504	1	1		
64505	5	4		
64506	1	1		
64507	12	9	1	
Grand Total	**120**	**112**	**12**	**3**

Responsible witness: Bruce Aiton