2017

Evaluation of Childhood Exposure to Lead in Community Water Systems in Maine

Nicholas Flavin
University of Southern Maine, Muskie School of Public Service

UNIVERSITY OF SOUTHERN MAINE
Muskie School of Public Service

FINAL

Evaluation of Childhood Exposure to Lead in Community Water Systems in Maine

Master of Public Health Capstone

May 2017

Prepared for:

Muskie School of Public Service Capstone Committee
University of Southern Maine
Portland, Me

Prepared by:

Nicholas Flavin
University of Southern Maine, Muskie School of Public Service

Reviewed By:

Andrew E. Smith, SM, ScD, Maine Center for Disease Control and Prevention
Elise Bolda, PhD, University of Southern Maine, Muskie School of Public Service

This page was intentionally left blank

EXECUTIVE SUMMARY

The concentration of lead in Maine's public drinking water was evaluated from 4,700 first-draw water samples collected from 358 Maine Community Water systems. Samples collected from 2012-2015 were obtained by request from the Maine Center for Disease Control and Prevention's (MeCDC)'s Drinking Water Program. The geometric mean (GM) and geometric standard deviation (GSD) the water samples for Maine were estimated to be 0.82 micrograms lead per liter of water (µg/L) and 6.59 µg/L, respectively, with an arithmetic mean concentration estimated to be 2.20 µg/L (95% CI:1.88-2.53); water-lead concentrations from individual samples ranged from 0.01 (not detected) to 240 µg/L. Water -lead results were further aggregated by County- and Public Health District and were not significantly different from the overall state values ($p>0.05$). The U.S. Environmental Protection Agency's (EPA's) Integrated Exposure Uptake Biokinetic Model (IEUBK model) was used to model potential childhood lead exposure. With the exception of the estimated drinking water concentration of 2.20 µg/L, IEUBK model defaults were applied for all other environmental media(*e.g.*, soil, dust, water, diet, air). Under these conditions, the GM blood lead concentrations for Maine children ages 0-84 months were estimated to be 2.59 µg/dL. This value was lower than the currently established IEUBK model GM blood lead concentration of 2.73 µg/dL. When IEUBK model default values were set to zero and using the drinking water concentration of 2.20 µg/L, the GM blood lead for children was estimated to be 0.094 µg/dL indicating that lead in drinking water contributes to childhood blood lead levels in the absence of all other lead contaminated media. Based on this research, the current IEUBK model default value of 4 µg/L continues to be a conservative value for modeling lead exposure in drinking water; however lowering the background IEUBK model to 2.20 µg/L may be an appropriate background lead concentration for children serviced by Community Water Systems in Maine. Appropriate background concentrations for environmental media specific to Maine for use in the IEUBK model remain unknown, and as such, using the current IEUBK model default values may over predict lead exposure to children in Maine. Further research regarding background environmental lead exposure is needed to better estimate lead exposure to children in Maine.

INTRODUCTION

1.1 Overview and Purpose of Study

Exposure to lead continues to be a threat to public health (U.S. Environmental Protection Agency [EPA], 2013; U.S. Centers for Disease Control and Prevention [CDC], 2012). Lead, a naturally occurring and abundant metal in the earth's crust, has been widely used for industrial purposes for millennia. The primary ways by which a person may be exposed to lead are breathing air contaminated with lead dust particles or by ingesting lead-contaminated dust, soil, water, or food (U.S. Environmental Protection Agency [EPA], 2013, 2000; Agency for Toxic Substance and Disease Registry [ATSDR], 2007). Lead is released from natural sources, such as volcanoes and erosion, but these releases are minor compared to anthropogenic sources of lead (EPA, 2013). Industrial releases of lead have resulted from the mining and smelting of lead ores, burning coal or wood, leaded gasoline, leaded paint, as well as other ores in which lead is a by-product or contaminant. As a result, trace amounts of anthropogenic lead are present in nearly all environmental media that we contact, and these "background" sources of lead contribute to the overall exposure to lead and corresponding body burden. In the United States, lead concentrations in public drinking water are monitored by the EPA's Office of Water as part of the Safe Drinking Water Act and the Lead and Copper Rule (EPA, 2010). State Agencies, including the Maine Center for Disease Control and Protection (MeCDC) Drinking Water Program (DWP), are responsible for reporting the 90th percentile values to EPA, providing insight for regulatory monitoring and triggering potential actions for reducing exposure.

Exposure and physiological uptake of lead can be mathematically modelled or predicted based on the amount of lead in "background" sources of contaminated media such as soil, dust, water, air or dietary items; the better the characterization of lead in these media, the better the exposure predictions. To assess childhood lead exposure, EPA recommends using the Integrated Exposure Uptake Biokinetic (IEUBK) model (EPA, 1994a,b). The IEUBK model either allows public health agencies, such as MeCDC's Environmental and Occupational Health (EOH) Program, to input site-specific media concentrations to predict blood lead concentrations in children ages 0-84 months. In the absence of site-specific concentrations, EPA provides recommended default media concentrations that are intended to be nationally representative of lead concentrations throughout the United States (EPA, 1994a,b). In the case of water, EPA (1994a) recommends a background water lead concentration of 4 µg/L. This value is a central tendency estimate that was based on a 1980s analysis of approximately 1,500 water systems throughout the United States (EPA, 1994a; Marcus, 1989; AWWSC, 1988).

The purpose of this study is twofold: 1) use data collected and publically reported by MeCDC's DWP to estimate lead concentrations in drinking water obtained from Community Water systems, and 2) examine whether the current EPA default background water-lead concentration of 4 µg/L continues to be an appropriate value for modeling background lead concentrations in Maine's drinking water obtained from Community Water systems.

1.2 Blood Lead and Children

It is widely documented in the literature that the human body is vulnerable to lead (EPA, 2013; CDC, 2012). Depending on the chemical and physical characteristics of lead, however, less than 100% of lead entering the body is readily absorbed into systemic circulation (EPA, 2007). This is referred to as the bioavailability of lead, a characteristic critical to understanding how the body absorbs lead, as well as determining the risk of detrimental health effects associated with lead (EPA, 2007). Once absorbed into the body, lead becomes widely distributed and interacts with the body's chemistry, affecting soft tissues (*e.g.*, kidneys, liver, heart), the brain, and eventually accumulating in the teeth and bones over time (EPA, 2013). Though relatively stable when stored in the bones, lead can be released back into the blood stream during osteoporosis, as well as during pregnancies exposing the fetus (ATSDR, 2007).

Young children are at the greatest risk for lead exposure from lead-contaminated water, air, dietary items or by incidentally ingesting lead-contaminated soil and dust. This is primarily due to the increased likelihood of more frequent hand-to-mouth behaviors (as a result of dermal adherence[1]) and increased water consumption relative to adults (Ruby and Lowney, 2012; Siciliano et al., 2009; EPA, 2013). Links between lead in environmental media and blood lead samples have also been statistically correlated from tap water, yard soil and house dust to the hands and blood of children (Deshommes et al. 2016; Triantafyllidou and Edwards, 2011; Gulson et al., 2009). As such, measuring the amount of lead in the bloodstream (typically recorded as micrograms of lead per deciliter of blood [µg/dL]) is widely viewed to be the most convenient index of both lead exposure and relative risk for various health effects (CDC, 2012; ATSDR, 2007). Further, establishing blood lead levels associated with adverse effects is a common and useful approach to assessing lead exposure (EPA, 2013; CDC, 2012).

In 2012, the CDC concluded that approximately 2.5% of U.S. children between the ages of 12 and 60 months, approximately 450,000 children, have blood lead levels greater than 5 micrograms lead per

[1]With the exception intentional soil-eating behaviors.

deciliter blood (>5 µg/dL). CDC (2012) noted that blood lead levels in children, the most sensitive population to the effects of lead, that are > 5 µg/dL may pose a risk for cognitive development and behavioral impairments in children under seven years (*i.e.*, 84 months) of age (CDC, 2012). In response to these findings, CDC (2012) established reference value of 5 µg/dL as the blood lead level that would trigger a public health or medical response (*e.g.*, lead education, environmental investigations, additional medical monitoring, and chelation therapy).

In Maine, all blood-lead screening tests are sent to the State Health and Environmental Testing Laboratory or in-office testing reported directly to the MeCDC Division of Environmental and Occupational Health (EOH), Childhood Lead Poisoning Prevention Program. As of September 2016, MeCDC EOH provides a full lead investigation of a child's home when a venous blood lead test is >5 µg/dL. These investigations include conducting environmental sampling of contaminated media (*e.g.*, soil, dust, tap water), remediating contaminated media, working with families and their providers to ensure blood leads are lowered, providing education, and gathering epidemiological surveillance information for tracking lead exposures in Maine.

1.3 Exposure to Lead in Drinking Water and Federal Regulation

Lead in drinking water is typically a colorless, odorless, and tasteless metal that can go undetected. Concentrations of lead in drinking water primarily derive from the corrosion of lead-containing plumbing (*e.g.*, solder, pipes, service lines, brass faucets) due to changes in the drinking water chemistry, such as pH, water temperature, or water treatments (Ngueta et al. 2014; EPA, 2013). While childhood blood lead levels in Maine are primarily driven by lead contaminated paints and dusts, lead concentrations found in Maine's water supply have historically been due to such corrosion of lead-containing plumbing (*e.g.*, lead solder, brass faucets and fittings) and service lines (MeCDC, 2016). Seasonal variations in the water-lead concentrations have also been observed due to the time that drinking water remains in the pipes, or standing times (Deshommes et al. 2016; Laidlaw et al. 2016). These variations can be more pronounced in homes serviced by lead service lines (Ngueta et al. 2014; Karalekas et al. 1983), prompting regulatory efforts at both the State and Federal level focus on preventing corrosion and releases of lead into the water supply (EPA 2013; EPA, 1991).

Since the passing of the Clean Water and Safe Drinking Water Acts in 1972 and 1974, respectively, the federal regulations have targeted reducing exposure to contaminants in drinking water. Briefly, the Clean Water Drinking Act enacted regulations on dumping specific pollutants into surface waters at a time when approximately two-thirds of the country's water had become unsafe for swimming, fishing, and other recreational activities. The Safe Water Drinking Act (SWDA) extended these

regulations to drinking water at the tap, initially, and by 1996, to all public drinking water sources (*e.g.*, ground water, lakes, rivers, reservoirs), with the exception of private wells that service fewer than 25 individuals (EPA, 2010).

The SDWA authorizes United States Environmental Protection Agency (EPA) to regulate and set health-based standards for public drinking water to protect against both geogenic and anthropogenic sources. As such, EPA is required to establish National Primary Drinking Water Regulations (NPDWRs) for drinking water contaminants that may cause adverse health effects. Contaminants were classified into six categories: micro-organisms, disinfectants, disinfection byproducts, organic chemicals, radionuclides and inorganic chemicals (*e.g.*, lead). Each contaminant has a specific concentration that triggers specific actions, or an 'action level'. For lead, EPA established a maximum contaminant level goal (MCLG) of zero µg/dL (although non-enforceable) and an action level of 15 µg/L for lead in public drinking water systems.[2] EPA continually works with State Agencies to monitor and take necessary actions if drinking water is deemed unsafe for consumption.[3]

In addition to the SDWA, EPA published the Lead and Copper Rule (LCR) in 1991 (EPA, 1991). The LCR specifically targets lead and copper concentrations in public drinking water systems by establishing the action levels (currently 15 µg/L) to be 'generally representative of what could be feasibly achieved at these taps with effective corrosion control treatment' (EPA, 1991). The LCR also established treatment technique standards to reduce corrosion of household plumbing and service lines, as well as erosion of natural lead deposits related to drinking water. This regulation requires State Agencies to monitor (*i.e.*, sample) water concentrations at the tap of locations serviced by specific water systems (as defined by the SWDA), and to report the highest concentrations (90^{th} percentiles) to EPA from each sampling location. Specifically, if lead concentrations are greater than 15 µg/L in more than 10 percent of public tap water samples, the system must take action to control corrosion and inform the public about steps they should take to protect their health.

The MeCDC DWP is tasked with sampling, analyzing and reporting public drinking water data to EPA. These public water system types vary in the number of systems as well as the size of the population served (Table 1). Each type of water system serves a unique population; each type of systems is defined in Table 1.[4] Water data submitted to EPA from each state allows EPA to periodically review the state of drinking water quality throughout the U.S., as well as assess current laboratory methods of analyzing water samples (EPA, 2010).

[2]Additional information is available online: https://www.epa.gov/dwreginfo/lead-and-copper-rule (viewed on February 24, 2017).
[3]Actions include funding for water treatments, water system improvements or public education.
[4]Additional data are available online from the MeCDC DWP: http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/pws/whataPWS.shtml

Table 1. State of Maine Drinking Water Program Population Using Public Water Systems by System Type, Maine 2015.

Public Water System Type	Number of Systems	Population Served (estimate)
Community[a]	375	670,320
Transient non-community[b]	1,133	178,680
Non-transient non-community[c]	368	64,911
Total	1,876	913,911

Source: Maine Environmental Public Health Tracking Program (https://data.mainepublichealth.gov/tracking/home) on February 5, 2017.

[a]Community water supply refers to a public water system that serves year-round residents of a community, subdivision, or mobile home park having at least 15 service connections or an average of at least 25 residents.

[b]Transient, non-community refers to a public water system that regularly supplies water to at least 25 of the same people at least six months per year. Some examples are schools, factories, office buildings, and hospitals which have their own water systems.

[c]Non-transient, non-community refers to a public water system that provides water in a place such as a gas station or campground where people do not remain for long periods of time.

1.4 Modeling Childhood Blood Lead Concentrations

Lead in environmental media has been statistically correlated to blood lead levels in children (Lanphear et al., 2002; Laidlaw et al., 2005; Ruby and Lowney, 2012; Simon et al., 2007). This relationship allows public health agencies, such as MeCDC EOH, to mathematically predict or model potential childhood exposures to lead based on environmental lead concentrations (EPA, 1994a,b); however, assessing actual lead exposure is difficult due to the variability of lead levels in air, water, and food (EPA, 2013; CDC, 2012, Clark et al., 2006). While a number of lead-exposure models exist, EPA (1994a,b) has recommended using the Integrated Exposure Uptake Biokinetic Model (IEUBK model) for predicting childhood blood lead concentrations to support environmental cleanup decisions at U.S. Superfund Sites since 1994.

As shown in Figure 1, the IEUBK model can be divided into three major components: Exposure, Uptake and Biokinetic (EPA, 1994a,b). [5] EPA's Office of Solid Waste and Emergency Response (OSWER) developed the IEUBK model in the 1980s & 1990s by carefully examining how a child's body absorbs and processes specific amounts of lead from different environmental sources at lead-contaminated Superfund Sites. Further, using site-specific environmental media concentrations (*e.g.*, soil, dust, air, diet, and water), the IEUBK model can be used to estimate the uptake of lead from

[5]Additional technical details regarding the IEUBK model are available in EPA (1994b), and can be found online at: https://semspub.epa.gov/work/HQ/176287.pdf

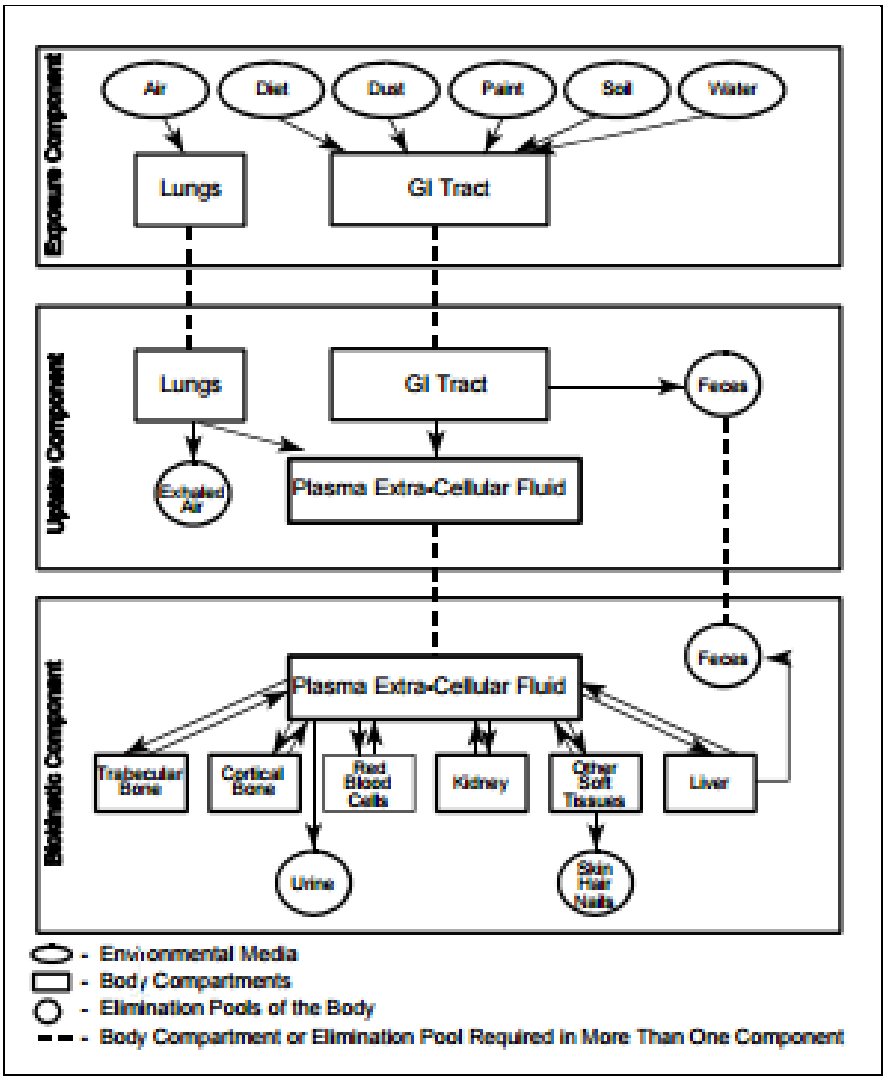

Figure 1. Biological Structure of the IEUBK model in Children (obtained from EPA, 1994b).

specific environmental media, as well as, the GM blood lead concentration for a modeled population of children (ages 0-84 months). At sites where environmental media are not collected, EPA provides approximately 100 input parameters that are initially set to media-specific default values. As mentioned previously, these default values are central tendency estimates intended to represent typical background exposure (*e.g.*, exposure durations, media concentrations) for sites in the United States (EPA, 1994a,b).

With regard to drinking water, the default drinking water consumption rates for children (ages 0-84 months) was obtained from an evaluation of CDC's National Health and Nutritional Examination Survey (CDC, 2005). Default drinking water lead concentrations were estimated based on an analysis by Marcus (1989), and assume that 50% of drinking water consumption is from first-draw water,

15% of fountain water (with a default concentration of 10 µg/L), and the remainder (35%) from flushed tap water (EPA, 1994a,b).

Marcus (1989) used data obtained from a national drinking water study performed by the American Water Works Service Company (AWWC, 1988). Water samples were randomly selected first-draw and flushed samples from 1,484 locations throughout the U.S, servicing approximately 0.1% of American Water System customers. First draw samples were collected after a minimum 6-hour stagnation period and flushed samples were collected after flushing the water for two-to-three minutes. All samples were collected at the tap. The minimum detection for lead during this study was 5 µg/L; concentrations below 5 µg/L were modeled using regression analysis. The study authors reported a geometric mean (GM) lead concentration of 2.65 and 0.21 µg/L for first draw and flushed samples, respectively. Based on these estimates, EPA implemented a weighted default background water lead concentration of 4 µg/L in the IEUBK model (EPA, 1994a,b).

METHODS

2.1 Literature Search

A literature search was conducted. PubMed, TOXLINE, and the University of Southern Maine's One Search were searched using various strategies that incorporated the search terms: *childhood lead exposure, drinking water policy, lead in drinking water, lead risk assessments,* and *modeling lead exposure*. Retrieved documents were reviewed, and systematic bias was evaluated. In addition, reports and analyses performed by CDC, EPA, MeCDC, National Institute of Health, and the World Health Organization were reviewed.

2.2 Institutional Review

The University of Southern Maine's Office of Research Integrity and Outreach reviewed and approved this research in March 2017.

2.3 Maine's Community Water Systems: General Characteristics

A total of 4,700 water samples were obtained from MeCDC that were sampled from 358 Community water systems in Maine from 2012 to 2015.[6] A minimum of seven and 24 sampling locations were collected from each county and public health district, respectively, and included drinking water sampled from both residential and commercial buildings. Sampling dates (2012-2015) were selected based on the most recent data available and the availability of the data electronically. Community Water systems were selected for this analysis because it was estimated approximately 670,000 year-round residents, or roughly half of all Maine residents in 2015 were serviced by these public water systems (Table 1).[7] This is an important distinction as the IEUBK model was not designed to assess short-term or infrequent exposures. As such, a continuous, approximately 90 days, is required before children reach a steady blood level (EPA, 1994a). Additional transient, non-community drinking water data (schools, factories, hospitals, etc.) are currently beyond the scope of this analysis, but may have provided additional insight to lead exposure due to the length of exposure (likely greater than 90 days). Non-transient data (*e.g.*, campgrounds) were not considered due to the infrequent exposure scenario.

All drinking water samples were first-draw samples taken from cold water taps that were used for consumption. All public water systems are required to select pre-approved locations, regularly sample and submit test results to MeCDC DWP. Sampling locations were not randomly selected by MeCDC DWP. Requested data included the water district ID, system name, system type, principal city served, population served, collection date, laboratory providing the results, and measured water lead concentrations (mg/L). Data were not requested on the age of the water district's infrastructure (*e.g.*, pipes, mains) or of the specific sampling location (*e.g.*, kitchen or bathroom tap), whether solder or brass fixtures were present, or a whether a thorough water chemistry analysis were conducted (*e.g.*, pH). Zip codes were used to assign specific water systems to applicable counties and public health districts for mapping purposes. It was assumed that the water systems serviced the zip codes associated with the sampling location (*i.e.*, water systems that serviced more than one zip code, county or public health district). Five-digit Federal Information Processing Standard (FIPS) codes obtained from the U.S. Census Bureau were used to map county- and public health district data.[8] Additional details regarding each public health district (*e.g.*, towns, population density) were provided by MeCDC's Division of Public Health Operations.

[6]Community water systems are defined as serving at least 25 year-round residents or at least 15 service connections used by year-round residents (EPA, 1991)
[7]Estimates for total Maine census are based 2010 US Census data available online at: http://www2.census.gov/geo/maps/dc10_thematic/2010_Profile/2010_Profile_Map_Maine.pdf
[8]2010 FIPS data were downloaded from https://www.census.gov/geo/reference/codes/cou.html on February 1, 2017.

First-draw samples consisted of collecting the initial volume of water after a minimum stagnation time of six hours following required by the Lead and Copper Rule EPA (1991). Total lead concentrations were analyzed according to the EPA 200.8 method by EPA accredited laboratories certified by the Maine Department of Human Services (MeCDC, 2010). Method detection limits for each laboratory were obtained from MeCDC's DWP. It was assumed that all data were reliable and accurate. Lead concentrations were converted to µg/L for entry into the IEUBK model. Detection limits reported by laboratories ranged from 0.02 and 0.5 µg/L. In cases where water sample data were reported below the detection limit (*i.e.*, water concentration reported as zero µg/L), concentrations were converted to 0.01 µg/L allowing for logarithmic analysis of the data.

2.4 Estimating Exposure using the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK model)

The IEUBK model (version 1.1, build 11) was used in this study to estimate lead uptake from water, total lead uptake, and the GM blood lead concentration for children ages 0-84 months.[9] Since only first-draw water lead concentrations were available for Community Water systems, mean first-draw water lead concentrations derived for each county, public health district, and for the state and were entered in the IEUBK model as 'alternate water values' (see Figure 2), replacing the current IEUBK model default value of 4 µg/L. Other default drinking water concentrations (*e.g.*, flushed- and fountain- water concentrations of 1 and 10 µg/L, respectively), as well as the percent of total consumed as first-draw (50%) were not adjusted for this analysis. IEUBK model default lead concentrations for other environmental media are provided in Tables 2 and 3. GM blood lead concentrations for children ages 0-84 months and the percentage of children exceeding MeCDC's level of concern (5 µg/dL) were calculated. Total lead uptake (all environmental media including water) and lead uptake from only water were estimated by IEUBK model age group. Exposures were estimated by county, public health district, and for an overall State exposure.

[9]IEUBK version 1.1, build 11 was downloaded from https://www.epa.gov/superfund/lead-superfund-sites-software-and-users-manuals#integrated on December 5, 2016.

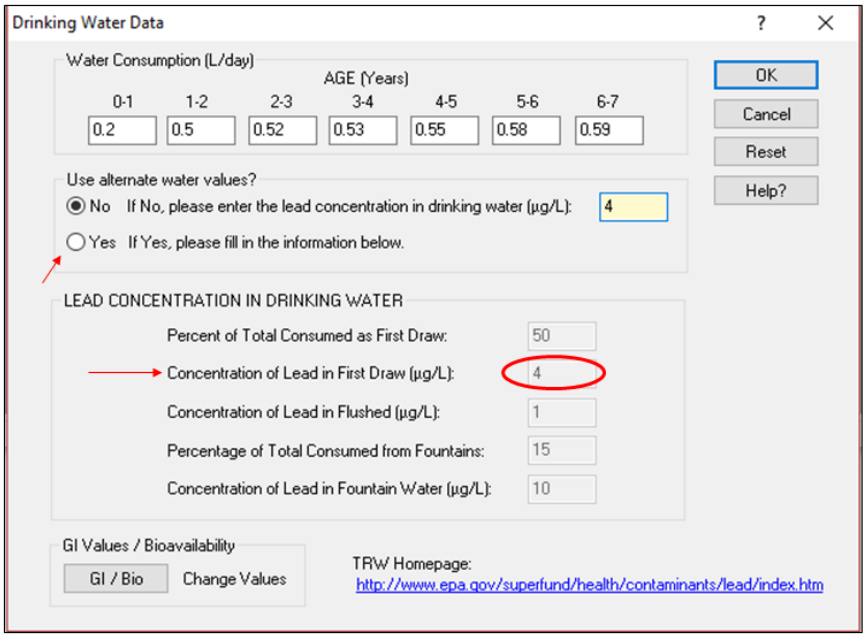

Figure 2. IEUBK model (version 1.1, build 11) drinking water input window (default values shown). Estimated first draw concentrations were entered in the 'Concentration of Lead in First Draw (µg/L)' input window under after selecting 'Yes' under the 'Use alternate water values?' (highlighted). All other IEUBK model defaults remained the same.

Table 2. Media concentrations used in the IEUBK model (version 1.1, build 11).

Media	Concentration	Absorption Fraction
Air (µg/m^3)	Outdoor: 0.1 Indoor: 0.03	32[a]
Water (µg/L)	Variable	50
Soil (µg/g)	200	30
Dust (µg/g)	150	30

Table 3. Age-specific values used in the IEUBK model.

Media	IEUBK Age Ranges (months)						
	0-12	12-24	24-36	36-48	48-60	60-72	72-84
Air[a]							
Time Spent Outdoors (hr/day)	1	2	3	4	4	4	4
Ventilation Rate (m^3/day)	2	3	5	5	5	7	7
Dietary Lead Intake (µg/day)[b]	2.26	1.96	2.13	2.04	1.95	2.05	2.22
Water Consumption (L/day)[c]	0.2	0.5	0.52	0.53	0.55	0.58	0.59
Amount of Soil/Dust ingested (g/day)[d]	0.085	0.135	0.135	0.135	0.100	0.090	0.085

[a]Values based on values reported by EPA (1994b,1989), Altman and Dittmer (1972, 1971), ICRP (1975), Nutritional Foundation (1982), and Phalen et al. (1985).
[b]Values based on an analysis of the U.S.Food and Drug Administration (2006), CDC (1997) and Pennington (1983).
[c]Values obtained from the EPA (1997).
[d]Values obtained from EPA (1999).

2.5 Statistical Analysis

Summary statistics (*e.g.*, mean, standard deviations, GM, percentiles) were calculated for each water system across the four year time period using Equations 1 and 2:

Eq 1. Estimating mean water district lead concentrations across all years.

$$\boldsymbol{X = \frac{\mathbf{Sum(Water\ District\ Lead\ Concentrations)}}{\mathbf{Number\ of\ Samples\ Collected\ in\ Water\ District}}}$$

Eq 2. Estimating mean lead concentrations by County, Public Health District, and the State across all years.

$$\boldsymbol{Y = \frac{\mathbf{Sum(Mean\ Water\ District\ Concentrations)}}{\mathbf{Number\ of\ Water\ Districts}}}$$

Unpaired t-tests were performed on estimated mean water concentrations to compare differences between counties, public health districts, and at the state level. Results were considered significant with a p-value ≤ 0.05. Outliers in the drinking water database were identified using the raw, non-aggregated water sampling data, and were defined as any water samples that were beyond one and a half times the interquartile range (IQR).

Summary statistics were calculated using both SAS (version 9.4, SAS Institute Inc., Cary, NC) and Alteryx (version 10, Alteryx Inc., Irving CA) software. Tableau software (version 9.2) was used to graphically display the data, including the geospatial data using water-supplier-specific zip codes and FIPS codes. FIPS codes were used to identify counties, and were blended together to form Public Health Districts. Population-weighted estimates were not performed due to the limitations of the IEUBK model (*i.e.,* current default environmental media [*e.g.*, soil, dust, air, diet] concentrations are not population-weighted).

3.0 RESULTS

3.1 Predicting Childhood Blood based on the current EPA Drinking Water Action Level of 15 µg/L.

As shown in Table 4, current EPA values for the IEUBK default and the action level for drinking water (4 and 15 µg/L, respectively) were evaluated in the IEUBK model using IEUBK model default values for soil, dust, air, and diet. In addition, the IEUBK model was run with the drinking water concentration set to zero (Table 4). Compared to the current EPA drinking water action level of 15 µg/L for lead and the IEUBK model default values for all other media, the predicted blood GM blood lead and predicted number of children exceeding 5 µg/dL increased approximately 114% and 162%, respectively (Table 4). In addition, using the current EPA action level for drinking water and the current IEUBK model defaults, it is estimated that approximately 16% of children (ages 0-84) would have blood lead concentrations >5 µg/dL.

As shown in Table 4, without the contribution of drinking water, GM blood lead concentrations ranged from 1.6-3.1 µg/dL. This value is slightly less than the estimated blood lead concentrations predicted from community water systems in Maine, or by using the IEUBK model default value of 4 µg/L. Further, water contributed to between 7-33% of the total lead uptake, and water contributed to a higher percentage of total lead uptake as children aged. As children aged, however, the GM blood lead concentrations decreased. This supports the theory that other sources of lead, namely soil or dust, contribute most to total lead uptake at younger ages in areas of relatively low lead concentrations in drinking water. This is also supported by increased hand-to-mouth activity in the younger age groups leading to incidental ingestion of fine soil and dust particles (EPA, 2013).

3.2 State Results

Summary statistics for first-draw water samples collected across all years are presented in Table 5. The number of samples collected from each water system ranged from 1-156 over the four year time period (see Attachment 1). As shown in Table 5, water concentrations ranged from 0.01 (non-detects) to 240 µg/L. Arithmetic mean lead concentrations were estimated to be 2.20±3.15 µg/L (95%CI: 1.88-2.53) with the GM water lead concentrations (± GSD) were estimated to be 0.82 ±6.59. The current IEUBK model default value of 4 µg/L falls within these ranges, and was not significantly different from these estimates ($p<0.05$).

Table 4. Summary of estimated lead uptake from water, calculated total lead uptake, and geometric mean blood lead concentration (µg/dL) for children ages 0-84 months, by IEUBK model age groups (2012-2015).

Parameter	Mean First-Draw Value (µg/L)[a]	Alternate Value (µg/L)[b]	Weighted Drinking Water Conc. (µg/L)[b]	Measure	IEUBK Model Age Range (months)							GM (0-84)	P5
					6-12	12-24	24-36	36-48	48-60	60-72	72-84		
IEUBK Model Default	0	0	0	Lead Uptake from Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.42	6.17
				Calculated Total Lead Uptake	5.23	7.50	7.67	7.70	6.02	5.63	5.47		
				Geometric Mean Blood Lead	2.80	3.10	2.90	2.70	2.20	1.80	1.60		
IEUBK Model Default	4	4	4	Lead Uptake from Water	0.38	0.93	0.98	1.00	1.06	1.12	1.15	2.73	9.89
				Calculated Total Lead Uptake	5.59	8.37	8.59	8.65	7.05	6.72	6.59		
				Geometric mean Blood Lead	3.00	3.50	3.20	3.00	2.50	2.10	1.90		
EPA Drinking Water Action Level	15	15	9.35	Lead Uptake from Water	0.87	2.15	2.26	2.33	2.46	2.61	2.66	3.13	15.98
				Calculated Total Lead Uptake	6.06	9.51	9.81	9.91	8.40	8.17	8.07		
				Geometric Mean Blood Lead	3.30	3.90	3.70	3.50	3.00	2.60	2.30		

GM (0-84): Geometric mean blood lead concentration for children ages 0-84 months; P5: Percent of children predicted with a GM blood lead concentration greater than 5µg/dL

[a]Mean first-draw lead concentration (µg/L).

[b]Value entered into the 'Concentration of Lead in First Draw (µg/L):' input window rounded to 0.1.

[c]Weighted first-draw, flushed and fountain water concentration that is used to estimate drinking water exposure in the IEUBK model. For this analysis, IEUBK model default values for lead in flushed (1 µg/L) and water fountains (10 µg/L) were used.

The estimated GM blood lead concentrations (µg/dL) for specific age groups were similar between the current IEUBK model default value of 4 µg/L and the mean water values estimated for Maine Community Water systems (2.20 µg/L; p>0.05) (Table 6). The modeled results indicate that potentially between 9% of Maine children have blood lead levels >5 µg/dL with blood lead concentrations ranging from 1.8-3.4 µg/dL depending on the age group. Children ages 12-24 month-old children had the highest predicted blood lead concentration and the second lowest lead uptake from water. When IEUBK model default values were set to zero and using the drinking water concentration of 2.20 µg/L, the GM blood lead for children was estimated to be 0.094 µg/dL.

Table 5. Summary of lead concentrations in Maine's Community Drinking Water Systems (2012-2015).

State	Samples (n)	Water Districts (n)	Mean	StDev	SEM	Min	Max	LCL	UCL	Median	90th	95th	GM	GSD
Maine	4700	358	2.20	3.15	0.17	0.01	32.2	1.88	2.53	1.33	5.06	7.25	0.82	6.59

Samples (n): Number of samples collected; Water Districts (n): Number of Water Districts sampled; StDev: Standard Deviation; SEM: Standard Error of the Mean; LCL: 95% Lower confidence limit; UCL: 95% Upper confidence limit; Min: Minimum lead concentration reported; Max: Maximum lead concentrations reported; Median: 50^{th} percentile; 90^{th}: 90^{th} percentile; 95^{th}: 95^{th} percentile; GM: Geometric mean; GSD: Geometric standard deviation

Table 6. Summary of estimated lead uptake from water, calculated total lead uptake, and geometric mean blood lead concentration (µg/dL) for children ages 0-84 months, by IEUBK model age groups (2012-2015).

Mean First-Draw Value (µg/L)[a]	Weighted Drinking Water Conc. (µg/L)[b]	Measure	IEUBK Model Age Range (months)							GM (0-84)	P5
			6-12	12-24	24-36	36-48	48-60	60-72	72-84		
2.20	2.90	Lead Uptake from Water	0.28	0.69	0.72	0.74	0.78	0.83	0.85	2.65	8.83
		Calculated Total Lead Uptake	5.49	8.14	8.35	8.40	6.78	6.43	6.30		
		Geometric Mean Blood Lead	3.00	3.40	3.10	3.00	2.40	2.10	1.80		

GM (0-84): Geometric mean blood lead concentration for children ages 0-84 months; P5: Percent of children predicted with a GM blood lead concentration greater than 5µg/dL.

[a]Value entered into the 'Concentration of Lead in First Draw (µg/L):' input window rounded to 0.1.

[bc]Weighted first-draw, flushed and fountain water concentration that is used to estimate drinking water exposure in the IEUBK model. For this analysis, IEUBK model default values for lead in flushed (1 µg/L) and water fountains (10 µg/L) were used.

3.2 Public Health Districts

Summary statistics for first-draw drinking water samples collected across each public health district are presented in Table 7. Between 24-51 and water districts and samples were sampled in each public health district; these included a total of 316-838 water samples collected.

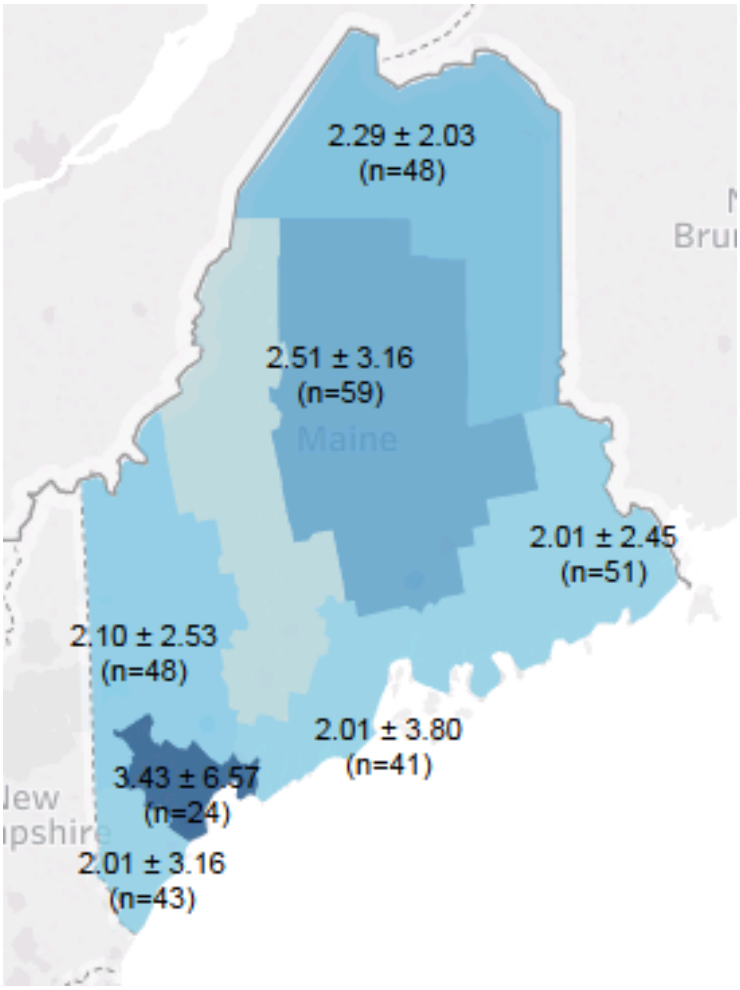

Figure 5. Mean (±SD) water lead concentrations (µg/L) by Public Health District from Community Water Systems in Maine. 'n' refers to the number of water districts sampled.

Arithmetic mean lead concentrations ranged from 1.76-3.43 µg/L (Figure 5, Table 7). The highest mean concentrations were observed in Cumberland (3.43±6.57, 95%CI:0.80-6.06); the lowest were observed in York, Midcoast, and Downeast (2.01 µg/L). All mean concentrations were below the IEUBK model default first-draw drinking water value of 4 µg/L.

Relatively low GM water lead concentrations (<2 µg/L) were observed for all public health districts using the water system analysis (Table 7). Values ranged from 0.52-1.47 µg/L with corresponding GSD ranging from 3.34-9.47, suggesting large variability in the distribution of GM lead concentrations. As shown in Table 7, the Aroostook and Penquis districts had the most samples collected (838 and 831, respectively) and the highest GM lead concentrations observed for aggregated data by water district (1.47 and 1.23 µg/L, respectively).

Overall, mean and GM values did not differ significantly when compared between districts (Figure 6), as well as compare to the overall state value ($p>0.05$), suggesting that at the Public Health District level, lead concentrations in the selected Community Water systems were similarly distributed.

Table 7. Summary of lead concentrations (µg/L) in Maine's Community Drinking Water Systems, by Public Health District (2012-2015).

Public Health District	Samples (n)	Districts (n)	Mean	StDev	SEM	LCL	UCL	Min	Max	Median	25th	75th	90th	95th	GM	GSD
Aroostook	838	48	2.29	2.03	0.29	1.71	2.86	0.01	9.4	1.79	1.06	2.79	3.98	6.93	1.47	3.34
Central	567	44	1.76	1.73	0.26	1.25	2.27	0.01	7.8	1.40	0.28	2.58	3.84	4.97	0.66	7.42
Cumberland	316	24	3.43	6.57	1.34	0.80	6.06	0.01	32.2	1.48	0.48	2.99	6.89	8.31	0.86	8.96
Downeast	645	51	2.01	2.45	0.34	1.34	2.68	0.01	15.5	1.30	0.62	2.65	4.40	5.09	1.00	4.63
Midcoast	466	41	2.01	3.80	0.59	0.85	3.18	0.01	23.7	1.11	0.30	2.32	4.55	5.06	0.52	9.00
Penquis	831	59	2.51	3.16	0.41	1.71	3.32	0.01	19.8	1.40	0.76	3.08	6.17	7.39	1.23	4.60
Western	506	48	2.10	2.53	0.37	1.38	2.81	0.01	10.0	1.08	0.22	2.91	5.65	7.24	0.57	9.47
York	511	43	2.01	3.16	0.48	1.07	2.96	0.01	16.1	1.01	0.33	2.30	3.43	9.13	0.57	8.27

Samples (n): Number of samples collected; Water Districts (n): Number of Water Districts sampled; StDev: Standard Deviation; SEM: Standard Error of the Mean; LCL: 95% Lower confidence limit; UCL: 95% Upper confidence limit; Min: Minimum lead concentration reported; Max: Maximum lead concentrations reported; Median: 50^{th} percentile; 25^{th}: 25^{th} percentile; 75^{th}: 75^{th} percentile; 90^{th}: 90^{th} percentile; 95^{th}: 95^{th} percentile; GM: Geometric mean; GSD: Geometric standard deviation

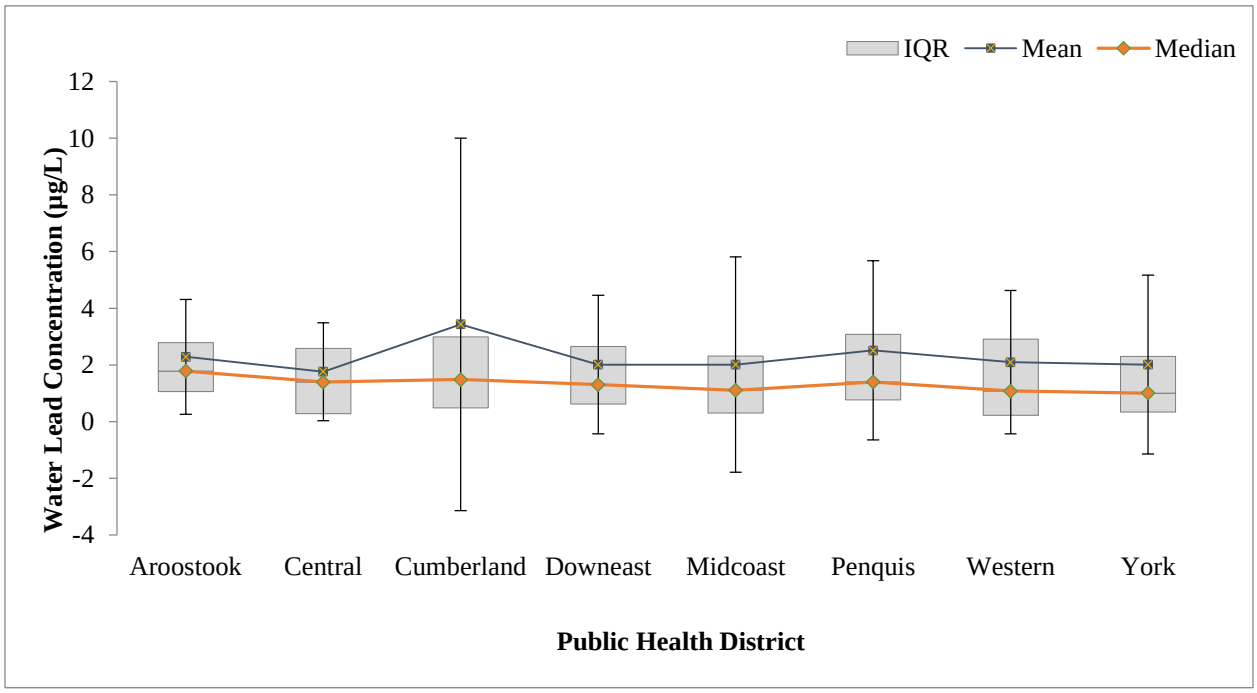

Figure 6. Summary of mean water lead concentrations by Public Health District from Community Water Systems in Maine. Box values represent the interquartile range (IQR); whiskers represent standard deviation.

Weighted drinking water concentrations ranged from 2.73-3.65 µg/L (Table 8). GM blood lead concentrations for children ages 0-84 months ranged from 2.64-2.70 µg/dL (Figure 7, Table 8) which was lower that than the current IEUBK model default prediction of 2.73 µg/dL. Cumberland public health district had the highest GM blood lead at 2.70 µg/dL, though it was not significantly different than the other public health districts. The percentage of children with blood lead concentrations > 5 µg/dL was estimated to be approximately 9% across all districts.

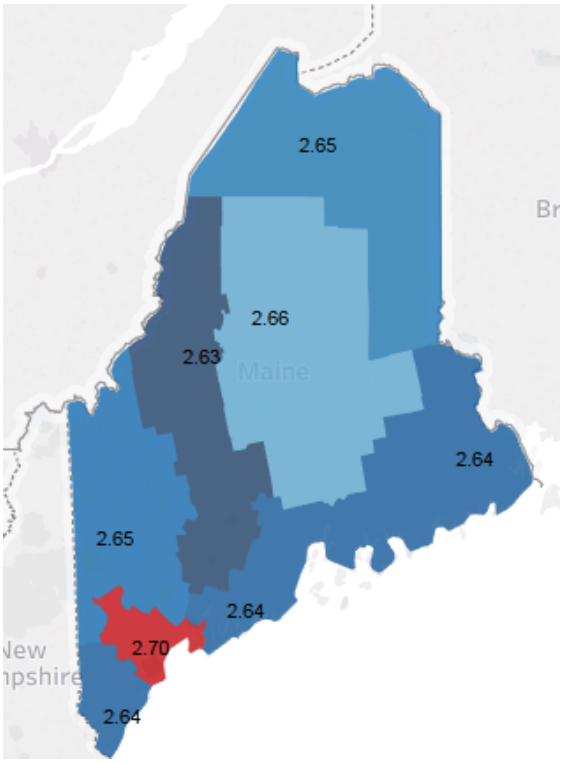

Figure 7. Geometric mean blood lead concentrations (µg/dL) for children ages 0-84 months concentrations (µg/L) by Public Health District.

Table 8. Summary of estimated lead uptake from water, calculated total lead uptake, and geometric mean blood lead concentration (µg/dL) for children ages 0-84 months, by IEUBK model age group and public health district (2012-2015).

Public Health District	Mean First-Draw Value (µg/L)[a]	Alternate Value (µg/L)[b]	Drinking Water Conc. (µg/L)[c]	Measure	IEUBK Model Age Range (months)							GM (0-84)	P5
					6-12	12-24	24-36	36-48	48-60	60-72	72-84		
Aroostook	2.29	2.3	2.95	Lead Uptake from Water	0.28	0.69	0.72	0.74	0.78	0.83	0.85	2.65	8.83
				Calculated Total Lead Uptake	5.49	8.14	8.35	8.40	6.78	6.43	6.30		
				Geometric Mean Blood Lead	3.00	3.40	3.10	3.00	2.40	2.10	1.80		
Central	1.76	1.8	2.73	Lead Uptake from Water	0.26	0.64	0.67	0.69	0.73	0.77	0.79	2.63	8.64
				Calculated Total Lead Uptake	5.48	8.10	8.31	8.35	6.73	6.38	6.24		
				Geometric Mean Blood Lead	3.00	3.40	3.10	2.90	2.40	2.00	1.80		
Cumberland	3.43	3.4	3.55	Lead Uptake from Water	0.33	0.83	0.87	0.89	0.94	1.00	1.02	2.70	9.43
				Calculated Total Lead Uptake	5.55	8.27	8.49	8.54	6.93	6.60	6.47		
				Geometric Mean Blood Lead	3.00	3.40	3.20	3.00	2.50	2.10	1.90		
Downeast	2.01	2.0	2.85	Lead Uptake from Water	0.27	0.66	0.70	0.72	0.76	0.80	0.82	2.64	8.74
				Calculated Total Lead Uptake	5.48	8.12	8.33	8.38	6.75	6.41	6.27		
				Geometric Mean Blood Lead	3.00	3.40	3.10	2.90	2.40	2.00	1.80		
Midcoast	2.01	2.0	2.85	Lead Uptake from Water	0.27	0.66	0.70	0.72	0.76	0.80	0.82	2.64	8.74
				Calculated Total Lead Uptake	5.48	8.12	8.33	8.38	6.75	6.41	6.27		
				Geometric Mean Blood Lead	3.00	3.40	3.10	2.90	2.40	2.00	1.80		
Penquis	2.51	2.5	3.1	Lead Uptake from Water	0.29	0.72	0.76	0.78	0.82	0.87	0.89	2.66	8.98
				Calculated Total Lead Uptake	5.51	8.17	8.39	8.44	6.82	6.47	6.34		
				Geometric Mean Blood Lead	3.00	3.40	3.10	3.00	2.40	2.10	1.80		
Western	2.1	2.1	2.9	Lead Uptake from Water	0.27	0.68	0.71	0.73	0.77	0.82	0.83	2.65	8.79
				Calculated Total Lead Uptake	5.49	8.13	8.34	8.39	6.76	6.42	6.29		
				Geometric Mean Blood Lead	3.00	3.40	3.10	2.90	2.40	2.10	1.80		
York	2.01	2.0	2.85	Lead Uptake from Water	0.27	0.66	0.70	0.72	0.76	0.80	0.82	2.64	8.74

Table 8. Summary of estimated lead uptake from water, calculated total lead uptake, and geometric mean blood lead concentration (µg/dL) for children ages 0-84 months, by IEUBK model age group and public health district (2012-2015).

Public Health District	Mean First-Draw Value (µg/L)[a]	Alternate Value (µg/L)[b]	Drinking Water Conc. (µg/L)[c]	Measure	IEUBK Model Age Range (months)							GM (0-84)	P5
					6-12	12-24	24-36	36-48	48-60	60-72	72-84		
				Calculated Total Lead Uptake	5.48	8.12	8.33	8.38	6.75	6.41	6.27		
				Geometric Mean Blood Lead	3.00	3.40	3.10	2.90	2.40	2.00	1.80		

GM (0-84): Geometric mean blood lead concentration for children ages 0-84 months; P5: Percent of children predicted with a GM blood lead concentration greater than 5µg/dL

[a]Mean first-draw lead concentration (µg/L).

[b]Value entered into the 'Concentration of Lead in First Draw (µg/L); input window rounded to 0.1.

[c]Weighted first-draw, flushed and fountain water concentration that is used to estimate drinking water exposure in the IEUBK model. For this analysis, IEUBK model default values for lead in flushed (1 µg/L) and water fountains (10 µg/L) were used.

3.3 County

Summary statistics for water samples collected across each county are presented in Table 9. Arithmetic mean lead concentrations for water samples were estimated to range between 0.93-3.43 µg/L. The highest mean concentrations were observed in Cumberland (3.43±6.57, 95%CI:0.80-6.06); the lowest was observed in Knox (0.93±1.11, 95%CI:0.11-1.75). Aroostook and Penobscot had the most samples collected (838 and 696, respectively) with the highest GM lead concentrations observed for water systems in Piscataquis (1.71 µg/L).

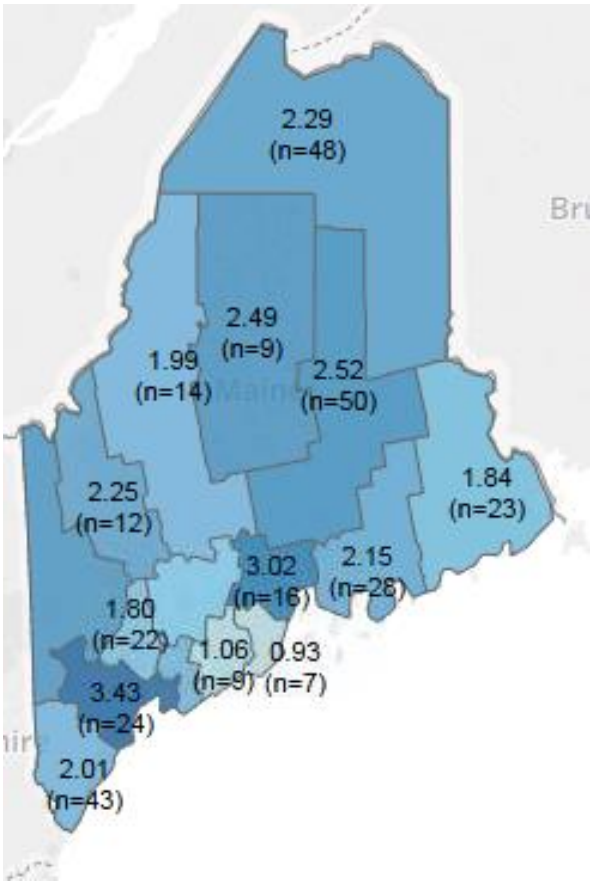

Figure 8. Mean (±SD) water lead concentrations (µg/L) by County from Community Water Systems in Maine. 'n' refers to the number of water districts sampled.

A total of 125 samples were greater than the action level of 15 µg/L collected from 57 different water systems between 2012-2015. Penobscot and Aroostook Counties had the most samples greater than 15 µg/L in this time period (Table 6). All mean drinking water lead concentrations were below the IEUBK model default first-draw drinking water value of 4 µg/L. Overall, the distribution of lead in drinking water did not vary significantly across counties (p>0.0.5, Figure 9).

Relatively low GM water lead concentrations (<2 µg/L) were observed for all counties using the water system analysis. Values ranged from 0.28 (Androscoggin) -1.71 (Piscataquis) µg/L with corresponding GSD ranging from 1.83-14.5, suggesting large variability in the distribution of mean lead concentrations. Of note, Lincoln had one of the smallest GM water lead concentrations and GSD (0.93±1.83 µg/L) of the nine water systems sampled.

Table 9. Summary of lead concentrations (µg/L) in Maine's Community Drinking Water Systems, by County (2012-2015).

County	Samples (n)	Districts (n)	Mean	StDev	SEM	LCL	UCL	Min	Max	Median	25th	75th	90th	95th	GM	GSD
Androscoggin	231	22	1.80	2.90	0.62	0.58	3.01	0.01	10.0	0.36	0.027	2.14	8.88	4.96	0.28	11.7
Aroostook	838	48	2.29	2.03	0.29	1.71	2.86	0.01	9.4	1.79	1.06	2.79	6.93	3.98	1.47	3.34
Cumberland	316	24	3.43	6.57	1.34	0.80	6.06	0.01	32.2	1.48	0.48	2.99	8.31	6.89	0.86	8.96
Franklin	120	12	2.25	2.03	0.59	1.11	3.40	0.23	6.8	1.37	0.82	2.96	5.85	4.96	1.53	2.62
Hancock	394	28	2.15	2.92	0.55	1.07	3.23	0.01	15.5	1.23	0.65	2.61	4.51	3.86	1.14	3.87
Kennebec	391	30	1.65	1.84	0.34	0.99	2.31	0.01	7.8	1.16	0.26	2.50	4.80	3.51	0.51	8.59
Knox	81	7	0.93	1.11	0.42	0.11	1.75	0.01	2.4	0.30	0.01	1.88	2.39	2.36	0.16	14.5
Lincoln	95	9	1.06	0.48	0.16	0.74	1.37	0.28	1.7	1.19	0.85	1.25	1.68	1.62	0.93	1.83
Oxford	155	14	2.43	2.40	0.64	1.17	3.69	0.01	7.5	1.71	0.87	3.19	6.77	6.08	0.75	11.3
Penobscot	696	50	2.52	3.33	0.47	1.60	3.44	0.01	19.8	1.39	0.76	2.83	7.60	6.09	1.15	4.96
Piscataquis	135	9	2.49	2.15	0.72	1.08	3.90	0.27	7.1	1.78	1.10	3.32	5.94	4.77	1.71	2.73
Sagadahoc	105	9	2.02	2.12	0.71	0.64	3.40	0.01	5.5	1.28	0.43	3.33	5.35	5.15	0.75	7.65
Somerset	176	14	1.99	1.51	0.40	1.20	2.79	0.01	5.6	1.64	1.17	2.72	4.56	3.83	1.17	4.79
Waldo	185	16	3.02	5.78	1.44	0.18	5.85	0.01	23.7	0.87	0.23	3.46	9.66	4.77	0.50	13.2
Washington	251	23	1.84	1.75	0.36	1.13	2.55	0.01	5.4	1.30	0.48	2.43	5.22	4.83	0.85	5.71
York	511	43	2.01	3.16	0.48	1.07	2.96	0.01	16.1	1.01	0.33	2.30	9.13	3.43	0.57	8.27

Samples (n): Number of samples collected; Water Districts (n): Number of Water Districts sampled; StDev: Standard Deviation; SEM: Standard Error of the Mean; LCL: 95% Lower confidence limit; UCL: 95% Upper confidence limit; Min: Minimum lead concentration reported; Max: Maximum lead concentrations reported; Median: 50^{th} percentile; 25^{th}: 25^{th} percentile; 75^{th}: 75^{th} percentile; 90^{th}: 90^{th} percentile; 95^{th}: 95^{th} percentile; GM: Geometric mean; GSD: Geometric standard deviation

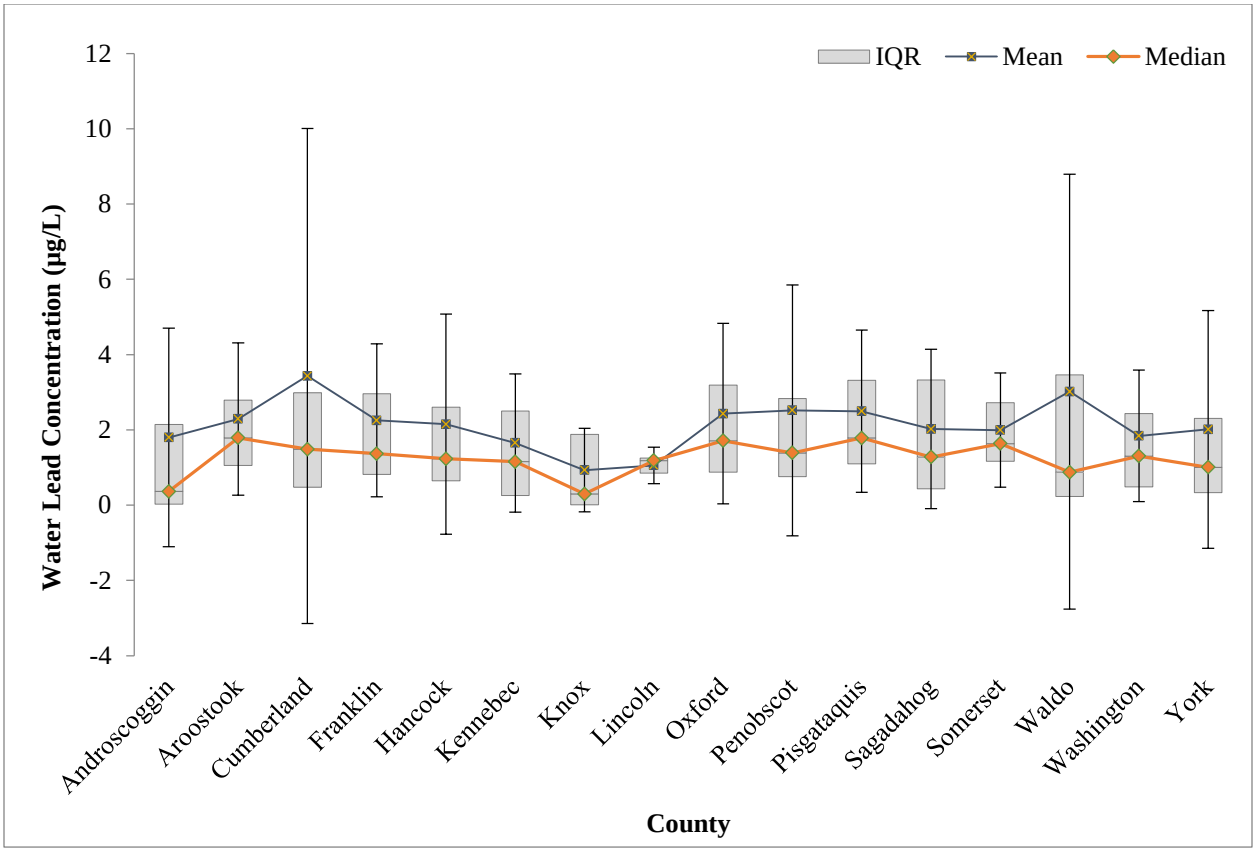

Figure 9. Summary of mean water lead concentrations by County from Community Water Systems in Maine. Box values represent the interquartile range (IQR); whiskers represent standard deviations.

GM blood lead concentrations for children ages 0-84 months ranged from 2.60-2.70 µg/dL (Figure 10, Table 10). These values were all lower than the current IEUBK model default prediction of 2.73 µg/dL. GM blood lead concentrations were greatest in Cumberland being the highest (2.70 µg/dL), though not significantly different from the other counties (p>0.05). Modeled lead uptake from water, total lead uptake and GM blood lead concentrations were not significantly different by age range (p>0.05).

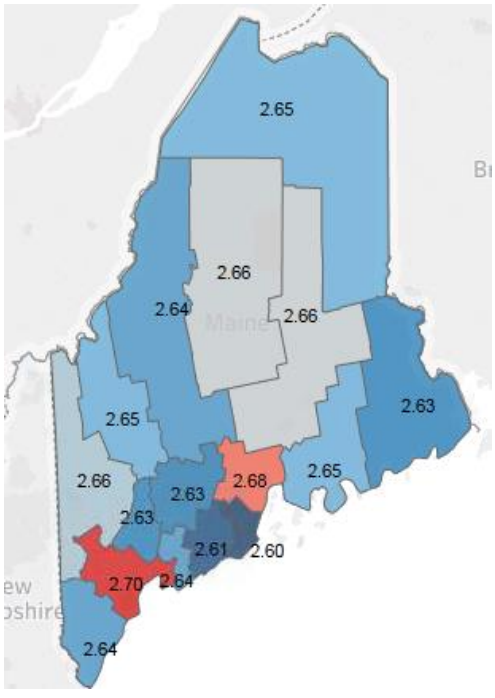

Figure 10. Geometric mean blood lead concentrations (µg/dL) for children ages 0-84 months concentrations (µg/L) by County.

Table 10. Summary of estimated lead uptake from water, calculated total lead uptake, and geometric mean blood lead concentration (µg/dL) for children ages 0-84 months, by IEUBK model age group and County (2012-2015).

County	Mean First-Draw Value (µg/L)[a]	Alternate Value (µg/L)[b]	Drinking Water Conc. (µg/L)[c]	Measure	IEUBK Model Age Range (months)							GM (0-84)	P5
					6-12	12-24	24-36	36-48	48-60	60-72	72-84		
Androscoggin	1.8	1.8	2.75	Lead Uptake from Water	0.26	0.64	0.67	0.69	0.73	0.77	0.79	2.63	8.64
				Calculated Total Lead Uptake	5.48	8.10	8.31	8.35	6.73	6.38	6.24		
				Geometric Mean Blood Lead	3.00	3.40	3.10	2.90	2.40	2.00	1.80		
Aroostook	2.29	2.3	2.95	Lead Uptake from Water	0.28	0.69	0.72	0.74	0.78	0.83	0.85	2.65	8.83
				Calculated Total Lead Uptake	5.49	8.14	8.35	8.40	6.78	6.43	6.30		
				Geometric Mean Blood Lead	3.00	3.40	3.10	3.00	2.40	2.10	1.80		
Cumberland	3.43	3.4	3.55	Lead Uptake from Water	0.33	0.83	0.87	0.89	0.94	1.00	1.02	2.70	9.43
				Calculated Total Lead Uptake	5.55	8.27	8.49	8.54	6.93	6.60	6.47		
				Geometric Mean Blood Lead	3.00	3.40	3.20	3.00	2.50	2.10	1.90		
Franklin	2.25	2.3	2.95	Lead Uptake from Water	0.28	0.69	0.72	0.74	0.78	0.83	0.85	2.65	8.83
				Calculated Total Lead Uptake	5.49	8.14	8.35	8.40	6.78	6.43	6.30		
				Geometric Mean Blood Lead	3.00	3.40	3.10	3.00	2.40	2.10	1.80		
Hancock	2.15	2.2	2.9	Lead Uptake from Water	0.28	0.69	0.72	0.74	0.78	0.83	0.85	2.65	8.83
				Calculated Total Lead Uptake	5.49	8.14	8.35	8.40	6.78	6.43	6.30		
				Geometric Mean Blood Lead	3.00	3.40	3.10	3.00	2.40	2.10	1.80		
Kennebec	1.65	1.7	2.7	Lead Uptake from Water	0.25	0.63	0.66	0.68	0.72	0.76	0.78	2.63	8.59
				Calculated Total Lead Uptake	5.47	8.09	8.30	8.34	6.71	6.37	6.23		
				Geometric Mean Blood Lead	3.00	3.40	3.10	2.90	2.40	2.00	1.80		
Knox	0.93	0.9	2.3	Lead Uptake from Water	0.22	0.54	0.56	0.58	0.61	0.65	0.66	2.60	8.21
				Calculated Total Lead Uptake	5.44	8.00	8.20	8.25	6.61	6.26	6.12		
				Geometric Mean Blood Lead	3.00	3.30	3.10	2.90	2.40	2.00	1.80		
Lincoln	1.06	1.1	2.4	Lead Uptake from Water	0.23	0.56	0.59	0.60	0.64	0.68	0.69	2.61	8.30
				Calculated Total Lead Uptake	5.44	8.02	8.23	8.27	6.64	6.28	6.15		
				Geometric Mean Blood Lead	3.00	3.30	3.10	2.90	2.40	2.00	1.80		

Table 10. Summary of estimated lead uptake from water, calculated total lead uptake, and geometric mean blood lead concentration (µg/dL) for children ages 0-84 months, by IEUBK model age group and County (2012-2015).

Oxford	2.43	2.4	3.05	Lead Uptake from Water	0.29	0.71	0.75	0.77	0.81	0.86	0.88	2.66	8.93
				Calculated Total Lead Uptake	5.50	8.16	8.38	8.43	6.80	6.46	6.33		
				Geometric Mean Blood Lead	3.00	3.40	3.10	3.00	2.40	2.10	1.80		
Penobscot	2.52	2.5	3.1	Lead Uptake from Water	0.29	0.72	0.76	0.78	0.82	0.87	0.89	2.66	8.98
				Calculated Total Lead Uptake	5.51	8.17	8.39	8.44	6.82	6.47	6.34		
				Geometric Mean Blood Lead	3.00	3.40	3.10	3.00	2.40	2.10	1.80		
Piscataquis	2.49	2.5	3.1	Lead Uptake from Water	0.29	0.72	0.76	0.78	0.82	0.87	0.89	2.66	8.98
				Calculated Total Lead Uptake	5.51	8.17	8.39	8.44	6.82	6.47	6.34		
				Geometric Mean Blood Lead	3.00	3.40	3.10	3.00	2.40	2.10	1.80		
Sagadahoc	2.02	2.0	2.85	Lead Uptake from Water	0.27	0.66	0.70	0.72	0.76	0.80	0.82	2.64	8.74
				Calculated Total Lead Uptake	5.48	8.12	8.33	8.38	6.75	6.41	6.27		
				Geometric Mean Blood Lead	3.00	3.40	3.10	2.90	2.40	2.00	1.80		
Somerset	1.99	2.0	2.85	Lead Uptake from Water	0.27	0.66	0.70	0.72	0.76	0.80	0.82	2.64	8.74
				Calculated Total Lead Uptake	5.48	8.12	8.33	8.38	6.75	6.41	6.27		
				Geometric Mean Blood Lead	3.00	3.40	3.10	2.90	2.40	2.00	1.80		
Waldo	3.02	3.0	3.35	Lead Uptake from Water	0.32	0.78	0.82	0.84	0.89	0.94	0.96	2.68	9.23
				Calculated Total Lead Uptake	5.53	8.23	8.44	8.50	6.88	6.54	6.41		
				Geometric Mean Blood Lead	3.00	3.40	3.20	3.00	2.50	2.10	1.90		
Washington	1.84	1.8	2.75	Lead Uptake from Water	0.26	0.64	0.67	0.69	0.73	0.77	0.79	2.63	8.64
				Calculated Total Lead Uptake	5.48	8.10	8.31	8.35	6.73	6.38	6.24		
				Geometric Mean Blood Lead	3.00	3.40	3.10	2.90	2.40	2.00	1.80		
York	2.01	2.0	2.85	Lead Uptake from Water	0.27	0.66	0.70	0.72	0.76	0.80	0.82	2.64	8.74
				Calculated Total Lead Uptake	5.48	8.12	8.33	8.38	6.75	6.41	6.27		
				Geometric Mean Blood Lead	3.00	3.40	3.10	2.90	2.40	2.00	1.80		

GM (0-84): Geometric mean blood lead concentration for children ages 0-84 months; P5: Percent of children predicted with a GM blood lead concentration greater than 5µg/dL

[a]Mean first-draw lead concentration (µg/L).

[b]Value entered into the 'Concentration of Lead in First Draw (µg/L); input window rounded to 0.1.

[c]Weighted first-draw, flushed and fountain water concentration that is used to estimate drinking water exposure in the IEUBK model. For this analysis, IEUBK model default values for lead in flushed (1 µg/L) and water fountains (10 µg/L) were used.

CONCLUSIONS & LIMITATIONS

Drinking water continues to be an ongoing source of lead exposure in Maine and throughout the United States (EPA, 2017, 2013; Triantafyllidou et al., 2011), namely in homes and businesses serviced with water lines and plumbing that contains lead materials (Brown et al. 2011). Since 1972, public health efforts made through policy, science and education have reduced the amount of lead exposure that we are exposed to (Figure 11), and efforts are currently underway EPA (2017) to re-evaluate EPA's Drinking Water action level of 15 µg/L to better protect human health.

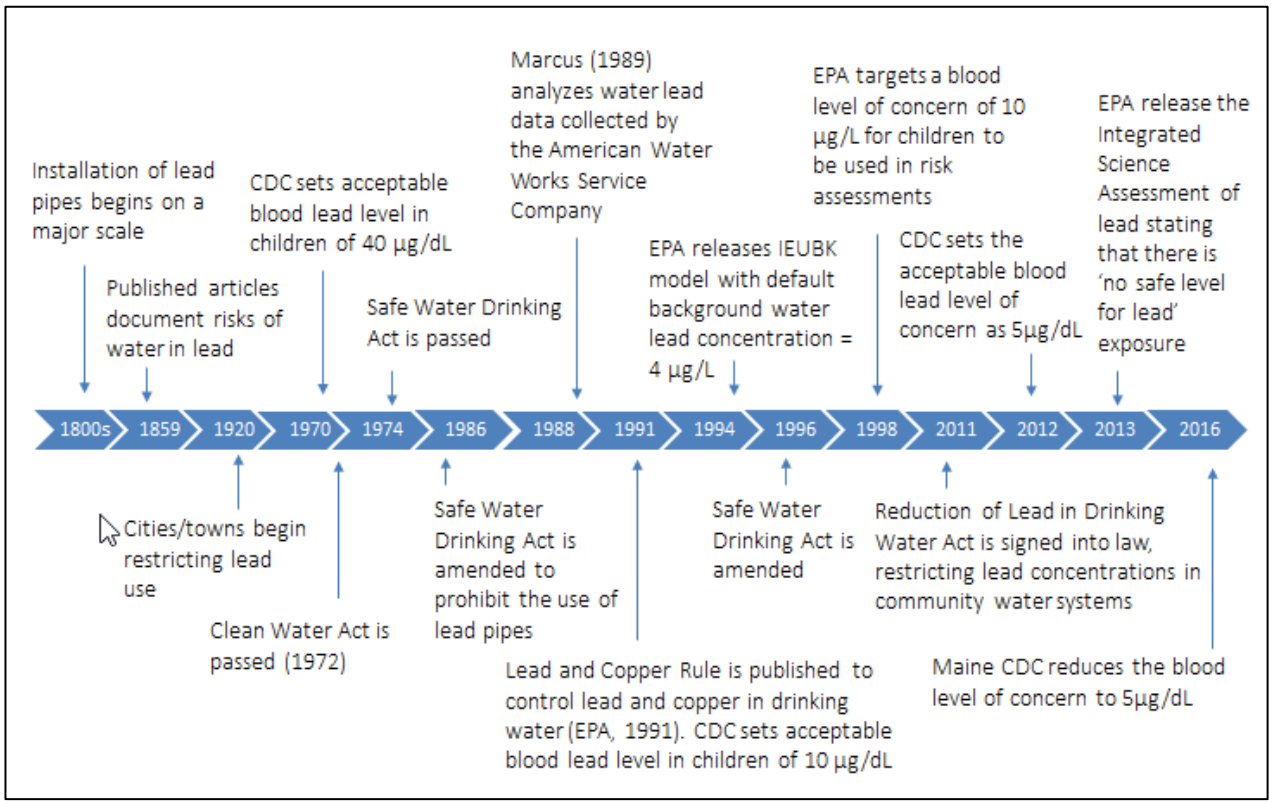

Figure 11. Overview of the history of lead in drinking water regulation and public policy.

Perhaps the primary limitation to this research is the use of currently recommended IEUBK model default values for background exposures to lead-contaminated soil, dust, air and dietary items. While the IEUBK model is intended to represent a typical background exposure to lead throughout the United States, the IEUBK model is most reliable with site-specific data, and the current values may not be reliably applied to assess exposure in Maine. For instance, without further analysis, it remains unknown if IEUBK model assumptions, such as the concentration of water from a fountain (10 µg/L) or a flushed value of 1 µg/L may over estimate actual lead concentrations. Based on the data presented in this study, and using the current IEUBK model defaults for environmental exposures, it is estimated that approximately 9% of Maine children between the ages of 0-84 months will likely

have a blood lead concentration greater than 5 µg/dL. Compared to recent blood lead surveillance data provided by MeCDC, these estimates likely overestimate the true exposure of approximately 3% of children having a blood lead concentration > 5 µg/dL (Table 11).

Table 11. Summary of childhood blood lead concentrations greater than 5 µg/dL in Maine (2011-2015).

Location	Year of Test	Number Screened	Number Confirmed ≥5ug/dL	Number Unconfirmed 5-<10ug/dL	Estimated Number ≥5ug/dL (Conf+ 0.38*Unconf)	Estimated Percent
Maine	2011	11,656	290	421	450	3.9
	2012	11,486	273	513	468	4.1
	2013	11,114	218	455	391	3.5
	2014	10,798	213	373	355	3.3
	2015	10,997	232	216	314	2.9
	2011-2015	56,051	1,226	1,978	1,978	3.5
	2012-2015[a]	**44,395**	**936**	**1557**	**1528**	**3.4**

Source: The Maine Childhood Lead Poisoning Prevention Unit provided the blood lead testing data used to calculate the percent of children with a blood lead level ≥5 ug/dL. Data downloaded from the Maine Environmental Public Health Tracking Program (https://data.mainepublichealth.gov/tracking/home) on February 5, 2017.

[a]Values represent estimates made for this analysis based on reported values.

The primary drivers of blood lead in Maine children are likely the result of lead contaminated soils and dusts, especially in young children who most likely incidentally consumed small lead particles through hand-to-mouth activities. As such, the IEUBK model estimates can be improved by using more representative background soil and dust lead concentrations specific to Maine. Data collected by MeCDC EOH from site-specific risk assessments could potentially be used to estimate exposure within a community, as recent research suggests that lead exposure may occur beyond the boundary of a child's home (NRC, 2005; von Lindern et al., 2016).

In 2013, the U.S. Geological Survey released a study that categorized geologic 'background' soil samples collected throughout the lower 48 states (Smith et al., 2013). As shown in Table 12, 53 samples were collected in Maine, with an average soil-lead concentration of 35.4 µg/g. These values, however, do not represent cities or areas of known contamination, but rather, the natural geology of the state (Smith et al. 2013). It would be unlikely that a residential home would have soil-lead concentrations this low due to numerous anthropogenic sources, including the use of leaded paint and leaded gasoline; however, it is similarly unlikely that Maine homes would have the default IEUBK model soil-lead concentration of 200 µg/g.

In a study to better model soil and dust lead predictions, the U.S. Department of Housing and Urban Development (HUD) (2011) administered a national survey to measure the levels of lead in soils and dusts in permanently occupied, non-institutional homes in the United States where children lived. Data were further aggregated into homes that were built prior to- and after- 1950. In homes built before 1950, HUD suggested that it was expected that lead-based paints would be present, and childhood blood lead levels would reflect that. A GM value of 221 µg/g and 134 µg/g for soils and dusts in homes built before 1950 was observed in the study (HUD, 2011). As mentioned previously, MeCDC collects soil and dust samples from locations of known elevated blood lead concentrations. A comparison of these soils and dust values (HUD vs. MeCDC) may provide insight into homes built prior to 1950 and potential lead exposures. In turn, these values could be applied to the IEUBK model to estimate potential lead exposure to children in communities with housing stock that was built ≤1950s.

Table 12. Geogenic Soil Lead Concentrations (mg/kg): 2007-2010.

Number of Samples	Mean	SEM	95 UCL	Std Dev	Min	Max	25th	Median	75th	90th	95th	99th
53	35.4	5.6	44.7	40.4	7.2	233	19.2	22.9	32.1	59.4	91.7	233

SEM: Standard Error of the mean; 95UCL: 95th % upper confidence limit; StdDev: standard deviation; Min: minimum concentration; Max: maximum concentration; 25th: 25th percentile; Median: 50th percentile; 75th: 75th percentile; 90th: 90th percentile; 95th: 95th percentile; 99th: 99th percentile
Source: Smith et al. 2013. Summary statistics are available online at: https://www.epa.gov/superfund/usgs-background-soil-lead-survey-state-data#ME

Several key components in this analysis can also be expanded to improve the reliability of estimating background water-lead concentrations in Maine, including utilizing transient-non community public water systems, as well as residences using well water. There are inherent issues with the sampling design and locations of the Community Water system data, and a more rigorous process for location selection should be implemented. Additional steps at the State level to share information more consistently between departments within MeCDC would provide further insight into background water lead exposures in Maine. Currently, the MeCDC DW and EOH programs both collect first-draw tap water and analyze the samples using the same EPA laboratories and methodologies; however, little is shared between the two groups.

It is clear that lead continues to be present in Community Water Systems throughout the state, and while it is difficult to argue for changing the default IEUBK model of 4 µg/L without a more robust data analysis of water-lead concentrations in Maine, it is recommended that more actions are needed to better understand background exposures to lead. In addition to more sampling data, there is also a

need to identify risk factors associated with the drinking water at the sampling location (*e.g.*, water chemistry [pH, water hardness], age of building, efforts being taken to reduce corrosion and the effectiveness of such efforts. It also important that public health agencies work together to sample, analyze, and assess risk to human health.

REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). (2007). Toxicological profile for lead. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, Agency for Toxic Substances and Disease Registry. Atlanta, GA. July.

Altman, P.L. and Dittmer, D.S. (1971). Respiration and Circulation. Federation of American Societies for Experimental Biology. Bethesda MD. 40-41, 78-84.

Altman, P.I. and Dittmer, D.S. (1972). Biology Data Book, 2nd ed. Federation of American Societies for Experimental Biology. Bethesda MD. 1:195-201.

American Water Works Service Company, Inc. (AWWSC). (1988). Lead at the tap – sources and control: A survey of the American water system, pp 1-72.

Britton A. and RichardsWN. (1981). Factors influencing plumbosolvency in Scotland. *J InstWater Eng Sci*, 35(5):349–64.

Brown, M.J., Raymond, J., Homa, D., Kennedy, C., Sinks, T. (2011). Association between children's blood lead levels, lead service lines, and water disinfection. Washington DC, 1998-2006. *Environ. Res*, 111: 67-74.

Clark, H.F., Bradander, D.J., Erdil, R.M. (2006). Sources, sinks, and exposure pathways of lead in urban garden soil. *J. Environ. Quality, 35(6)*: 2066-2074.

Deshommes, E., Andrews, R.C., Gagnon, G., McCluskey, T., McIlwain, B., Doré, E., Nour, S., Prévost, M. (2016). Evaluation of exposure to lead from drinking water in large buildings. *Water Research*, *99*, 46–55.

Gulson, B.L., Korsch, M.J., Matisons, M., Douglas, C., Gillam, L., McLaughlin, V. (2009). Windblown lead carbonate as the main source of lead in blood of children from a seaside community: an example of local birds as "canaries in the mine". *Environ Health Perspectives, 117(1):,* 148-154.

Karalekas, P.C., Ryan, C.R., Taylor, F.B. (1983). Control of lead, copper, and iron pipe corrosion in Boston. Journal of the American Water Works Association 75, 92-95.

International Commission on Radiological Protection (ICRP). Report to the Task Group on reference man: Report 23. Pergamon Press, New York.

Laidlaw, M.A.S, Mielke, H.W., Filippelli, G.M., Johnson, D.L., Gonzales, C.R. (2005). Seasonality and children's blood lead levels: developing a predictive model using climatic variables and blood lead data from Indianapolis, Indiana, Syracuse, New York, and New Orleans, Louisiana (USA). *Environ. Health Perspectives, 113*(6), 793-800.

Laidlaw, M.A.S., Filippelli, G.M., Sadler, R.C., Gonzales, C.R., Ball, A.S., Mielke, H.W. (2016). Children's blood lead seasonality in Flint, Michigan (USA), and soil-sourced lead hazard risks. *Int. J. Environ. Res. Public Health,* 13 (358): 1-13.

Lanphear, B.P., Hornung, R., Ho, M., Howard, C., Eberle, S., Knauf, K. (2002). Environmental lead exposure during early childhood. *J Pediatr, 140*(1), 40-47.

Maine Centers for Disease and Prevention (MeCDC). (2010). Chapter 263, Maine Comprehensive and limited environmental laboratory certification rules. Department of Health and Human Services jointly with Department of Environmental Protection. April 1.

Maine Centers for Disease and Prevention (MeCDC). (2015a). Pediatric blood lead screening guidelines. Maine CDC Childhood Lead Poisoning Prevention Program. March.

Maine Centers for Disease and Prevention (MeCDC). (2015b). RE: Notification of changes to pediatric blood lead testing recommendations. Memorandum to Health Care Providers. From Andrew E. Smith. March.

Maine Centers for Disease and Prevention (MeCDC). (2016). Childhood lead poisoning website. Viewed September 11, 2016.

Marcus, A.H. (1989). Distribution of lead in Tap Water. Parts I and II. Report to the U.S. Environmental Protection Agency, Office of Drinking Water, Office of Toxic Substances. Batelle Memorial Institute, Contract 68-D8-0115. January.

National Research Council (NRC). (2005). Superfund and mining megasites: Lessons learned from the Coeur d'Alene River Basin. National Research Council.

Nevin, R. (2000). How lead exposure relates to temporal changes in IQ, violent crime, and unwed pregnancy. *Environ. Res.*, 83, 1–22.

Ngueta, G., Prevost, M., Deshommes, E., Abdous, B., Gauvin, D., Levallois, P. (2014). Exposure of young children to household water lead in the Montreal area (Canada): the potential influence of winter-to-summer changes in water lead levels on children's blood lead concentration. *Environ Int, 73*, 57–65.

Nutritional Foundation, Inc. (1982). Assessment of safety of lead and lead slats in food: A report of the Nutrition Foundation's Expert Advisory Committee. Washington, DC. The Nutrition Foundation.

Pennington, J.A.T. (1983). Revision of the Total Diet Study food list and diets. *J. Am. Diet. Assoc. 82*:166-173.

Phalen, R.F., Oldman, M.J., Beavcage, C.R., Cricker, T.T., Mortenson, J.D. (1985). Postnatal enlargement of human tracheobronchial airways and implications for particle deposition. *Anat. Rec. 212*:368-380.

Ruby, M.V. and Lowney, Y.W. (2012). Selective soil particle adherence to hands: implications for understanding oral exposure to soil contaminants. *Environmental Science and Technology, 46(23):* 12759-12771.

Siciliano, S.D., James, K., Zhang, G., Schafer, A.N., Peak, J.D. (2009). Adhesion and enrichment of metals on human hands from contaminated soil at an arctic urban Brownfield. *Environmental Science and Technology, 43:* 6385-6390.

Simon, DL; Maynard, EJ; Thomas, KD. (2007). Living in a sea of lead changes in blood- and hand-lead of infants living near a smelter. *J Expo Sci Environ Epidemiol* 17: 248-259.

Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, Federico, Kilburn, J.E., and Fey, D.L. (2013). Geochemical and mineralogical data for soils of the conterminous United States: U.S. Geological Survey Data Series 801, 19 p.

Triantafyllidou, S. and Edwards, M. (2011). Lead (Pb) in tap water and in blood: implications for lead exposure in the United States. Critical Reviews in Environmental Science and Technology.

U.S. Centers of Disease Control and Prevention (CDC). (1991). Preventing Lead Poisoning in Young Children. Atlanta, GA.

U.S. Centers of Disease Control and Prevention (CDC). (1997). National Health and Nutrition Examination Survey, III 1988-1994. July, 1997.

U.S. Centers of Disease Control and Prevention (CDC). (2012). Low level lead exposure harms children: A renewed call for primary prevention. Report of the Advisory Committee on Childhood Lead Poisoning Prevention. Atlanta, GA. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

U.S. Centers of Disease Control and Prevention (CDC). (2005). National Health and Nutrition Examination Survey Data. Hyattsville, MD: U.S. Department of Health and Human Services

U.S. Department of Housing and Urban Development (HUD). (2011). American Healthy Homes Survey: Lead and Arsenic Findings. Office of Healthy Homes and Lead Hazard Control. Contract No. C-PHI-00882. April.

U.S. Environmental Protection Agency (EPA). (1989). Review of the National Ambient Air Quality Standards for Lead: Exposure analysis methodology and validation. Office of Air Quality, Planning, and Standards. Research Triangle Park, NC. EPA/450/2-89/011.

U.S. Environmental Protection Agency (EPA). (1991). Drinking water regulations: maximum contaminant level goals and national drinking water regulations for lead and copper. Federal Register, 56(110), 26460–26564.

U.S. Environmental Protection Agency (EPA). (1994a). Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. Washington, DC. EPA/540/R-43/081, PB93-963510.

U.S. Environmental Protection Agency (EPA). (1994b).Technical Support Document: Parameters and Equations Used in the Integrated Exposure Uptake Biokinetic Model for Lead in Children. Washington, DC. EPA 540/R-94/040, PB94-963505.

U.S. Environmental Protection Agency (EPA). (1997). Exposure Factors Handbook. National Center for Environmental Assessment, Office of Research and Development. EPA/600/P-95/002Fa. Washington, DC. August.

U.S. Environmental Protection Agency (EPA). (1999). Short Sheet: IEUBK model soil/dust ingestion rates. Office of Solid Waste and Emergency Response. EPA-540-F-00-007. Washington, DC. December.

U.S. Environmental Protection Agency (U.S. EPA). (2007). Estimation of Relative Bioavailability of Lead in Soil and Soil-like Materials Using In Vivo and In Vitro Methods. Office of Solid Waste and Emergency Response: Washington, DC. OSWER 9285.7-77. May.

U.S. Environmental Protection Agency (EPA). (2010). Lead and Copper Rule: Monitoring and reporting guidance for public water systems. Washington, DC. EPA 816-R-10-004. March.

U.S. Environmental Protection Agency (EPA). (2013). Integrated Science Assessment for Lead (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-10/075F.

U.S. Environmental Protection Agency (EPA). (2017). Proposed modeling approaches for a health-based benchmark for lead in drinking water. Office of Ground Water and Drinking Water. January.

U.S. Food and Drug Administration (FDA). (2006). Total Diet Study. U.S. Food and Drug Administration Center for Food Safety and Applied Nutrition Office of Plant and Dairy Foods and Beverages.

von Lindern I., Spalinger S., Stifelman M.L., Stanek L.W., Bartrem C. (2016). Estimating children's soil/dust ingestion rates through retrospective analyses of blood lead biomonitoring from the Bunker Hill Superfund Site in Idaho. *Environ Health Perspect 124*:1462–1470.

ATTACHMENT 1. Summary of Drinking Water Sampling Data by Community Water Systems in Maine (2012-2015).

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
Aroostook	Aroostook	Crest View Manor	5	3.76	7.42	3.32	-2.74	10.27	0.01	17.00	0.01	0.50	1.30	10.72	13.86	0.26	25.27
Aroostook	Aroostook	Hodgdon Homestead	30	8.63	18.37	3.35	2.05	15.20	0.86	74.00	1.43	2.20	3.90	12.92	56.05	3.04	3.29
Aroostook	Aroostook	Houlton Mobile Home Park	5	1.67	1.91	0.85	0.00	3.34	0.01	4.90	0.65	1.10	1.70	3.62	4.26	0.57	10.78
Aroostook	Aroostook	Houlton Water Company	20	2.27	1.41	0.32	1.65	2.89	0.01	6.50	1.55	1.95	3.03	3.24	3.75	1.33	5.60
Aroostook	Aroostook	Ashland Water & Sewer District	120	6.12	17.81	1.63	2.93	9.30	0.01	162	0.01	1.65	6.08	12.20	17.09	0.43	23.17
Aroostook	Aroostook	A Place For All Seasons	5	2.86	2.46	1.10	0.70	5.02	1.20	7.10	1.20	2.00	2.80	5.38	6.24	2.25	2.09
Aroostook	Aroostook	Caribou Stream Mobile Home Pk	10	0.49	0.54	0.17	0.15	0.82	0.01	1.30	0.01	0.32	0.86	1.21	1.26	0.10	10.99
Aroostook	Aroostook	Caribou Trailer Park #2	10	3.08	4.97	1.57	0.00	6.16	0.01	15.00	0.14	0.78	2.88	9.42	12.21	0.43	16.52
Aroostook	Aroostook	Caribou Utilities District	40	0.18	0.35	0.05	0.08	0.29	0.01	1.20	0.01	0.01	0.01	0.86	0.89	0.03	6.26
Aroostook	Aroostook	Del-wood Trailer Park	5	1.10	0.92	0.41	0.30	1.91	0.01	2.10	0.50	0.91	2.00	2.06	2.08	0.45	9.15
Aroostook	Aroostook	Lazy Acres Mobile Home Park	5	2.26	3.21	1.44	-0.55	5.08	0.50	8.00	0.92	0.95	0.95	5.18	6.59	1.27	2.90
Aroostook	Aroostook	Rivers Bend Mobile Home Park	5	1.08	1.09	0.49	0.12	2.03	0.01	2.54	0.01	1.21	1.61	2.17	2.35	0.22	16.89
Aroostook	Aroostook	Riverside Court	5	0.71	1.56	0.70	-0.66	2.08	0.01	3.50	0.01	0.01	0.01	2.10	2.80	0.03	13.73
Aroostook	Aroostook	Sunny Slope Trailer Park	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Aroostook	Aroostook	West Gate Villa Mhp	5	0.80	0.84	0.38	0.06	1.54	0.01	2.00	0.01	0.79	1.20	1.68	1.84	0.18	14.29
Aroostook	Aroostook	Eagle Lake Water & Sewer Dist	40	1.50	1.30	0.21	1.10	1.91	0.01	6.40	0.65	1.30	2.23	2.90	3.24	0.62	7.47
Aroostook	Aroostook	Osgood Farm Homes	10	1.49	1.16	0.37	0.76	2.21	0.70	4.40	0.81	1.02	1.55	2.69	3.55	1.22	1.82
Aroostook	Aroostook	West Ridge Manor	5	2.63	1.73	0.77	1.11	4.15	0.70	4.70	0.96	3.30	3.50	4.22	4.46	2.05	2.35
Aroostook	Aroostook	Windermere Apartments	10	0.88	1.10	0.35	0.20	1.56	0.01	3.40	0.01	0.74	0.93	2.23	2.82	0.18	12.44
Aroostook	Aroostook	Fort Fairfield Utility District	10	1.89	0.86	0.27	1.35	2.42	1.01	3.20	1.21	1.65	2.64	3.08	3.14	1.72	1.57
Aroostook	Aroostook	Forest Hill	5	2.56	1.34	0.60	1.38	3.73	0.59	4.20	2.30	2.40	3.30	3.84	4.02	2.14	2.14
Aroostook	Aroostook	Forest Hill Manor	5	1.00	0.92	0.41	0.20	1.81	0.01	1.90	0.01	1.50	1.60	1.78	1.84	0.21	16.46
Aroostook	Aroostook	Fort Kent W & W Department	10	1.59	1.09	0.34	0.92	2.27	0.01	3.60	0.86	1.25	2.43	2.70	3.15	0.93	5.36
Aroostook	Aroostook	Mountain View Trailer Park	5	2.87	2.10	0.94	1.03	4.70	0.74	5.50	1.60	1.80	4.70	5.18	5.34	2.23	2.29
Aroostook	Aroostook	Rosewood Estates	20	1.78	1.81	0.41	0.99	2.58	0.01	7.00	0.67	1.25	2.30	2.83	5.86	0.63	9.09
Aroostook	Aroostook	St Joseph Nursing Home	30	2.20	5.27	0.96	0.31	4.08	0.01	21.00	0.01	0.01	1.48	4.14	14.65	0.09	17.87
Aroostook	Aroostook	St Josephs Memory Care	5	1.09	2.41	1.08	-1.02	3.20	0.01	5.40	0.01	0.01	0.01	3.24	4.32	0.04	16.67
Aroostook	Aroostook	Grand Isle Water System	10	0.79	0.49	0.15	0.49	1.10	0.01	1.50	0.61	0.91	1.08	1.23	1.37	0.38	6.96

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
Aroostook	Aroostook	Island Falls Water Dept	20	3.27	3.22	0.72	1.86	4.68	0.01	11.00	1.05	1.85	4.90	7.72	9.77	1.74	4.57
Aroostook	Aroostook	Limestone Water & Sewer District	10	0.84	0.60	0.19	0.47	1.22	0.01	1.80	0.60	0.80	1.11	1.71	1.76	0.39	7.13
Aroostook	Aroostook	Loring Development Authority	50	9.40	25.69	3.63	2.28	16.52	0.01	144.00	0.01	0.01	5.90	15.50	52.75	0.24	31.72
Aroostook	Aroostook	Loring Woods Park	10	0.57	0.55	0.17	0.23	0.91	0.01	1.50	0.01	0.62	1.00	1.14	1.32	0.15	10.30
Aroostook	Aroostook	Madawaska Water District	10	0.29	0.59	0.19	-0.08	0.65	0.01	1.44	0.01	0.01	0.01	1.38	1.41	0.03	8.04
Aroostook	Aroostook	Mapletree Estates	5	1.26	1.35	0.60	0.08	2.45	0.01	3.20	0.01	1.20	1.90	2.68	2.94	0.24	18.28
Aroostook	Aroostook	Mars Hill And Blaine Water Company	20	2.13	1.55	0.35	1.45	2.80	0.01	5.60	1.18	1.45	2.75	4.32	5.41	1.43	3.69
Aroostook	Aroostook	Monticello Housing Corporation	10	4.48	5.37	1.70	1.15	7.81	0.96	18.00	1.48	2.20	4.45	10.17	14.09	2.83	2.53
Aroostook	Aroostook	Heritage View Apts	20	0.04	0.14	0.03	-0.02	0.10	0.01	0.65	0.01	0.01	0.01	0.01	0.04	0.01	2.54
Aroostook	Aroostook	Pine Grove Terrace	5	2.25	1.06	0.47	1.33	3.18	0.66	3.20	1.70	2.80	2.90	3.08	3.14	1.96	1.93
Aroostook	Aroostook	Golden Gate Trailer Park	5	1.40	0.53	0.24	0.93	1.87	0.80	2.00	1.00	1.30	1.90	1.96	1.98	1.32	1.49
Aroostook	Aroostook	Mcculley Commons Apartments	5	3.61	3.36	1.50	0.67	6.55	0.85	9.30	1.50	2.80	3.60	7.02	8.16	2.60	2.48
Aroostook	Aroostook	Pine Village	10	3.62	4.82	1.52	0.63	6.60	0.01	13.00	0.76	1.65	3.15	12.10	12.55	0.87	12.74
Aroostook	Aroostook	Presque Isle Utilities District	120	1.79	3.78	0.35	1.11	2.47	0.01	39.00	0.61	1.00	1.83	4.00	5.14	0.49	9.13
Aroostook	Aroostook	Town And Country Apartments	16	7.37	12.51	3.13	1.24	13.50	0.67	53.00	1.70	4.15	6.60	9.25	21.50	3.83	3.02
Aroostook	Aroostook	Montfort Heights	5	2.76	3.36	1.50	-0.19	5.71	0.72	8.70	0.98	1.30	2.10	6.06	7.38	1.76	2.66
Aroostook	Aroostook	St Agatha Housing	10	1.51	1.65	0.52	0.49	2.53	0.01	5.90	0.79	0.97	1.50	2.57	4.24	0.79	5.29
Aroostook	Aroostook	St Francis Water District	27	2.75	7.20	1.39	0.03	5.46	0.01	38.00	0.57	0.83	1.90	4.78	4.97	0.58	8.90
Aroostook	Aroostook	Van Buren Water District	20	1.33	0.92	0.21	0.92	1.73	0.01	3.80	0.75	1.25	1.73	2.28	3.04	0.79	4.84
Aroostook	Aroostook	Washburn Water & Sewer Dist	20	1.86	2.53	0.57	0.75	2.97	0.01	11.00	0.57	0.92	1.93	4.03	4.64	0.67	7.30
Central	Kennebec	Monmouth Water Association	10	0.58	0.73	0.23	0.12	1.03	0.01	2.00	0.01	0.28	0.90	1.64	1.82	0.10	11.72
Central	Kennebec	West Village Mobile Home Park	10	1.39	3.75	1.19	-0.93	3.72	0.01	12.00	0.01	0.01	0.41	2.37	7.18	0.05	14.53
Central	Kennebec	Deer Ridge Mobile Home Park	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Central	Kennebec	Greater Augusta Utility District	61	2.10	4.10	0.52	1.07	3.13	0.01	28.00	0.56	1.00	1.80	3.80	10.00	0.56	8.67
Central	Kennebec	Snow Pond Residential Care Ctr	5	4.49	7.28	3.25	-1.89	10.86	0.01	17.00	0.01	0.62	4.80	12.12	14.56	0.35	31.42
Central	Kennebec	Summer Haven Apartments-bldg 1	20	2.03	2.34	0.52	1.01	3.05	0.01	9.40	0.85	1.35	2.18	3.85	7.12	0.96	5.67
Central	Kennebec	Summer Haven Apartments-bldg 2	10	7.83	3.51	1.11	5.66	10.00	3.00	14.00	4.88	7.65	10.60	11.30	12.65	7.09	1.63
Central	Kennebec	Summer Haven Apartments-bldg 3	15	2.51	2.66	0.69	1.16	3.86	0.01	10.00	0.82	2.10	2.95	5.36	7.20	0.80	10.66

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
Central	Kennebec	Togus Pond Mobile Home Park	5	3.41	4.83	2.16	-0.82	7.64	0.79	12.00	0.94	1.30	2.00	8.00	10.00	1.87	2.99
Central	Kennebec	Brookside Mhp	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Central	Kennebec	East Pittston Water District	10	0.25	0.42	0.13	-0.01	0.51	0.01	1.20	0.01	0.01	0.42	0.76	0.98	0.04	8.25
Central	Kennebec	Gardiner Water District	20	0.07	0.27	0.06	-0.05	0.19	0.01	1.22	0.01	0.01	0.01	0.01	0.07	0.01	2.93
Central	Kennebec	Kennebec View Park	5	0.52	0.46	0.21	0.11	0.92	0.01	0.87	0.01	0.83	0.86	0.87	0.87	0.14	11.42
Central	Kennebec	Hallowell Water District	10	0.98	1.44	0.46	0.08	1.87	0.01	4.90	0.14	0.62	1.04	1.48	3.19	0.25	10.08
Central	Kennebec	Hallowell Road Mobile Home Park	5	0.30	0.42	0.19	-0.06	0.67	0.01	0.91	0.01	0.01	0.57	0.77	0.84	0.06	10.47
Central	Kennebec	Pond Acres Llc	25	2.80	2.35	0.47	1.88	3.72	0.01	8.50	1.10	2.20	3.30	6.68	7.56	1.76	3.75
Central	Kennebec	Round Stone Mobile Home Park	5	5.06	4.03	1.80	1.52	8.59	1.68	9.55	1.84	2.88	9.34	9.47	9.51	3.80	2.35
Central	Kennebec	Readfield Corner Water Association	20	3.17	5.54	1.24	0.75	5.60	0.01	26.00	1.03	2.05	3.40	3.88	5.67	1.24	6.40
Central	Kennebec	Dirigo Mobile Home Park	5	1.89	2.30	1.03	-0.13	3.90	0.01	5.80	0.68	0.94	2.00	4.28	5.04	0.59	11.33
Central	Kennebec	Weeks Mills Water System	10	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Central	Kennebec	Pine Ridge Village	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Central	Kennebec	Lakes Region Mobile Village	5	3.04	0.62	0.28	2.50	3.58	2.50	4.00	2.60	2.80	3.30	3.72	3.86	2.99	1.21
Central	Kennebec	Winthrop Utilities District	10	1.03	1.99	0.63	-0.21	2.26	0.01	6.60	0.01	0.64	0.77	1.43	4.01	0.16	12.12
Central	Kennebec	Averills Mobile Home Park	5	2.47	2.88	1.29	-0.06	4.99	0.01	6.26	0.01	1.27	4.78	5.67	5.96	0.33	25.62
Central	Kennebec	Kennebec Water District	60	1.72	4.66	0.60	0.54	2.90	0.01	31.00	0.01	0.80	1.33	3.22	4.83	0.17	14.20
Central	Kennebec	Town And Country Ways Mhp	5	0.28	0.59	0.27	-0.25	0.80	0.01	1.34	0.01	0.01	0.01	0.81	1.07	0.03	8.94
Central	Kennebec	Clinton Water District	10	1.29	0.82	0.26	0.78	1.79	0.01	2.90	0.86	1.15	1.53	2.36	2.63	0.79	4.94
Central	Kennebec	Kennebec Mobile Home Park	5	0.27	0.59	0.26	-0.24	0.79	0.01	1.32	0.01	0.01	0.01	0.80	1.06	0.03	8.88
Central	Kennebec	Brocks Mobile Home Park	10	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Central	Kennebec	East Vassalboro Water Company Llc	15	0.04	0.13	0.03	-0.02	0.11	0.01	0.53	0.01	0.01	0.01	0.01	0.17	0.01	2.79
Central	Somerset	Starks Water District	25	2.02	3.15	0.63	0.79	3.26	0.01	14.00	0.75	1.10	1.50	3.98	8.50	0.68	7.61
Central	Somerset	Bingham Water District	20	1.60	0.84	0.19	1.23	1.96	0.01	3.30	1.28	1.60	1.93	2.48	3.21	1.00	5.01
Central	Somerset	Goodwill Home Association	5	0.24	0.52	0.23	-0.21	0.70	0.01	1.17	0.01	0.01	0.01	0.71	0.94	0.03	8.41
Central	Somerset	Woodlands Mobile Home Park	10	1.75	3.63	1.15	-0.50	4.00	0.01	12.00	0.15	0.70	1.20	2.37	7.18	0.29	12.02
Central	Somerset	Jackman Utility District	10	2.95	4.83	1.53	-0.04	5.95	0.01	16.00	0.64	1.55	1.95	6.37	11.19	0.71	11.39
Central	Somerset	Anson And Madison Water District	40	1.68	2.05	0.32	1.04	2.31	0.01	9.20	0.01	1.30	2.08	4.07	5.85	0.38	12.04
Central	Somerset	Somerset Residential Care Ctr	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Central	Somerset	New Portland Water District	5	1.28	1.48	0.66	-0.02	2.59	0.01	3.60	0.01	1.10	1.70	2.84	3.22	0.23	18.20

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
Central	Somerset	Norridgewock Water District	20	1.41	0.82	0.18	1.05	1.76	0.01	2.90	0.75	1.25	2.05	2.52	2.71	1.00	3.38
Central	Somerset	Pleasant Acres Estates	5	0.88	0.87	0.39	0.13	1.64	0.01	2.00	0.01	1.10	1.30	1.72	1.86	0.20	15.23
Central	Somerset	Pittsfield Water Dept	10	1.13	1.84	0.58	-0.01	2.26	0.01	5.90	0.01	0.26	1.45	2.39	4.15	0.13	15.65
Central	Somerset	Lynns Way	11	5.56	3.49	1.05	3.50	7.62	1.78	10.00	2.22	4.14	9.15	10.00	10.00	4.49	2.04
Central	Somerset	Riverside Terrace	5	3.38	2.75	1.23	0.97	5.79	1.30	8.00	1.80	2.00	3.80	6.32	7.16	2.70	2.06
Central	Somerset	Solon Water District	5	4.02	7.30	3.26	-2.37	10.42	0.01	17.00	0.01	1.20	1.90	10.96	13.98	0.33	28.32
Cumberland	Cumberland	Bridgton Water District	10	0.42	0.67	0.21	0.00	0.83	0.01	1.70	0.01	0.01	0.83	1.34	1.52	0.04	10.70
Cumberland	Cumberland	East Slope Condos At Shawnee Peak	5	1.96	0.98	0.44	1.10	2.82	1.10	3.20	1.10	1.60	2.80	3.04	3.12	1.77	1.66
Cumberland	Cumberland	Knights Hill Association	10	8.50	14.46	4.57	-0.46	17.47	0.01	48.00	0.01	6.00	6.75	15.60	31.80	0.62	36.89
Cumberland	Cumberland	Sandy Creek Housing	5	1.51	0.63	0.28	0.97	2.06	0.57	2.10	1.20	1.80	1.90	2.02	2.06	1.37	1.71
Cumberland	Cumberland	Brunswick / Topsham Water Dist	35	0.05	0.22	0.04	-0.03	0.12	0.01	1.30	0.01	0.01	0.01	0.01	0.01	0.01	2.28
Cumberland	Cumberland	Wood Pond Village	10	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Cumberland	Cumberland	Casco Inn Residential Care	25	6.08	5.83	1.17	3.79	8.36	0.01	22.00	2.10	3.00	12.00	13.60	14.00	2.77	6.70
Cumberland	Cumberland	Tidal Brook Development	5	1.31	2.05	0.92	-0.49	3.10	0.01	4.70	0.01	0.01	1.80	3.54	4.12	0.10	22.77
Cumberland	Cumberland	Wardtown Park	20	7.24	19.62	4.39	-1.36	15.83	0.01	69.40	0.01	0.27	2.00	11.84	59.52	0.18	24.15
Cumberland	Cumberland	Dingley Spring Estates	25	5.70	6.30	1.26	3.23	8.17	1.10	32.00	2.00	4.40	6.50	9.16	13.12	4.00	2.24
Cumberland	Cumberland	Friendly Village Of Gorham Mhp	10	1.40	1.44	0.46	0.51	2.29	0.01	4.20	0.21	0.92	2.45	3.03	3.62	0.36	12.49
Cumberland	Cumberland	Gray Water District	10	2.88	1.71	0.54	1.82	3.94	1.20	6.10	1.68	2.45	3.20	5.65	5.88	2.49	1.75
Cumberland	Cumberland	Harrison Water District	10	1.46	2.66	0.84	-0.19	3.10	0.01	8.90	0.15	0.79	1.15	2.06	5.48	0.29	11.56
Cumberland	Cumberland	Brook Hollow	20	1.54	1.50	0.33	0.89	2.20	0.01	6.10	0.62	1.10	1.90	3.13	4.39	0.81	5.19
Cumberland	Cumberland	Pond & Pond Trailer Park	10	1.95	1.71	0.54	0.89	3.00	0.01	4.50	0.66	1.65	3.10	4.50	4.50	0.68	10.20
Cumberland	Cumberland	Crystal Spring Mobile Home Pk	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Cumberland	Cumberland	Scarborough Gardens	10	32.18	40.53	12.82	7.06	57.30	0.01	100	3.10	12.30	61.75	93.70	96.85	7.03	15.79
Cumberland	Cumberland	Raymond Woods Townhouses	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Cumberland	Cumberland	Lombos Peninsula Owners Association	5	2.81	3.21	1.44	0.00	5.62	0.65	8.50	1.50	1.60	1.80	5.82	7.16	1.89	2.54
Cumberland	Cumberland	Millstone Apartments	5	0.50	0.48	0.22	0.08	0.92	0.01	1.10	0.01	0.63	0.76	0.96	1.03	0.14	11.17
Cumberland	Cumberland	Northeastern Estates	10	0.51	1.05	0.33	-0.14	1.16	0.01	3.40	0.01	0.12	0.32	1.04	2.22	0.08	9.52
Cumberland	Cumberland	Pine Tree Mobile Estates	30	0.92	1.54	0.28	0.37	1.48	0.01	7.10	0.01	0.26	1.20	2.20	3.41	0.12	12.79
Cumberland	Cumberland	New Gloucester Water District	31	3.30	7.31	1.31	0.73	5.88	0.01	33.90	0.01	1.30	2.35	4.50	16.15	0.46	14.13
Cumberland	Cumberland	Wayfarer Village	5	0.12	0.25	0.11	-0.10	0.34	0.01	0.56	0.01	0.01	0.01	0.34	0.45	0.02	6.05

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
Downeast	Hancock	Harriman Cove Park Llc	5	0.15	0.32	0.14	-0.13	0.43	0.01	0.72	0.01	0.01	0.01	0.44	0.58	0.02	6.77
Downeast	Hancock	Maine Water Company Bucksport Division	1	4.61	0.00	0.00	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	1.00
Downeast	Hancock	Sherwood Forest Mhp	10	0.97	0.72	0.23	0.52	1.41	0.01	2.10	0.57	0.80	1.58	1.83	1.97	0.42	7.57
Downeast	Hancock	Castine Water Department	70	0.64	1.09	0.13	0.39	0.90	0.01	5.30	0.01	0.01	0.77	1.81	3.24	0.07	11.20
Downeast	Hancock	Hancock Village Mhp	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Downeast	Hancock	Northern Bay Residential Living Center	5	1.10	1.10	0.49	0.13	2.06	0.01	2.90	0.57	0.80	1.20	2.22	2.56	0.44	9.00
Downeast	Hancock	Penobscot Nursing Home	30	3.30	4.21	0.77	1.79	4.81	0.01	15.00	0.59	1.75	3.75	10.10	12.65	0.83	11.32
Downeast	Hancock	Ellsworth Water Department	40	4.32	9.69	1.53	1.32	7.33	0.01	44.00	0.01	1.40	3.05	7.48	24.80	0.37	19.35
Downeast	Hancock	Town Of Bar Harbor- Water Division	4	1.01	2.00	1.00	-0.95	2.96	0.01	4.00	0.01	0.01	1.01	2.80	3.40	0.04	20.00
Downeast	Hancock	Blue Hill Terrace	35	15.53	18.39	3.11	9.43	21.62	0.01	71.00	2.60	7.60	26.00	43.80	49.00	6.23	5.71
Downeast	Hancock	Harborview I & Ii	5	0.71	1.03	0.46	-0.20	1.61	0.01	2.30	0.01	0.01	1.20	1.86	2.08	0.08	16.61
Downeast	Hancock	Parker Ridge Retirement Comm	6	0.23	0.35	0.14	-0.05	0.51	0.01	0.74	0.01	0.01	0.47	0.68	0.71	0.04	8.83
Downeast	Hancock	Deer Run Apts	5	0.65	0.64	0.29	0.09	1.21	0.01	1.50	0.01	0.80	0.92	1.27	1.38	0.16	12.82
Downeast	Hancock	Island Nursing Home	5	3.66	1.09	0.49	2.70	4.62	2.30	5.30	3.20	3.70	3.80	4.70	5.00	3.53	1.35
Downeast	Hancock	Franklin Water Dept	40	0.59	1.98	0.31	-0.02	1.20	0.01	12.00	0.01	0.01	0.01	1.21	2.82	0.03	8.73
Downeast	Hancock	Spinsfield Commons	10	2.42	2.56	0.81	0.83	4.00	0.01	5.20	0.01	1.96	5.05	5.20	5.20	0.22	25.89
Downeast	Hancock	Birch Haven Trailer Park	10	0.37	0.71	0.22	-0.07	0.81	0.01	2.20	0.01	0.01	0.53	0.87	1.53	0.04	9.60
Downeast	Hancock	Birch Tree Meadows Mhp	5	2.50	4.25	1.90	-1.22	6.22	0.01	10.00	0.01	0.87	1.60	6.64	8.32	0.27	22.98
Downeast	Hancock	Crescent Park Llc	5	1.56	1.92	0.86	-0.12	3.25	0.01	4.70	0.01	1.30	1.80	3.54	4.12	0.26	20.04
Downeast	Hancock	Hancock Heights Mhp	15	0.56	0.51	0.13	0.30	0.82	0.01	1.70	0.01	0.56	0.82	1.12	1.35	0.18	8.54
Downeast	Hancock	Mount Desert Water Dist -Seal	11	2.93	3.07	0.92	1.12	4.74	0.01	9.12	0.01	2.27	4.99	5.60	7.36	0.44	21.17
Downeast	Hancock	Mount Desert Water Dist North	12	2.48	2.93	0.85	0.82	4.14	0.01	8.00	0.01	1.77	3.53	7.50	7.96	0.31	21.41
Downeast	Hancock	Benjamin River Apts	5	3.32	1.06	0.48	2.39	4.25	2.40	4.90	2.50	2.90	3.90	4.50	4.70	3.19	1.36
Downeast	Hancock	Long Pond Water District	10	1.37	1.94	0.61	0.16	2.57	0.01	6.10	0.01	0.61	1.80	3.04	4.57	0.15	18.08
Downeast	Hancock	Southwest Harbor Water Dept	10	1.00	1.88	0.59	-0.16	2.17	0.01	6.06	0.01	0.01	1.17	2.00	4.03	0.08	15.57
Downeast	Hancock	Stonington Manor	5	0.93	0.66	0.29	0.36	1.51	0.01	1.60	0.61	0.94	1.50	1.56	1.58	0.42	8.42
Downeast	Hancock	Stonington Water Company	20	1.68	2.09	0.47	0.76	2.59	0.01	10.00	0.80	1.10	1.73	2.61	3.07	0.86	5.18
Downeast	Hancock	Winter Harbor Water District	10	1.62	1.67	0.53	0.59	2.66	0.01	5.90	0.77	1.02	2.05	2.75	4.33	0.84	5.45
Downeast	Washington	Danforth Water District	10	1.35	1.30	0.41	0.54	2.15	0.01	3.80	0.70	1.03	1.35	3.53	3.67	0.51	8.61
Downeast	Washington	Addison Point Water District	5	0.56	0.56	0.25	0.07	1.05	0.01	1.30	0.01	0.63	0.86	1.12	1.21	0.15	11.84

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
Downeast	Washington	Calais Water Dept	10	2.06	1.55	0.49	1.10	3.02	0.01	4.80	0.74	2.20	2.70	4.08	4.44	1.09	6.02
Downeast	Washington	Narraguagus Estates	10	0.41	0.69	0.22	-0.02	0.83	0.01	1.70	0.01	0.01	0.51	1.61	1.66	0.04	10.34
Downeast	Washington	Allen Water Company	5	3.94	3.23	1.44	1.11	6.77	1.40	9.20	1.70	2.60	4.80	7.44	8.32	3.07	2.17
Downeast	Washington	Pleasant View Manor	15	1.54	2.71	0.70	0.17	2.91	0.01	11.00	0.27	0.98	1.35	2.10	4.91	0.37	10.52
Downeast	Washington	Dennysville Housing	15	2.03	2.29	0.59	0.86	3.19	0.01	7.80	0.65	1.00	2.55	5.10	6.75	0.64	9.76
Downeast	Washington	Hadleys Lake Apartments	5	4.94	6.00	2.68	-0.33	10.20	0.51	12.00	0.52	0.65	11.00	11.60	11.80	1.87	5.27
Downeast	Washington	Passamaquoddy Water District	10	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Downeast	Washington	Quantabacook Water District	5	0.99	0.85	0.38	0.25	1.73	0.01	2.30	0.71	0.72	1.20	1.86	2.08	0.43	8.60
Downeast	Washington	Gaelic Square Housing	15	2.81	3.16	0.82	1.21	4.40	0.88	13.00	1.45	1.60	2.25	5.34	8.59	2.04	2.05
Downeast	Washington	Sunrise Care Facility	5	0.20	0.43	0.19	-0.17	0.58	0.01	0.97	0.01	0.01	0.01	0.59	0.78	0.02	7.74
Downeast	Washington	Thomas Kelley Apartments	5	0.29	0.40	0.18	-0.06	0.64	0.01	0.87	0.01	0.01	0.55	0.74	0.81	0.05	10.24
Downeast	Washington	Us Cg Jonesport - Station	20	5.38	6.18	1.38	2.67	8.09	1.08	28.90	2.02	3.49	5.78	9.28	11.33	3.68	2.32
Downeast	Washington	Lubec Water District	10	1.30	2.44	0.77	-0.21	2.82	0.01	8.00	0.01	0.56	1.00	2.69	5.34	0.18	13.63
Downeast	Washington	Machias Trailer Park	10	0.11	0.31	0.10	-0.09	0.30	0.01	1.00	0.01	0.01	0.01	0.11	0.55	0.02	4.29
Downeast	Washington	Machias Water Company	20	1.32	1.19	0.27	0.80	1.84	0.01	4.40	0.56	0.85	1.95	2.68	3.45	0.60	6.53
Downeast	Washington	Downeast Correctional Facility	5	1.29	1.70	0.76	-0.20	2.78	0.01	4.00	0.01	0.54	1.90	3.16	3.58	0.21	17.65
Downeast	Washington	Milbridge Water District	5	0.93	0.16	0.07	0.79	1.07	0.81	1.20	0.83	0.86	0.93	1.09	1.15	0.92	1.17
Downeast	Washington	Country View Apts	15	5.25	3.60	0.93	3.43	7.07	0.99	16.00	3.10	5.10	5.70	8.02	10.89	4.30	1.97
Downeast	Washington	Boudreau Trailer Park	10	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Downeast	Washington	Princeton Water District	31	4.40	7.41	1.33	1.79	7.01	0.01	33.00	0.77	1.20	3.65	15.00	17.50	1.43	5.84
Downeast	Washington	Baileyville Utilities District	10	1.22	0.94	0.30	0.63	1.80	0.01	2.70	0.63	1.10	1.85	2.52	2.61	0.50	8.34
Midcoast	Knox	Friendship Water Department	5	0.30	0.40	0.18	-0.05	0.65	0.01	0.82	0.01	0.01	0.64	0.75	0.78	0.06	10.46
Midcoast	Knox	Washington Manor - Jsls	10	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Midcoast	Knox	North Haven Water Department	40	2.32	2.83	0.45	1.44	3.19	0.01	15.00	0.82	1.30	2.73	4.54	7.59	1.06	5.76
Midcoast	Knox	Port Clyde Water District	5	1.44	1.60	0.72	0.04	2.85	0.01	3.80	0.01	1.20	2.20	3.16	3.48	0.25	19.52
Midcoast	Knox	Crawford Commons	10	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Midcoast	Knox	Maine Water Company Union Division	1	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Midcoast	Knox	Vinalhaven Water District	10	2.42	3.51	1.11	0.25	4.60	0.01	12.00	0.98	1.35	2.33	4.17	8.08	0.71	10.59
Midcoast	Lincoln	Dresden Water Department	10	1.25	1.14	0.36	0.54	1.95	0.01	3.30	0.20	1.25	1.75	2.76	3.03	0.35	11.99
Midcoast	Lincoln	Indian Run Estates Llc	5	1.19	1.70	0.76	-0.30	2.67	0.01	3.70	0.01	0.01	2.20	3.10	3.40	0.10	22.24
Midcoast	Lincoln	Country Manor Nursing Home	10	0.43	0.60	0.19	0.06	0.80	0.01	1.70	0.01	0.01	0.86	1.04	1.37	0.06	10.90

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
Midcoast	Lincoln	Pemaquid Villas Mhp	15	0.85	0.98	0.25	0.36	1.35	0.01	2.90	0.01	0.55	1.15	2.36	2.55	0.18	11.80
Midcoast	Lincoln	Great Salt Bay Sanitary Dist	20	1.59	2.37	0.53	0.55	2.62	0.01	8.70	0.42	1.10	1.45	2.58	7.85	0.41	10.07
Midcoast	Lincoln	Pines Mobile Home Park Llc	5	1.74	1.45	0.65	0.47	3.01	0.01	3.80	1.10	1.30	2.50	3.28	3.54	0.67	11.06
Midcoast	Lincoln	Brookside Mobile Home Court	10	0.96	1.65	0.52	-0.06	1.98	0.01	5.40	0.01	0.38	1.08	1.71	3.56	0.12	14.32
Midcoast	Lincoln	Maplewood Mobile Home Park	10	1.23	0.85	0.27	0.70	1.76	0.01	2.70	0.69	1.12	1.48	2.52	2.61	0.73	4.97
Midcoast	Lincoln	Whippoorwill Hill Mobile Home	10	0.28	0.67	0.21	-0.13	0.70	0.01	2.10	0.01	0.01	0.01	0.80	1.45	0.03	7.61
Midcoast	Sagadahog	Bowdoinham Water District	10	0.43	0.59	0.19	0.06	0.80	0.01	1.50	0.01	0.01	0.75	1.32	1.41	0.06	10.91
Midcoast	Sagadahog	Cathance Trailer Park	5	1.28	1.07	0.48	0.34	2.22	0.01	2.70	0.69	1.00	2.00	2.42	2.56	0.52	9.70
Midcoast	Sagadahog	Happy Trails Mhp	30	5.06	8.40	1.53	2.05	8.06	0.01	35.00	0.60	1.15	5.70	10.30	24.75	1.05	11.28
Midcoast	Sagadahog	Meadowview Apartments	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Midcoast	Sagadahog	Topsham Mobile Home Park Inc	5	0.12	0.25	0.11	-0.10	0.34	0.01	0.56	0.01	0.01	0.01	0.34	0.45	0.02	6.05
Midcoast	Sagadahog	Pinewood Acres Trailer Park	10	3.33	5.17	1.63	0.12	6.53	0.53	17.00	0.71	0.80	3.70	7.19	12.10	1.54	3.30
Midcoast	Sagadahog	Richmond Utilities District	10	1.69	1.64	0.52	0.68	2.71	0.01	4.80	0.59	1.15	2.75	3.81	4.31	0.59	9.56
Midcoast	Sagadahog	Bath Water District	20	5.54	21.70	4.85	-3.97	15.05	0.01	97.60	0.01	0.01	1.35	2.22	9.15	0.09	19.53
Midcoast	Sagadahog	Hillhouse Inc	10	0.74	0.51	0.16	0.43	1.06	0.01	1.50	0.51	0.69	1.18	1.23	1.37	0.35	6.78
Midcoast	Waldo	Winterport Water District	19	0.46	0.55	0.13	0.21	0.71	0.01	1.60	0.01	0.01	0.81	1.26	1.51	0.08	10.17
Midcoast	Waldo	The Sandy Point Water Company	15	3.44	1.48	0.38	2.69	4.19	1.60	6.90	2.30	3.30	4.10	5.04	5.71	3.15	1.55
Midcoast	Waldo	Northport Village Corp Wtr Dep	10	3.28	4.42	1.40	0.55	6.02	0.56	13.00	0.84	1.40	2.05	10.30	11.65	1.77	2.92
Midcoast	Waldo	Belfast Cohousing & Ecovillage Condos	20	0.30	0.45	0.10	0.10	0.50	0.01	1.30	0.01	0.01	0.55	0.98	1.30	0.05	8.52
Midcoast	Waldo	Belfast Water District	20	4.55	11.06	2.47	-0.30	9.40	0.01	50.90	1.42	1.87	2.88	4.84	10.22	0.92	11.63
Midcoast	Waldo	Howards Trailer Park	10	0.64	0.53	0.17	0.32	0.97	0.01	1.40	0.13	0.65	0.92	1.40	1.40	0.22	8.78
Midcoast	Waldo	Piper Stream Mobile Home Park	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Midcoast	Waldo	Moosehead Trail Village	20	3.52	3.33	0.74	2.06	4.97	0.01	12.00	0.96	1.65	5.45	7.86	8.58	1.81	4.82
Midcoast	Waldo	Lake St George Apartments	11	23.67	71.82	21.65	-18.77	66.11	0.01	240.00	0.01	0.67	4.15	9.80	124.90	0.43	30.51
Midcoast	Waldo	Birchwood Trailer Park	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Midcoast	Waldo	Morrill Village Water District	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Midcoast	Waldo	Searsport Water District	20	1.11	0.71	0.16	0.80	1.42	0.01	3.10	0.75	0.96	1.15	2.05	2.53	0.82	3.12
Midcoast	Waldo	The Sandy Point Water Company	10	4.99	3.38	1.07	2.90	7.08	0.58	11.00	2.70	4.15	7.75	8.21	9.61	3.72	2.50

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
Midcoast	Waldo	Sandy Stream Park	5	1.83	2.07	0.92	0.02	3.64	0.01	5.30	0.76	1.10	2.00	3.98	4.64	0.62	11.22
Midcoast	Waldo	Sandy Stream Village	5	0.43	0.93	0.42	-0.39	1.25	0.01	2.10	0.01	0.01	0.01	1.26	1.68	0.03	10.93
Midcoast	Waldo	School Street Village	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Penquis	Penobscot	Bangor Water District	156	4.54	9.24	0.74	3.09	5.99	0.01	86.00	0.01	1.47	4.40	10.85	19.20	0.48	19.58
Penquis	Penobscot	Boulier Place Apts	5	0.60	0.60	0.27	0.07	1.12	0.01	1.30	0.01	0.56	1.10	1.22	1.26	0.15	12.20
Penquis	Penobscot	Colonial Pines	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Penquis	Penobscot	Hermon Mhp Llc	5	0.98	0.37	0.17	0.65	1.30	0.63	1.60	0.79	0.89	0.97	1.35	1.47	0.93	1.41
Penquis	Penobscot	Homestead Estates Llc	10	2.53	2.22	0.70	1.16	3.90	0.01	6.10	0.85	1.80	4.43	5.56	5.83	1.23	6.43
Penquis	Penobscot	Prays Mobile Home Park	15	2.49	3.25	0.84	0.84	4.13	0.01	11.00	0.28	0.83	3.85	6.52	8.34	0.50	13.52
Penquis	Penobscot	Sunny Gables- Glenburn Housing	30	3.78	5.19	0.95	1.92	5.63	0.01	30.00	1.80	2.65	3.88	5.20	6.21	2.07	4.84
Penquis	Penobscot	Towne Center-ridgewood Apartments	25	7.80	4.92	0.98	5.87	9.73	1.30	18.00	3.90	7.00	10.00	15.80	17.80	6.26	2.06
Penquis	Penobscot	Brewer Water Department	20	1.57	1.80	0.40	0.77	2.36	0.01	6.60	0.59	0.84	1.83	3.78	5.46	0.52	8.60
Penquis	Penobscot	R&K Mobile Home Park Llc	5	1.80	1.10	0.49	0.83	2.77	0.88	3.60	0.92	1.70	1.90	2.92	3.26	1.57	1.79
Penquis	Penobscot	Sweet Fern Trailer Pk Inc	5	0.26	0.34	0.15	-0.04	0.56	0.01	0.69	0.01	0.01	0.57	0.64	0.67	0.05	9.66
Penquis	Penobscot	Grandeur Mobile Home Estates	15	1.40	1.12	0.29	0.83	1.97	0.01	3.30	0.29	1.30	2.05	2.84	3.09	0.43	10.96
Penquis	Penobscot	South Slope Estates Mhp	5	0.63	0.70	0.31	0.02	1.24	0.01	1.70	0.01	0.61	0.81	1.34	1.52	0.15	12.41
Penquis	Penobscot	Charleston Correctional Fac	10	0.07	0.19	0.06	-0.05	0.19	0.01	0.62	0.01	0.01	0.01	0.07	0.35	0.02	3.69
Penquis	Penobscot	Faith School Of Theology	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Penquis	Penobscot	Corinthian Manor	5	5.78	2.80	1.25	3.32	8.24	3.00	9.90	3.50	5.50	7.00	8.74	9.32	5.25	1.63
Penquis	Penobscot	Scroggins Mobile Home Park	5	0.90	0.39	0.18	0.56	1.25	0.63	1.60	0.72	0.77	0.80	1.28	1.44	0.85	1.44
Penquis	Penobscot	Town & Country Trailer Park	5	0.84	0.62	0.28	0.29	1.38	0.01	1.50	0.51	0.76	1.40	1.46	1.48	0.38	8.04
Penquis	Penobscot	Village Green Mhp	10	0.77	0.89	0.28	0.22	1.32	0.01	2.30	0.01	0.50	1.44	2.03	2.17	0.16	11.70
Penquis	Penobscot	Wentworth Mobile Home Park	5	0.95	0.69	0.31	0.34	1.55	0.01	1.80	0.52	1.20	1.20	1.56	1.68	0.42	8.51
Penquis	Penobscot	Cedar Haven Mobile Home Pk	5	0.75	0.75	0.33	0.09	1.41	0.01	1.60	0.01	0.73	1.40	1.52	1.56	0.17	13.86
Penquis	Penobscot	Greenwood Garden Apartments	5	1.56	0.45	0.20	1.17	1.96	0.82	2.00	1.50	1.70	1.80	1.92	1.96	1.50	1.42
Penquis	Penobscot	Holden Mobile Home Park	10	1.38	2.14	0.68	0.05	2.71	0.01	6.10	0.01	0.30	1.64	4.48	5.29	0.14	17.24
Penquis	Penobscot	Holden Square Apts	5	0.14	0.30	0.13	-0.12	0.41	0.01	0.68	0.01	0.01	0.01	0.41	0.55	0.02	6.60
Penquis	Penobscot	Pine Cone Mobile Home Ct #1	5	0.85	0.56	0.25	0.35	1.34	0.01	1.50	0.72	0.81	1.20	1.38	1.44	0.40	8.05
Penquis	Penobscot	East Millinocket Water Works	10	2.69	1.39	0.44	1.83	3.55	1.40	6.40	2.00	2.30	2.65	3.52	4.96	2.47	1.50
Penquis	Penobscot	Exeter Water Department	5	1.70	0.23	0.10	1.49	1.91	1.40	1.90	1.50	1.80	1.90	1.90	1.90	1.69	1.15
Penquis	Penobscot	Hampden Water District	20	9.36	33.63	7.52	-5.38	24.10	0.01	152.0	0.01	1.71	3.64	5.32	13.02	0.36	23.32

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
										0							
Penquis	Penobscot	Persistence Seniors Housing	25	4.23	2.65	0.53	3.19	5.27	1.20	11.00	2.30	4.00	5.80	7.82	9.42	3.50	1.90
Penquis	Penobscot	Howland Water Dept	10	1.14	1.32	0.42	0.33	1.96	0.01	4.28	0.01	1.19	1.50	2.10	3.19	0.22	14.49
Penquis	Penobscot	Country Mobile Home Park	10	0.38	0.40	0.13	0.13	0.63	0.01	0.92	0.01	0.30	0.76	0.83	0.88	0.09	9.67
Penquis	Penobscot	Wooded Grove Mobile Home Park	5	0.92	0.23	0.10	0.71	1.12	0.61	1.20	0.83	0.85	1.10	1.16	1.18	0.89	1.31
Penquis	Penobscot	Town Hall Apts - Lagrange	20	6.01	13.03	2.91	0.30	11.72	0.01	56.00	0.97	1.50	2.50	14.10	25.60	1.74	5.46
Penquis	Penobscot	Willow Brook Mobile Home Park	5	1.43	3.18	1.42	-1.36	4.23	0.01	7.13	0.01	0.01	0.01	4.28	5.71	0.04	18.88
Penquis	Penobscot	Lincoln Water District	10	1.54	1.00	0.32	0.92	2.16	0.01	2.80	0.85	1.50	2.45	2.71	2.76	0.89	5.37
Penquis	Penobscot	Mattawamkeag Housing Corp	5	0.63	0.86	0.39	-0.13	1.38	0.01	1.80	0.01	0.01	1.30	1.60	1.70	0.07	15.76
Penquis	Penobscot	Old Town Water District	40	2.86	2.34	0.37	2.14	3.59	0.01	11.00	1.30	2.20	3.58	5.65	7.02	1.60	5.07
Penquis	Penobscot	Streets Mobile Home Park	10	0.68	0.86	0.27	0.14	1.21	0.01	2.60	0.01	0.40	0.98	1.52	2.06	0.11	12.80
Penquis	Penobscot	Vigneaults Mobile Home Park	5	3.30	2.90	1.30	0.76	5.84	0.01	7.30	1.10	3.40	4.70	6.26	6.78	1.05	14.80
Penquis	Penobscot	Havasu Pines Mhp	5	7.34	4.60	2.06	3.31	11.37	2.30	13.00	3.00	8.40	10.00	11.80	12.40	5.96	2.16
Penquis	Penobscot	Havasu Pines Mhp #1	5	1.25	1.01	0.45	0.36	2.14	0.01	2.40	0.52	1.20	2.10	2.28	2.34	0.50	9.67
Penquis	Penobscot	Orono-veazie Water District	20	2.20	1.43	0.32	1.58	2.83	0.58	5.60	1.35	1.75	3.03	4.05	5.41	1.83	1.87
Penquis	Penobscot	Stillwater Mobile Home Park	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Penquis	Penobscot	Fairground Apts	10	2.74	2.76	0.87	1.03	4.45	0.64	8.80	0.96	1.30	3.93	6.19	7.50	1.83	2.50
Penquis	Penobscot	Patten Water Dept	5	1.11	0.87	0.39	0.34	1.87	0.01	2.30	0.75	0.87	1.60	2.02	2.16	0.47	9.07
Penquis	Penobscot	Corinna Water District	5	3.41	2.20	0.99	1.47	5.34	0.83	5.90	2.10	2.70	5.50	5.74	5.82	2.73	2.23
Penquis	Penobscot	Maple Ridge Mobile Home Park	10	19.83	59.82	18.92	-17.25	56.91	0.01	190.00	0.01	0.01	1.41	24.40	107.20	0.13	36.18
Penquis	Penobscot	Dexter Utility District	10	1.36	1.14	0.36	0.65	2.06	0.01	3.00	0.15	1.55	2.18	2.64	2.82	0.37	12.60
Penquis	Penobscot	Newport Water District	60	6.82	16.96	2.19	2.52	11.11	0.01	100.00	0.58	1.40	4.58	15.00	25.60	1.04	11.39
Penquis	Penobscot	Plymouth Water District	5	0.64	0.68	0.30	0.04	1.24	0.01	1.60	0.01	0.58	1.00	1.36	1.48	0.16	12.61
Penquis	Pisgataquis	Brownville Jct Water Dept	10	1.78	1.12	0.35	1.09	2.48	0.67	4.20	1.00	1.50	1.95	3.30	3.75	1.53	1.77
Penquis	Pisgataquis	Brownville Water Department	10	1.10	1.13	0.36	0.40	1.79	0.01	3.60	0.17	0.85	1.48	2.25	2.93	0.31	11.15
Penquis	Pisgataquis	Three Rivers M H Community	5	0.27	0.58	0.26	-0.24	0.77	0.01	1.30	0.01	0.01	0.01	0.78	1.04	0.03	8.82
Penquis	Pisgataquis	Dover-foxcroft Water District	10	1.24	1.58	0.50	0.26	2.22	0.01	5.10	0.01	0.90	1.83	2.31	3.71	0.22	14.82
Penquis	Pisgataquis	Covered Bridge Apartments	5	0.69	0.67	0.30	0.11	1.28	0.01	1.50	0.01	0.85	1.10	1.34	1.42	0.17	13.36
Penquis	Pisgataquis	Milo Water District	20	4.19	3.87	0.87	2.49	5.89	0.01	18.00	2.18	3.60	4.40	7.58	9.64	2.59	4.32
Penquis	Pisgataquis	Monson Utilities District	55	2.72	2.08	0.28	2.17	3.27	0.01	11.00	1.15	2.20	3.85	5.00	5.69	1.94	2.82

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
Penquis	Pisgataquis	Guilford-sangerville Water Dis	10	3.32	2.42	0.77	1.82	4.82	0.80	7.30	1.35	2.50	5.00	6.94	7.12	2.56	2.18
Penquis	Pisgataquis	Guilford-sangerville Water District	10	7.11	8.09	2.56	2.10	12.12	2.40	29.60	3.78	4.40	5.75	10.70	20.15	5.24	2.02
Western	Androscoggin	Auburn Water District	44	9.99	21.93	3.31	3.51	16.47	0.01	125.00	1.48	3.45	7.05	21.09	41.97	1.37	17.62
Western	Androscoggin	Country Acres Trailer Park	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Western	Androscoggin	The Meadows	5	0.81	0.68	0.31	0.22	1.41	0.01	1.90	0.65	0.73	0.78	1.45	1.68	0.37	7.88
Western	Androscoggin	Woodland Acres Mobile Home Pk	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Western	Androscoggin	Lewiston Water & Sewer Division	30	9.08	22.74	4.15	0.95	17.22	0.01	120.00	0.88	2.37	7.51	13.81	33.21	2.31	5.80
Western	Androscoggin	Sunset Gardens Trailer Park Inc	10	0.08	0.22	0.07	-0.06	0.21	0.01	0.69	0.01	0.01	0.01	0.08	0.38	0.02	3.82
Western	Androscoggin	Lisbon Water Department	21	4.43	5.79	1.26	1.96	6.91	0.01	20.00	0.01	0.01	7.00	10.00	16.00	0.25	31.79
Western	Androscoggin	Livermore Falls Water District	10	3.31	4.54	1.44	0.49	6.12	0.01	11.00	0.01	0.01	6.50	10.10	10.55	0.14	31.51
Western	Androscoggin	Pine Ridge Hunton Brook Assn	5	0.42	0.91	0.41	-0.38	1.21	0.01	2.04	0.01	0.01	0.01	1.23	1.63	0.03	10.79
Western	Androscoggin	Mechanic Falls Water Dept	11	5.01	12.61	3.80	-2.44	12.47	0.01	42.80	0.01	1.20	2.45	4.30	23.55	0.25	24.86
Western	Androscoggin	Spring Rock Park	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Western	Androscoggin	Northern Spring Park	10	0.20	0.42	0.13	-0.06	0.47	0.01	1.20	0.01	0.01	0.01	0.80	1.00	0.02	6.86
Western	Androscoggin	Poland Country Village Mhp,Inc	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Western	Androscoggin	Poland Trailer Park - Poland	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Western	Androscoggin	Begin Trailer Park	5	0.11	0.22	0.10	-0.09	0.31	0.01	0.51	0.01	0.01	0.01	0.31	0.41	0.02	5.80
Western	Androscoggin	Sabattus Sanitary District	10	2.40	1.90	0.60	1.23	3.58	0.82	6.40	1.18	1.60	2.60	5.32	5.86	1.91	1.96
Western	Androscoggin	Springbrook Mobile Home Court	10	0.27	0.56	0.18	-0.08	0.62	0.01	1.60	0.01	0.01	0.01	1.06	1.33	0.03	7.72
Western	Androscoggin	Hillview Estates	5	1.37	2.21	0.99	-0.57	3.30	0.01	5.10	0.01	0.01	1.70	3.74	4.42	0.10	23.06
Western	Androscoggin	Moark Llc-turner	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Western	Androscoggin	Nezinscot Village	10	0.64	1.41	0.45	-0.24	1.51	0.01	4.50	0.01	0.01	0.60	1.34	2.92	0.05	11.82
Western	Androscoggin	Sandy Bottom Estates Mhp	5	1.05	1.81	0.81	-0.54	2.64	0.01	4.20	0.01	0.01	1.00	2.92	3.56	0.08	19.28
Western	Androscoggin	Turner Square Apartments	10	0.31	0.40	0.13	0.07	0.56	0.01	0.95	0.01	0.01	0.70	0.78	0.86	0.06	9.36
Western	Franklin	Jay Village Water District	10	3.93	8.62	2.73	-1.41	9.27	0.01	28.20	0.01	1.47	2.39	6.13	17.17	0.32	22.09
Western	Franklin	North Jay Water District	10	0.70	1.05	0.33	0.05	1.34	0.01	3.12	0.01	0.01	1.07	1.79	2.45	0.08	13.76
Western	Franklin	Wilton Water Department	20	5.07	12.47	2.79	-0.40	10.53	0.01	57.00	0.69	1.90	3.75	5.76	12.26	0.73	14.92
Western	Franklin	Eustis Water Department	10	1.37	1.13	0.36	0.67	2.07	0.01	3.90	0.83	1.05	1.33	2.91	3.41	0.79	5.10
Western	Franklin	Farmington Falls Std Water	5	0.84	0.71	0.32	0.22	1.46	0.01	1.80	0.50	0.58	1.30	1.60	1.70	0.37	8.06

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
		Dist															
Western	Franklin	Farmington Village Corp Water Dept	20	6.80	5.63	1.26	4.33	9.26	0.01	18.60	1.88	5.13	10.95	14.60	16.51	2.93	8.32
Western	Franklin	Kingfield Water District	10	1.37	1.40	0.44	0.50	2.23	0.01	4.30	0.62	0.84	1.93	3.22	3.76	0.50	8.68
Western	Franklin	New Sharon Water District	5	0.23	0.30	0.13	-0.03	0.49	0.01	0.59	0.01	0.01	0.52	0.56	0.58	0.05	9.02
Western	Franklin	Mt Blue Standard Water District	10	0.76	0.64	0.20	0.36	1.15	0.01	1.70	0.15	0.70	1.18	1.61	1.66	0.25	9.50
Western	Franklin	Oquossoc Standard Water System	5	1.08	0.75	0.34	0.42	1.74	0.01	2.10	0.91	1.10	1.30	1.78	1.94	0.49	8.97
Western	Franklin	Rangeley Water District	10	2.64	1.57	0.50	1.66	3.61	0.67	5.10	1.48	2.40	3.83	4.74	4.92	2.18	2.00
Western	Franklin	Strong Water District	5	2.26	1.10	0.49	1.29	3.23	1.50	4.20	1.70	1.90	2.00	3.32	3.76	2.10	1.50
Western	Oxford	Fryeburg Water Company	10	1.07	0.52	0.16	0.75	1.39	0.01	1.90	0.90	1.10	1.35	1.54	1.72	0.71	4.62
Western	Oxford	Andover Water District	5	1.68	1.04	0.47	0.77	2.60	0.01	2.80	1.50	2.00	2.10	2.52	2.66	0.71	10.92
Western	Oxford	Buckfield Village Corporation	10	1.85	1.67	0.53	0.82	2.88	0.01	4.80	0.88	1.25	3.13	3.99	4.40	0.66	9.88
Western	Oxford	Canton Point Park	10	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Western	Oxford	Canton Water District	10	5.34	5.30	1.68	2.05	8.62	0.98	16.00	2.38	2.85	5.63	14.20	15.10	3.70	2.38
Western	Oxford	Dixfield Water & Sewer Dept	10	3.33	8.69	2.75	-2.06	8.72	0.01	28.00	0.01	0.68	1.03	4.60	16.30	0.22	17.39
Western	Oxford	Hebron Water Company	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Western	Oxford	Mt Abram Chalet Association	5	7.48	4.95	2.21	3.14	11.82	1.30	13.00	4.70	6.40	12.00	12.60	12.80	5.72	2.54
Western	Oxford	Mexico Water District	20	6.39	26.52	5.93	-5.23	18.01	0.01	119.00	0.01	0.01	0.64	2.10	8.80	0.07	17.40
Western	Oxford	Norway Water District	10	0.81	2.53	0.80	-0.76	2.38	0.01	8.00	0.01	0.01	0.01	0.81	4.40	0.02	8.28
Western	Oxford	Oxford Water District	10	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
Western	Oxford	Paris Utility District	10	1.74	1.44	0.46	0.85	2.64	0.01	5.00	1.20	1.50	2.23	2.93	3.97	0.68	9.60
Western	Oxford	Rumford Water District	20	1.52	1.76	0.39	0.75	2.29	0.01	7.60	0.50	1.10	2.03	2.98	3.90	0.45	10.24
Western	Oxford	West Paris Water District	20	2.78	2.38	0.53	1.73	3.82	0.78	9.70	1.55	2.00	2.98	4.63	8.56	2.16	1.98
York	York	Berwick Water Department	10	9.50	23.50	7.43	-5.06	24.07	0.01	76.00	0.26	1.00	5.25	13.90	44.95	0.63	22.98
York	York	Sunrise Hill Estates	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
York	York	Marshwood Estates	12	3.53	4.68	1.35	0.88	6.18	0.29	14.50	0.76	1.39	3.80	11.00	12.96	1.77	3.32
York	York	Kittery Water District	30	0.91	1.26	0.23	0.45	1.36	0.01	4.00	0.01	0.01	2.00	3.00	3.00	0.08	14.39
York	York	North Berwick Water District	10	1.11	1.37	0.43	0.26	1.95	0.01	4.00	0.01	0.51	2.00	2.20	3.10	0.14	16.64
York	York	South Berwick Water District	20	2.75	3.79	0.85	1.09	4.41	0.01	17.00	1.00	2.00	3.00	5.20	7.50	0.80	10.58
York	York	Woodland Hills Condo Assoc	20	0.90	0.80	0.18	0.55	1.25	0.01	2.60	0.01	0.79	1.33	1.86	2.41	0.28	9.63
York	York	York Water District	30	2.64	9.07	1.66	-0.60	5.89	0.01	49.00	0.01	0.01	0.01	5.10	7.65	0.04	15.81

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
York	York	Alfred Water District	10	0.41	1.26	0.40	-0.37	1.19	0.01	4.00	0.01	0.01	0.01	0.41	2.20	0.02	6.65
York	York	Keywood Manor Mobile Village	5	0.67	0.90	0.40	-0.13	1.46	0.01	1.80	0.01	0.01	1.50	1.68	1.74	0.08	16.36
York	York	Oakwood Mobile Community Association	10	0.99	0.56	0.18	0.64	1.33	0.01	1.80	0.61	0.98	1.35	1.71	1.76	0.63	4.56
York	York	Oakwood Mobile Community Association-2	25	2.09	2.07	0.41	1.28	2.90	0.01	6.50	0.01	1.60	2.80	5.82	6.38	0.52	13.05
York	York	York County Shelters	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
York	York	Cornish Water District	10	1.92	1.42	0.45	1.04	2.80	0.01	4.70	1.05	1.30	2.98	3.44	4.07	1.08	5.69
York	York	Colonial Mobile Home Park	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
York	York	Evergreen Estates Of Lebanon Llc	10	0.32	0.72	0.23	-0.13	0.76	0.01	2.20	0.01	0.01	0.01	1.00	1.60	0.03	8.09
York	York	Nichols Trailer Park	15	0.12	0.29	0.07	-0.03	0.27	0.01	0.89	0.01	0.01	0.01	0.47	0.81	0.02	4.73
York	York	Tanglewood Mobile Estates 2	15	0.35	0.86	0.22	-0.08	0.79	0.01	3.20	0.01	0.01	0.01	0.99	1.66	0.03	8.01
York	York	Kennebunk, Kennebunkport & Wells Wd	24	16.09	44.57	9.10	-1.75	33.92	0.01	200.00	0.01	1.00	2.25	46.00	84.80	0.37	30.18
York	York	Charter Oak Mobile Home Village	10	11.01	20.01	6.33	-1.39	23.41	0.01	65.00	0.79	2.00	10.18	24.50	44.75	2.15	11.32
York	York	Shady Oaks Mobile Home Park	5	1.21	0.62	0.28	0.66	1.75	0.54	2.19	0.84	1.18	1.29	1.83	2.01	1.08	1.69
York	York	The Pines At Arundel	10	2.39	2.66	0.84	0.74	4.04	0.01	8.20	0.73	1.16	2.85	6.13	7.17	1.05	6.44
York	York	Limerick Mobile Home Park	5	1.00	1.00	0.44	0.13	1.88	0.01	2.00	0.01	1.00	2.00	2.00	2.00	0.21	16.28
York	York	Limerick Water District	10	1.08	1.07	0.34	0.41	1.74	0.01	2.40	0.01	0.86	2.20	2.40	2.40	0.21	14.24
York	York	Hidden Lake Village Inc	5	1.77	1.17	0.52	0.74	2.79	0.64	3.40	0.70	1.70	2.40	3.00	3.20	1.44	2.10
York	York	Hidden Lake Village Llc	5	0.89	0.55	0.25	0.41	1.37	0.01	1.50	0.83	1.00	1.10	1.34	1.42	0.42	8.21
York	York	Estes Lake Mobile Home Park	5	1.20	1.30	0.58	0.07	2.34	0.01	3.00	0.01	1.00	2.00	2.60	2.80	0.23	17.75
York	York	Marsh Brook Estates	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
York	York	Pinewood Vista Llc	5	2.82	1.63	0.73	1.39	4.25	0.01	4.10	3.00	3.20	3.80	3.98	4.04	1.08	13.77
York	York	Sanford Water District	30	2.61	5.84	1.07	0.52	4.69	0.01	27.00	0.01	0.01	2.00	6.10	13.05	0.14	19.75
York	York	Pine Spring Roads & Water	15	1.11	1.38	0.36	0.41	1.81	0.01	4.90	0.01	0.73	1.20	2.76	3.85	0.26	11.47
York	York	Applewood	10	5.80	6.39	2.02	1.84	9.76	0.94	18.00	1.55	3.10	5.78	17.10	17.55	3.54	2.79
York	York	Lake Arrowhead Community Inc	10	3.00	2.90	0.92	1.20	4.80	0.01	8.00	0.26	3.00	4.50	7.10	7.55	0.61	18.13
York	York	Twin Pines Estates #1	25	2.22	2.52	0.50	1.23	3.20	0.01	11.00	0.73	1.40	3.20	4.96	5.84	0.69	9.78
York	York	Twin Pines Estates #2	10	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00
York	York	Waterboro Water District	5	1.89	1.22	0.54	0.82	2.96	0.73	3.88	1.20	1.57	2.08	3.16	3.52	1.62	1.87
York	York	Blueberry Vista Llc	10	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00

Public Health District	County	SYSTEM NAME	nSize	Mean	StDev	SEM	LCL	UCL	Min	Max	25th	Median	75th	90th	95th	GM	GSD
York	York	Highpine Mobile Home Court	5	0.41	0.89	0.40	-0.37	1.19	0.01	2.00	0.01	0.01	0.01	1.20	1.60	0.03	10.69
York	York	Pheasant Hill Mhp	20	0.52	0.65	0.15	0.23	0.80	0.01	1.80	0.01	0.01	0.84	1.52	1.71	0.08	10.91
York	York	Pinetree Village Homeowners Association	10	0.21	0.63	0.20	-0.18	0.60	0.01	2.00	0.01	0.01	0.01	0.21	1.10	0.02	5.34
York	York	The Old Marsh Condominium	5	1.01	1.41	0.63	-0.23	2.24	0.01	3.00	0.01	0.01	2.00	2.60	2.80	0.09	20.42
York	York	Elwell Farms	15	0.05	0.15	0.04	-0.03	0.12	0.01	0.59	0.01	0.01	0.01	0.01	0.18	0.01	2.87
York	York	Harmon Pines Development	5	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.00

nSize: Number of samples collected; StDev: Standard Deviation; SEM: Standard Error of the Mean; LCL: 95% Lower confidence limit; UCL: 95% Upper confidence limit; Min: Minimum lead concentration reported; Max: Maximum lead concentrations reported; Median: 50^{th} percentile; 90^{th}: 90^{th} percentile; 95^{th}: 95^{th} percentile; GM: Geometric mean; GSD: Geometric standard deviation

ATTACHMENT 2. Master of Public Health Capstone Proposal.

NICK FLAVIN, MASTER OF PUBLIC HEALTH CANDIDATE

Estimating a Background Lead Concentration in Maine's Community Water Systems for Use in Human Health Risk Assessments

Statement of Need

Representative estimates of background lead concentrations in community drinking water are needed to support assessing lead exposure in Maine. This need is amplified by the recent lowering of the childhood blood lead reference level from 10µg/dL to 5µg/dL.

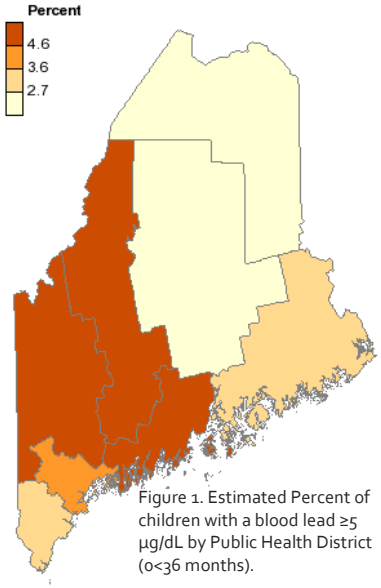

Figure 1. Estimated Percent of children with a blood lead ≥5 µg/dL by Public Health District (0<36 months).

Background

Exposure to lead continues to be a threat to public health (EPA, 2013; CDC 2012). In 2015, the Maine Legislature voted to amend the Lead Poisoning Control Act definition of lead poisoning (i.e., reduce the childhood blood lead reference level from 10µg/dL to 5µg/dL) to align with recent US Centers of Disease Control and Prevention recommendations (MeCDC 2015a,b). While childhood blood lead levels in Maine are primarily driven by lead contaminated paints and dusts, lead concentrations found in Maine's water supply have historically been due to the use of leaded pipes and solder (MeCDC, 2016).

In the United States, public water-lead concentrations are monitored by US Environmental Protection Agency's (EPA's) Office of Water as part of the Clean Water Act and the Lead and Copper Rule (EPA, 2010). State Agencies are responsible for collecting and reporting the 90th percentile (i.e., highest concentrations) values to EPA (2010), providing insight for regulatory monitoring and trigger potential action. In Maine, the Maine Centers for Disease and Protection (MeCDC) Drinking Water Program is charged with collecting, analyzing, monitoring and submitting these data. In addition, MeCDC's Environmental and Occupational Health Program collects site-specific water samples as part of their investigations of residential lead hazards where children with elevated blood lead have been identified.

Risks from lead exposure from drinking water (as well as other environmental media) are estimated by MeCDC's Environmental and Occupational Health Program. Utilizing both site-specific environmental samples, as well as default background values recommended by the US EPA (1994a), MeCDC will often estimate childhood blood lead concentrations using EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model. The IEUBK model is a tool recommended by EPA since 1994 to predict the distribution of blood lead within a population of children (EPA, 1994a,b). While site-specific media concentrations are recommended for use in the IEUBK model (EPA, 1994a), default background values for specific media are provided by EPA (EPA, 1994a). In the case of water, EPA (1994a) recommends a background water lead concentration of 4 µg/L. This value is a central tendency estimate that was based on a 1980s analysis of approximately 1,500 water systems throughout the United States (EPA, 1994a; Marcus, 1989; AWWSC, 1988).

The purpose of this study is twofold: 1) use data collected and reported by MeCDC's Division of Environmental Health to estimate background water concentrations in community water systems, and 2) examine whether the current EPA default background first-draw water-lead concentration of 4 µg/L continues to be an appropriate value for modeling lead exposure in Maine children.

Critical Elements of the Study

- Provide an overview of the history of water-lead exposures and drinking water regulations in the United States;
- Provide an overview of lead exposure and utilizing EPA's IEUBK model to model childhood blood lead;
- Establish a water-lead database based on MeCDC's reported sampling events;
- Provide summary statistics of water lead concentrations, including population-weighted estimates for three levels of detail: by County, Public Health District, and State-wide;
- Map results using a geographical information system (GIS);
- Compare the effects of changing the default water-lead concentration value in EPA's IEUBK model; and
- Provide recommendations whether or not to adjust the current default IEUBK model background value.

Study Overview

Background

- Exposure to lead continues to be a health concern, especially for children (CDC, 2012).
- Exposure to lead in drinking water has historically been a contributor to negative health outcomes in Maine (MeCDC, 2016).
- Recent lowering of the childhood blood lead reference level from 10µg/dL to 5µg/dL has increased the pressure to accurately characterize exposures (MeCDC, 2015a,b).

Current Conditions

- Current default background water lead concentrations used by MeCDC in risk assessments are based on national data from the 1980s.
- Water-lead samples are collected by MeCDC from Community water systems and site-specific risk assessments across the state.

Goals

- Provide methodology for determining background water-lead concentrations for community water systems.
- Provide representative estimates of background water-lead concentrations on three levels of detail: by County, Public Health District, State-wide.

Measures

Measure	Type of Data	Operational Definition	Data Source	Analytical Tools	Display
Lead concentration in drinking water	Continuous	Lead concentrations (µg/L) in Community water systems in Maine (2012-2015)[a]	MeCDC, Drinking Water Program[b] & EOH Program.	• Microsoft Office • Tableau • Alteryx/R • ArcGIS • IEUBK model	• Summary Tables • Histogram • Run & Control Chart • GIS Mapping

EOH: MeCDC Environmental & Occupational Health Program

[a]Community water systems are defined as serving at least 25 year-round residents or has at least 15 service connections used by year-round residents (MeCDC, 2004).

[b]Analysis of lead in water must be performed by an US EPA accredited laboratory certified by the Maine Department of Human Services to analyze for lead in drinking water (MeCDC, 2010).

Analysis, Data Assumption & Needs

- It is assumed that data are reliable and accurate. Samples collected and submitted by community water systems were handled following EPA and Me CDC guidance, water samples were evaluated using accurate techniques from certified labs.
- All Community Water Samples from 2012-2015 will be requested from Maine CDC, Drinking Water Program.
- Data will include the water district ID, system name, system type, principal city served, population served, collection date, laboratory providing the results, and measured lead concentrations (mg/L).
- Summary statistics will include the number of samples, mean, standard deviation, standard error, and distribution of the data via percentiles (25^{th}, 50^{th}, 75, 90^{th}, and 95^{th}). Mean concentrations will be mapped by, County, Public Health District, and for the entire State.
- Analyses will be performed on the samples to determine potential outliers, and to evaluate statistical relationships and differences between the levels of detail.
- If available, age of water system and population served will be noted
- Public Health District data (i.e., towns in district) will be requested from Maine CDC, Division of Public Health Operations.

Deliverable

- Analytical Research paper

The intended audience for this project:

- Public Health advocates
- Human health risk assessors
- Environmental scientists/ epidemiologists
- Toxicologists
- State and federal environmental policy makers

Anticipated Project Timeline

Tasks	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Begin Formulating Capstone/Proposal/Literature Review										
Select Capstone Advisors										
Draft Proposal & Submit to Advisors										
Faculty Review & Comment										
Finalize Proposal & Present										
Submit for IRB Review										
Request Data										
Identify Data Gaps & Perform Data Analysis										
Submit Initial Draft of Capstone										
Faculty Review & Comment										
Submit Draft Final Capstone										
Faculty Review & Comment										
Submit Final Capstone for Approval										
Present Capstone										

Contacts for Data

- Roger Crouse, Maine CDC, Drinking Water Program
- Andrew Smith, Maine CDC, Environmental and Occupational Health Program
- Jennifer Jamison, Office of Licensing and Regulatory Services
- Robin Frost, Office of Licensing and Regulatory Services
- James A. Markiewicz, Maine CDC, Division of Public Health Operations

References

American Water Works Service Company, Inc. (AWWSC). (1988). Lead at the tap – sources and control: A survey of the American water system, pp 1-72.

Maine Centers for Disease and Prevention (MeCDC). (2010). Chapter 263, Maine Comprehensive and limited environmental laboratory certification rules. Department of Health and Human Services jointly with Department of Environmental Protection. April 1.

Maine Centers for Disease and Prevention (MeCDC). (2015a). Pediatric blood lead screening guidelines. Maine CDC Childhood Lead Poisoning Prevention Program. March. Available online at:

Maine Centers for Disease and Prevention (MeCDC). (2015b). RE: Notification of changes to pediatric blood lead testing recommendations. Memorandum to Health Care Providers. From Andrew E. Smith. March 5. Available online at:

Maine Centers for Disease and Prevention (MeCDC). (2016). Childhood lead poisoning website. Viewed September 11, 2016.

Maine Department of Environmental Protection (MeDEP). (2004). Maine Solid Waste Management Rules. Chapter 424. Lead Management Regulations. December 11.

Marcus, AH. (1989). Distribution of lead in tap water. Parts I and II. Report to the U.S. Environmental Protection Agency, Office of Drinking Water. Batelle Memorial Institute, Contract 68-D8-0115. January.

U.S. Centers of Disease Control and Prevention (CDC). (2012). Low level lead exposure harms children: A renewed call for primary prevention. Report of the Advisory Committee on Childhood Lead Poisoning Prevention. Atlanta, GA. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

U.S. EPA (U.S. Environmental Protection Agency). (1994a). Guidance manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. Office of Solid Waste and Emergency Response, Washington, DC. Publication Number 9285.7-15-1. EPA/540/R-93/081.

U.S. EPA (U.S. Environmental Protection Agency). (1994b). Technical support document: parameters and equations used in the Integrated Exposure Uptake Biokinetic Model for Lead in Children (v0.99d). Office of Solid Waste and Emergency Response. EPA 540/R-94/040 PB 94-963505 OSWER #9285.7-22.

U.S. Environmental Protection Agency (EPA). (2010). Lead and Copper Rule: Monitoring and reporting guidance for public water systems. EPA 816-R-10-004. March.

U.S. Environmental Protection Agency (U.S. EPA). (2013). Integrated Science Assessment for Lead (Final

ATTACHMENT 2. Master of Public Health Capstone Poster Presentation.

Evaluation of Childhood Exposure to Lead in Community Water Systems in Maine

Nicholas Flavin[1] , Andrew E. Smith SM, ScD[2], Elise Bolda PhD[1]
[1]University of Southern Maine, Muskie School of Public Service, [2]Maine Center for Disease Control and Prevention

Introduction

- Exposure to lead in drinking water continues to be a threat to public health.[1,2]
- Young children are the most sensitive age group to the effects of lead, posing potential cognitive development and behavioral impairments in children under 7 years of age (*i.e.*, 84 months) at blood lead levels as low as 5 µg/dL.[2]
- Maine Center for Disease Control and Prevention (MeCDC) estimates approximately 3.4%, or 1528 Maine children have blood lead concentrations greater than 5 µg/dL.[3]
- Lead in drinking water is typically a colorless, odorless, and tasteless metal that can go undetected.
- Concentrations of lead in drinking water are primarily derived from the corrosion of lead-containing plumbing (*e.g.*, solder, pipes, service lines, brass faucets) due to changes in the drinking water chemistry, such as pH, water temperature, or water treatments[1,4]
- The Lead and Copper Rule of the Safe Drinking Water Act regulates corrosion of lead into public drinking water by establishing an action level (15 µg/L).
- The purpose of this study was to investigate lead concentrations in Community Water Systems, and to examine the impact of these concentrations on childhood blood lead concentrations.

Methods

- 4,700 first-draw water samples, collected from 358 Maine Community Water systems between 2012-2015, were obtained from MeCDC's Drinking Water Program.
- Data included the water district ID, system name, system type, principal city served, population served, collection date, laboratory, and measured water lead concentrations (mg/L). Concentrations below detection limits were converted to 0.01 µg/L.
- The IEUBK model (v.1.1, build 11) was used to predict blood lead concentrations in children ages 0-84 months using IEUBK model default values for environmental media.
- Summary statistics were calculated using SAS and Alteryx software. Tableau software (version 9.2) was used for mapping geospatial data using water-supplier-specific zip codes and Federal Information Processing Standard codes obtained from the U.S. Census Bureau.[5]

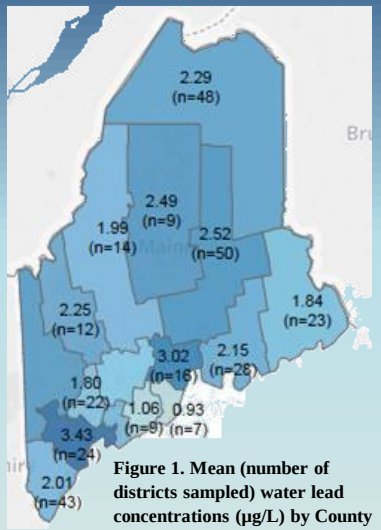

Figure 1. Mean (number of districts sampled) water lead concentrations (µg/L) by County from Community Water Systems in Maine.

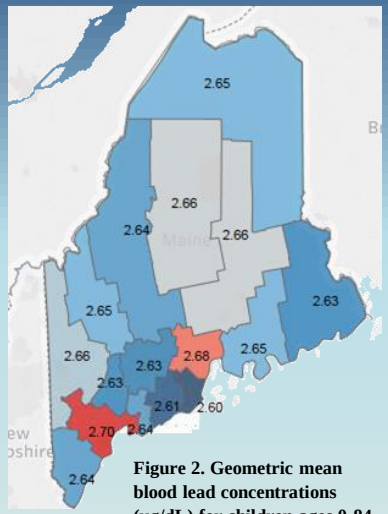

Figure 2. Geometric mean blood lead concentrations (µg/dL) for children ages 0-84 months by County based on Community Water Systens.

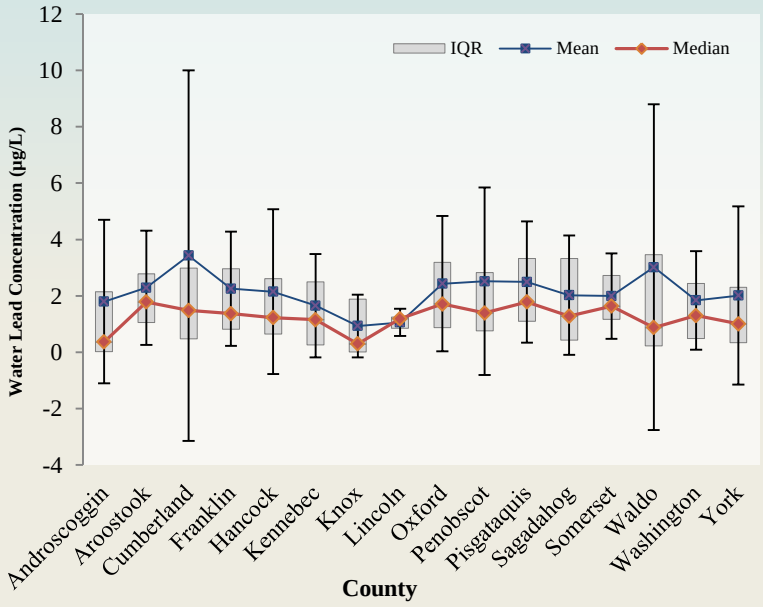

Figure 3. Summary of mean water lead concentrations by County from Community Water Systems in Maine. Box values represent the interquartile range (IQR); whiskers represent standard deviations.

Results

- The geometric mean ± geometric standard deviation drinking water-lead concentrations were estimated to be 0.82 ± 6.59 µg/L; the arithmetic mean concentration estimated to be 2.20 µg/L (95% CI:1.88-2.53). Water-lead concentrations from individual samples ranged from 0.01 (non-detected) to 240 µg/L. Based on these values and modeled conditions, approximately 9% of Maine children serviced by Community water systems would have a blood lead >5 µg/dL.
- State-wide predicted geometric mean blood lead or children was estimated to be 0.094 when IEUBK model default values were set to zero, sing the drinking water concentration of 2.20 µg/L.
- Aggregated by county, the highest mean water-lead concentrations were observed in Cumberland (3.43 µg/L), Waldo (3.02 µg/L) and Piscataquis (2.49 µg/L) (Figure 1).
- Water -lead results were further aggregated by County- and Public Health District and were not significantly different from individual counties (Figure 3) or overall state values ($p>0.05$).
- GM blood lead concentrations for Maine children ages 0-84 months were estimated to be 2.59 µg/dL (ranging from 2.60-2.70 µg/dL); this value is lower than the currently established EPA national value (2.73 µg/dL, $p>0.05$).

Limitations & Conclusion

- Water lead concentrations in Maine Community water systems likely contribute to childhood blood lead, though potentially less than the national default.
- Lowering the current IEUBK model default value of 4 µg/L to 2.20 µg/L may be an appropriate background lead concentration for children serviced by Community Water systems in Maine.
- Site-specific data , including differences among sampling locations and individual water use behaviors, are needed to further support predicting blood lead concentrations.

References

[1]U.S. Environmental Protection Agency (EPA). (2013). Integrated Science Assessment for Lead (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-10/075F.
[2]U.S. Centers of Disease Control and Prevention (CDC). (2012). Low level lead exposure harms children: A renewed call for primary prevention. Report of the Advisory Committee on Childhood Lead Poisoning Prevention. Atlanta, GA. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.
[3]The Maine Childhood Lead Poisoning Prevention Unit. Data downloaded from the Maine Environmental Public Health Tracking Program (https://data.mainepublichealth.gov/tracking/home) on February 5, 2017.
[4]Ngueta, G., Prevost, M., Deshommes, E., Abdous, B., Gauvin, D., Levallois, P. (2014). Exposure of young children to household water lead in the Montreal area (Canada): the potential influence of winter-to-summer changes in water lead levels on children's blood lead concentration. *Environ Int, 73*, 57–65.
[5]2010 FIPS data were downloaded from https://www.census.gov/geo/reference/codes/cou.html on February 1, 2017.