

# SUPPORTING INFORMATION

## Challenges detecting lead in drinking water using at-home test kits

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### DESCRIPTION OF SUPPORTING INFORMATION

Section S1. User confidence in reading at-home lead measurements

Section S2. Characterization of particle composition and lead content

Figure S1. Selection of test kits for analysis

Figure S2. Example of the test kits analyzed

Figure S3. Representative images of particles determined with Raman atomic force microscopy

Figure S4. Lead detection rate for binary test in Phase 1

Figure S5. Color change on the tile of a color strip when in contact with a lead solder particle

Table S1. Lead particle sources and characterization of lead content

Table S2. Metals and phosphorous analysis for samples and blanks for particulate testing in Phases 3 and 4

Table S3: Characterization from one sample of finished drinking water from the Kankakee River

Table S4: Metals and phosphorous analysis for samples and blanks in Phases 1 and 2

Table S5. Lead measurements reported by participants for test kits during Phase 1

Table S6. Size distributions of lead particles determined with Raman atomic force microscopy at a 40x zoom.

Table S7. Size distributions of lead particles determined with Raman atomic force microscopy at a 4x zoom.

Table S8. Particulate lead detection and dissolution when exposed to various corrosion control treatments

Table S9. Metals and phosphorous analysis for samples and blanks in Phase 5

Table S10. Accuracy, sensitivity, and specificity of binary strips

## Section S1. User confidence in reading at-home lead measurements

For Phase 1, participants measured lead in water and recorded their confidence in their measurement when using the 16 test kit brands. Confidence values ranged from a score of one (“Not at all confident”) to five (“Extremely confident”) (Table A). Confidence was generally lower for the color-based tests, which required matching the sample or tile color to a color-gradient scale ranging from light yellow to red. The vial test (one brand) and one of the color strips had median confidence scores of 1 (n=6 participants), while the other color strips (10 brands) had median confidence scores of 2.5-3 (n=5-6 participants). The large intervals between lead measurements (i.e., non-uniform increments of 20-300 mg/L) likely made accurate measurement challenging, since the 150 ug/L concentration represents <1% of the measurement increments. Binary tests had the highest confidence ratings, likely because lead presence was indicated either by a distinct binary color change from white to red or the appearance of indicator lines. The binary tests (three brands) had median confidence ratings of 3-3.5 and the binary color test (one brand) had a median rating of 4 (n=5-6 participants).

Table A. User confidence in reading at-home measurements

Test Kit	Min	Median	Max
B1	1	3	4
B2	2	3.5	5
B3	3	3.5	4
V	1	1	4
BC	2	4	5
C1	1	1	4
C2	1	2.5	3
C3	2	3	3
C4	1	3	3
C5	2	3	3
C6	2	3	4
C7	1	3	4
C8	1	3	4
C9	2	3	4
C10	2	3	4
C11	2	3	4

User confidence was reported from 5-6 participants for each test kit. Test kits include the vial test (V), 11 color strips (C1-C11), the binary color test (BC) and three binary strips (B1-B3).

## Section S2. Characterization of particle composition and lead content

Three to four samples were used to determine the variability in particle composition for particles used in Phases 3 and 4. These samples include a sample suspended in water, a sample dissolved using vinegar, and a sample dissolved using lemon juice for each particle type. An additional particle sample suspended in water was also analyzed for three particle types due to expired test kits. Specifically, kits from one brand of binary kit were expired when received and were not used. Once replacements for these kits were received, a second round of experiments were performed to test these binary strips with the three particle types that had been previously tested with the other two brands of binary strip (Table S2, Round 2).

The total recoverable particle mass was defined as the sum of the masses for the eight metals and phosphorous (Tables S1 and S2) in fully digested samples (also used to determine total lead). Because phosphorous could be present in particles, but was also added to the base water, the total recoverable particle mass was calculated using the difference between sample phosphorous concentrations and the initial dissolved phosphorous concentrations (phosphorous value from the filtered sample with the lowest particle contact time) to differentiate phosphorous in particles from dissolved phosphorous added in the water. The percentage of lead in the total recovered particle mass was calculated as the total lead divided by the total recovered particle mass.

Variability in the percentage of lead in the total recovered particle mass was observed among the different particles, with average lead content ranging from 0.8% to 92% (Table S1). However, variability among replicates (particles from the same source) exhibited much less variability, with standard deviations ranging from 0.3% to 14%. Prior dissolution steps are not expected to affect particle characterization results since samples were analyzed after full digestion using 2% nitric acid and 2% hydroxylamine and heated for at least 1 week. Therefore, samples with and without dissolution steps (lemon juice or vinegar) prior to full digestion were included in the particle composition analysis for particles in Phases 3 and 4.

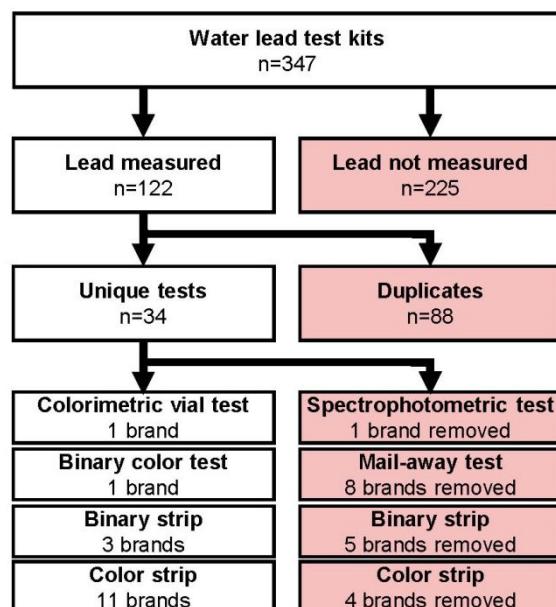


Figure S1. Selection of test kits for analysis. Red boxes indicate test kits that were removed.

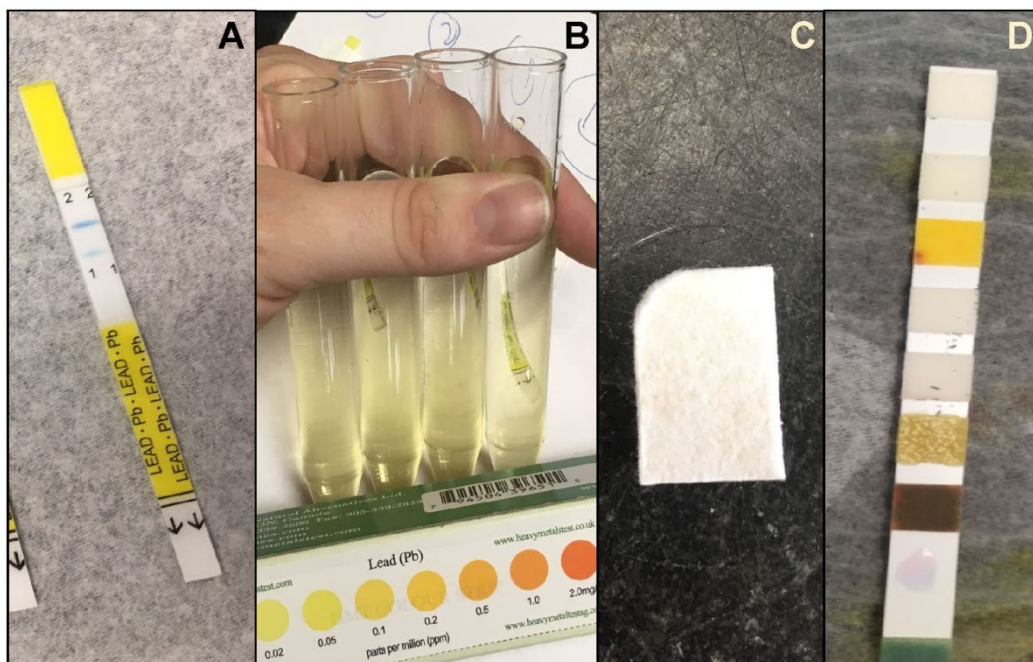


Figure S2. Example of the test kits analyzed (A) binary strip, (B) colorimetric vial test, (C) binary color test, and (D) color strip.

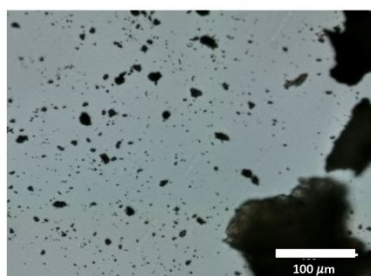
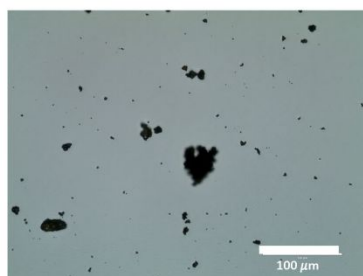
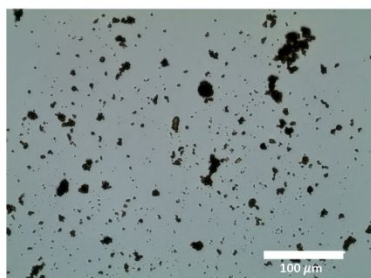
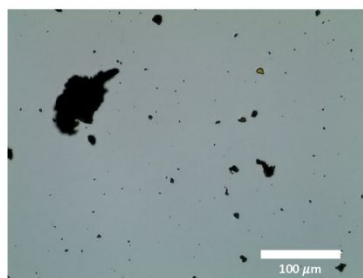
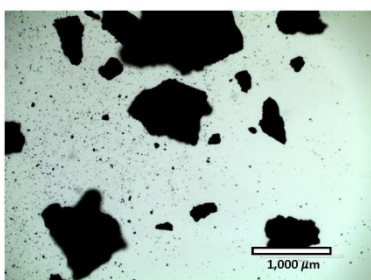
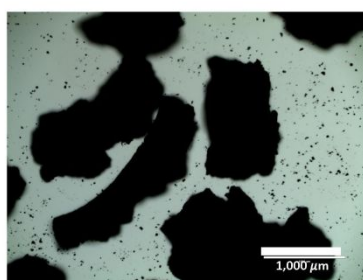
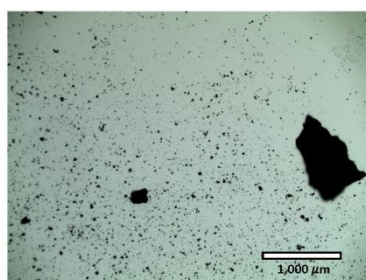
**A****Pb****Pb-Sn****Pb-Fe****50:50 Pb:Sn Solder****B****Al-Pb-1****Al-Pb-2****Zn-Fe**

Figure S3. Representative images of particles determined with Raman atomic force microscopy. Images are presented at A) 40x and B) 4x magnifications. Pb: lead; Sn: Tin; Fe: iron; Al: aluminum; Zn: zinc.

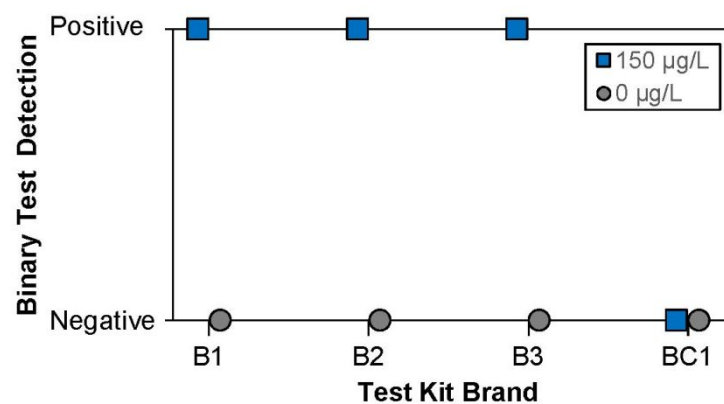


Figure S4. Lead detection rate for binary test in Phase 1 when measuring (1) 150 µg/L dissolved lead (blue squares) and (2) blank (gray circles). Test kits included: 3 binary strips (B1-B3) and 1 binary color test (BC1).



Figure S5. Color change on the tile of a color strip when in contact with a lead solder particle



Table S1. Lead particle sources and characterization of lead content

Particle type	Source type	Source location	Mean % total recovered particle mass (SD)	% lead of total recovered particle mass		
				Min	Mean (SD)	Max
Pb	Lead pipe	Laboratory	93% (3%)	92%	97% (4%)	103%
Al-Pb-1	LSL	Buffalo, NY	39% (4%)	23%	26% (3%)	30%
Zn-Fe	Galvanized iron pipe	Flint, MI	29% (6%)	0.8%	1.2% (0.3%)	1.4%
Pb-Sn	Lead solder	Flint, MI	47% (18%)	42%	58% (14%)	70%
Al-Pb-2	LSL	Flint, MI	34% (9%)	9%	19% (9%)	27%
Pb-Fe	LSL	Washington, D.C.	69% (9%)	55%	62% (6%)	67%
Fe-PO <sub>4</sub>	Particles in water	Cicero, IL	-	3%	9% (6%)	14%

Pb: lead; Al: aluminum; Fe: iron; Zn: zinc; Sn: tin; PO<sub>4</sub>: phosphate; LSL: Lead Service Line; SD: standard deviation

The % of total recovered particle mass could not be calculated for Fe-PO<sub>4</sub> particles because they were collected in water, so the total particle mass added was unknown.

Table S2. Metals and phosphorous analysis for samples and blanks for particulate testing in Phases 3 and 4.

Phase	Particle type	Round	Sample (Digestion time)	Pb (µg/L)	Al (µg/L)	Fe (µg/L)	Mn (µg/L)	Ni (µg/L)	Cu (µg/L)	Zn (µg/L)	Sn (µg/L)	P (µg/L)	Total particle mass added (mg/L)	Total recovered particle mass (mg/L)*	% recovered
Phase 3: Particulate Lead	Blank	1	Dissolved	0.4	<10.0	1,609.4	22.0	4.7	40.7	9.1	0.1	973.2	-	-	-
			Total	0.6	<10.0	8.1	0.6	0.5	33.6	8.9	0.1	983.8	-	-	-
	Pb	1	Dissolved (1 hr)	1.5	<10.0	<5.0	0.1	0.4	10.2	2.3	<0.1	1,065.5	5.8	<0.02	<0.5%
			Dissolved (24 hr)	4.7	10.8	<5.0	0.1	0.4	9.7	2.3	<0.1	1,028.8		<0.02	<0.5%
			Total	5,231.8	11.5	18.5	0.2	0.4	18.4	4.6	0.2	1,223.9		5.4	94%
		2	Dissolved	1.3	<10.0	<5.0	0.5	0.5	32.7	9.0	<0.1	1,004.0	4.9	0.04	0.9%
			Total	4,391.5	22.9	25.5	0.6	0.5	44.2	9.7	0.3	1,030.6		4.5	92%
	Al-Pb-1	1	Dissolved (1 hr)	0.4	<10.0	16.9	0.3	0.4	8.5	1.6	<0.1	1,024.8	5.6	0.03	0.6%
			Dissolved (24 hr)	1.1	12.7	<5.0	0.1	0.4	7.7	2.1	<0.1	1,043.9		0.05	0.8%
			Total	508.0	1,025.5	174.7	22.0	1.4	13.4	3.3	0.2	1,456.1		2.2	39%
		2	Dissolved	0.5	<10.0	11.9	0.6	0.5	30.5	9.0	<0.1	974.9	5.2	0.0	1%
			Total	495.9	790.6	177.2	20.7	1.9	36.0	8.5	0.3	1,227.9		1.8	34%
	Zn-Fe	1	Dissolved (1 hr)	0.5	<10.0	8.4	0.2	0.4	9.4	4.9	<0.1	1,033.9	5.2	0.03	0.5%
			Dissolved (24 hr)	0.3	11.6	<5.0	0.1	0.3	8.6	7.2	<0.1	1,033.6		0.03	0.5%
			Total	22.6	300.7	327.3	3.7	0.7	16.6	845.4	0.2	1,266.7		1.8	34%
		2	Dissolved	0.4	<10.0	44.1	0.9	0.6	32.3	10.5	<0.1	1,009.9	5.3	0.09	2%
			Total	15.0	249.0	269.1	4.2	0.8	38.8	622.8	0.2	1,059.9		1.3	24%
	Fe-PO <sub>4</sub>	1	Dissolved	2.8	21.7	<5.0	0.4	2.3	5.0	6.7	0.3	305.5	-	-	-
			Total	37.3	79.5	120.2	3.1	4.8	19.8	17.6	1.3	376.3		-	-
	Blank	2	Dissolved (<30 min)	0.5	<10.0	<5.0	0.1	0.4	8.7	2.1	<0.1	1,002.7	-	-	-
			Dissolved (1 hr)	0.3	<10.0	<5.0	0.1	0.4	9.8	2.6	<0.1	1,054.5		-	-
			Dissolved (24 hr)	0.2	11.1	<5.0	0.1	0.4	8.5	2.2	<0.1	1,053.9		-	-
			Total	0.4	<10.0	17.7	0.2	0.5	12.6	2.3	0.1	1,186.9		-	-
	Pb-Sn	1	Dissolved (<30 min)	33.7	<10.0	<5.0	<0.1	0.5	4.5	<1.0	0.1	912.6	5.2	0.04	0.9%
			Dissolved (1 hr)	27.4	<10.0	<5.0	<0.1	0.5	4.5	<1.0	<0.1	882.4		<0.02	<0.5%
			Dissolved (24 hr)	9.7	11.7	<5.0	<0.1	0.5	6.7	<1.0	0.2	819.7		<0.02	<0.5%
			Total	2,041.8	<10.0	30.9	0.3	1.0	188.8	17.9	480.2	1,078.9		2.9	56%
	Al-Pb-2	1	Dissolved (<30 min)	0.4	<10.0	<5.0	0.1	0.4	8.8	2.1	<0.1	1,086.6	5.2	<0.02	<0.5%
			Dissolved (1 hr)	0.5	<10.0	<5.0	<0.1	0.4	8.7	1.8	<0.1	1,065.0		<0.02	<0.5%
			Dissolved (24 hr)	1.3	12.0	<5.0	0.1	0.4	8.0	1.9	<0.1	1,041.6		<0.02	<0.5%
			Total	292.0	644.0	107.9	13.9	3.0	42.1	24.6	0.7	1,362.1		1.4	27%

	Pb-Fe	1	Dissolved (<30 min)	15.5	<10.0	<5.0	0.1	0.5	8.5	2.0	<0.1	1,055.2	5.4	0.03	0.6%
			Dissolved (1 hr)	19.4	<10.0	<5.0	0.1	0.5	8.6	2.0	<0.1	1,079.0		0.1	1%
			Dissolved (24 hr)	25.6	15.5	<5.0	<0.1	0.5	7.3	1.5	<0.1	1,015.5		<0.02	<0.5%
			Total	2,302.5	185.1	475.0	47.5	1.3	111.1	19.0	9.8	1,315.4		3.4	63%
Phase 4: Lemon Juice Dissolution	Blank	1	Dissolved (1 hr)	0.5	<10.0	28.2	7.4	1.0	38.8	32.9	<0.1	4,076.5	-	-	-
			Dissolved (24 hr)	1.3	<10.0	34.7	7.6	1.1	40.2	39.6	0.5	4,013.2		-	-
			Total	0.6	<10.0	32.4	7.1	1.0	40.6	23.5	0.1	4,129.2		-	-
	Pb	1	Dissolved (1 hr)	608.2	12.6	30.8	7.7	1.7	42.3	193.0	0.2	4,051.7	5.0	0.9	18%
			Dissolved (24 hr)	2,782.3	12.9	34.2	7.6	1.1	45.8	39.3	0.4	4,058.1		2.9	59%
			Total	4,466.9	<10.0	37.3	7.0	1.0	45.4	26.4	<0.1	4,294.2		4.8	97%
	Al-Pb-1	1	Dissolved (1 hr)	70.0	<10.0	31.1	8.2	1.1	40.9	42.5	<0.1	4,262.9	4.8	0.2	4%
			Dissolved (24 hr)	385.2	235.9	46.8	18.1	1.2	43.8	39.2	0.5	4,130.3		0.6	13%
			Total	501.1	869.2	196.7	30.8	1.9	40.8	23.5	<0.1	4,684.0		2.1	43%
	Zn-Fe	1	Dissolved (1 hr)	3.0	36.6	40.4	7.6	1.0	41.5	201.7	0.2	3,815.7	5.2	0.3	6%
			Dissolved (24 hr)	13.0	235.0	153.3	9.8	1.4	50.0	650.3	0.4	3,946.0		1.2	24%
			Total	14.4	241.6	260.3	9.7	1.4	44.2	651.5	<0.1	4,431.3		1.8	35%
	Fe-PO4	1	Dissolved (1 hr)	34.0	48.7	77.7	11.6	2.1	28.6	53.8	0.7	4,352.3	-	-	-
			Dissolved (24 hr)	35.4	57.7	108.5	12.1	2.2	38.8	56.6	2.8	4,316.7		-	-
			Total	35.7	89.4	164.7	12.2	2.4	31.3	51.9	2.5	5,278.2		-	-
	Pb-Sn	1	Dissolved (1 hr)	1,460.2	<10.0	30.1	6.7	1.3	86.4	35.3	72.2	4,526.5	5.0	1.7	34%
			Dissolved (24 hr)	1,698.9	13.4	24.3	6.7	1.5	109.1	38.6	188.3	4,252.6		1.8	36%
			Total	1,781.3	14.3	91.7	8.2	1.8	204.9	34.0	166.3	5,143.0		2.9	58%
	Al-Pb-2	1	Dissolved (1 hr)	36.5	22.9	32.6	7.6	1.0	21.7	26.9	0.4	4,385.8	5.4	0.1	3%
			Dissolved (24 hr)	172.9	331.1	63.4	12.3	2.4	41.1	33.2	0.8	4,313.3		0.6	11%
			Total	228.1	680.9	274.4	20.3	3.4	50.9	36.2	1.2	5,517.9		2.4	45%
	Pb-Fe	1	Dissolved (1 hr)	869.6	50.6	67.2	19.7	1.1	70.1	28.8	1.2	4,430.1	5.2	1.1	21%
			Dissolved (24 hr)	1,770.2	117.8	260.6	39.7	1.3	99.5	29.9	1.6	4,656.8		2.5	49%
			Total	2,278.2	153.3	412.6	46.1	1.5	114.3	26.3	2.8	5,511.3		4.1	79%
Phase 4: Vinegar Dissolution	Blank	1	Dissolved (1 hr)	0.6	<10.0	<5.0	0.9	0.9	33.6	19.3	<0.1	2,873.0	-	-	-
			Dissolved (24 hr)	1.5	<10.0	7.5	0.9	0.9	48.0	24.5	0.4	2,688.2		-	-
			Total	0.6	13.0	<5.0	0.8	0.8	32.1	12.0	0.1	2,656.4		-	-
	Pb	1	Dissolved (1 hr)	435.1	<10.0	12.2	1.0	1.1	34.2	25.8	<0.1	2,748.7	5.2	0.5	10%
			Dissolved (24 hr)	1,111.3	<10.0	<5.0	0.9	0.9	32.7	22.9	0.4	2,571.5		1.0	19%
			Total	4,733.4	<10.0	52.4	1.4	0.9	42.5	16.5	6.3	2,488.4		4.6	88%
	Al-Pb-1	1	Dissolved (1 hr)	73.4	<10.0	471.2	5.2	1.5	34.2	23.5	0.1	2,666.8	5.0	0.6	12%
			Dissolved (24 hr)	308.0	44.1	8.3	1.4	0.9	32.5	21.1	0.3	2,454.8		0.2	4%

			Total	591.0	979.3	199.7	28.5	1.8	31.7	10.4	0.5	2,769.0		1.9	39%
	Zn-Fe	1	Dissolved (1 hr)	0.9	<10.0	5.6	0.9	0.8	30.4	112.0	<0.1	2,639.9	5.0	0.2	3%
			Dissolved (24 hr)	4.9	48.4	7.0	1.4	1.0	33.5	491.7	0.6	2,762.5		0.7	14%
			Total	17.1	222.8	338.1	3.1	1.8	35.5	671.6	0.3	2,608.4		1.3	25%
	Fe-PO <sub>4</sub>	1	Dissolved (1 hr)	31.7	49.7	28.4	2.1	2.3	14.2	25.3	0.5	2,790.1	-	-	-
			Dissolved (24 hr)	31.4	54.8	46.0	2.7	1.6	15.6	34.3	0.7	2,599.6	-	-	-
			Total	34.4	67.8	279.1	5.1	2.0	17.8	29.1	1.1	2,600.3	-	-	-
	Pb-Sn	1	Dissolved (1 hr)	423.8	<10.0	<5.0	0.7	0.6	48.2	13.7	0.6	2,895.9	5.2	0.5	10%
			Dissolved (24 hr)	493.8	14.0	31.7	1.1	0.6	65.0	11.0	2.4	3,033.4		0.8	15%
			Total	598.9	<10.0	25.7	0.8	0.7	77.2	7.6	186.1	3,400.1		1.4	27%
	Al-Pb-2	1	Dissolved (1 hr)	29.8	<10.0	<5.0	0.7	0.5	10.9	12.8	0.1	2,887.6	5.8	0.06	1%
			Dissolved (24 hr)	201.3	43.2	<5.0	1.4	0.8	15.6	14.2	0.1	3,060.6		0.5	8%
			Total	492.6	597.3	106.1	23.9	2.9	41.8	25.2	0.6	3,396.5		1.8	31%
	Pb-Fe	1	Dissolved (1 hr)	492.7	21.2	13.5	1.2	0.6	35.8	15.5	<0.1	2,980.0	4.8	0.6	12%
			Dissolved (24 hr)	926.5	66.4	8.8	3.6	0.7	64.3	14.3	0.1	3,014.4		1.1	23%
			Total	1,920.4	144.3	380.1	39.0	1.1	101.0	14.0	3.7	3,413.8		3.0	63%

Pb: lead; Al: aluminum; Fe: iron; Mn: manganese; Ni: nickel; Cu: copper; Zn: zinc; Sn: tin; P: phosphorous; PO<sub>4</sub>: phosphate

– denotes values not calculated because no particles were added to these samples (blank or particles collected in water)

\*Calculated using the difference between sample phosphorous concentration and initial dissolved phosphorous (earliest filtered phosphorous value) to differentiate phosphorous in particle form from dissolved phosphorous added in water

Table S3. Characterization from one sample of finished drinking water from the Kankakee River

Parameter	Concentration
Alkalinity (mg/L as CaCO <sub>3</sub> )	50.2
Cl (mg/L)	33.3
S (mg/L)	70.8
Pb (µg/L)	3.4
Al (µg/L)	<10.0
Fe (µg/L)	269.5
Mn (µg/L)	2.4
Ni (µg/L)	1.8
Cu (µg/L)	130.9
Zn (µg/L)	39.4
Sn (µg/L)	1.8
P (µg/L)	<5.0

CaCO<sub>3</sub>: calcium carbonate; Cl: chloride; S: sulfur; Pb: lead; Al: aluminum; Fe: iron; Mn: manganese; Ni: nickel; Cu: copper; Zn: zinc; Sn: tin; P: phosphorous

Table S4. Metals and phosphorous analysis for samples and blanks in Phases 1 and 2

	Test kits	Sample	Sample treatment*	Pb (µg/L)	Al (µg/L)	Fe (µg/L)	Mn (µg/L)	Ni (µg/L)	Cu (µg/L)	Zn (µg/L)	Sn (µg/L)	P (µg/L)
Phase 1	B1-B2, V, C1-C11, BC1	Blank	Dissolved	0.4	72.9	5.5	2.8	5.2	11.9	10.3	<0.1	6.2
			Total	0.7	45.0	7.0	3.0	1.3	16.3	5.9	0.4	12.1
		150 µg/L dissolved Pb	Dissolved	148.8	69.8	5.6	1.8	0.6	14.9	10.0	<0.1	5.1
			Total	171.4	15.1	8.5	3.0	0.6	18.6	7.3	0.2	22.9
	B3	Blank	Dissolved	0.4	< 10.0	<5.0	2.5	0.6	23.9	8.3	<0.1	<5.0
			Total	0.5	<10.0	<5.0	2.7	0.6	30.0	7.1	0.1	<5.0
		150 µg/L dissolved Pb	Dissolved	154.7	<10.0	<5.0	2.6	0.6	26.4	6.0	<0.1	<5.0
			Total	166.4	<10.0	<5.0	2.7	0.6	28.8	6.0	<0.1	151.3
Phase 2A	B1-B2, V	Blank	Dissolved	0.4	<10.0	<5.0	2.5	0.3	18.8	13.3	0.1	<5.0
			Total	0.5	<10.0	<5.0	2.8	0.2	24.5	9.4	0.1	8.7
		10 µg/L dissolved Pb	Dissolved	8.0	<10.0	<5.0	2.5	0.1	20.0	9.5	<0.1	<5.0
			Total	9.5	<10.0	<5.0	2.7	0.1	24.1	7.3	0.1	<5.0
		20 µg/L dissolved Pb	Dissolved	16.3	<10.0	<5.0	2.5	0.2	19.7	10.8	<0.1	<5.0
			Total	18.2	223.7	<5.0	2.8	0.4	23.2	8.1	0.1	5.9
	B3	Blank	Dissolved	0.2	<10.0	6.7	1.8	0.6	13.2	4.5	<0.1	<5.0
			Total	0.4	<10.0	30.8	2.2	0.6	15.2	3.1	0.1	71.2
	B1- B3, V	5 µg/L dissolved Pb	Dissolved	4.4	<10.0	21.7	2.2	0.5	14.7	3.4	<0.1	<5.0
			Total	5.0	<10.0	<5.0	2.0	0.5	16.5	4.3	0.1	76.6
	B3	10 µg/L dissolved Pb	Dissolved	9.1	<10.0	145.6	19.4	0.9	16.3	3.0	<0.1	<5.0
			Total	9.8	<10.0	<5.0	23.1	0.5	16.5	2.3	<0.1	113.0
		20 µg/L dissolved Pb	Dissolved	18.0	<10.0	17.7	2.9	0.6	14.4	2.7	<0.1	<5.0
			Total	19.6	<10.0	134.5	3.8	0.9	17.0	2.4	<0.1	125.5
Phase 2B	C1-C11BC1	Blank	Dissolved	0.4	<10.0	<5.0	2.5	0.3	18.8	13.3	0.1	<5.0
			Total	0.5	<10.0	<5.0	2.8	0.2	24.5	9.4	0.1	8.7
		Lead Solder	Dissolved	8.6	<10.0	<5.0	2.8	0.2	18.6	9.5	0.5	<5.0
			Total	50,781.1	<10.0	146.7	3.7	1.4	28.2	9.1	NA	<5.0

Test kits include the vial test (V), 11 color strips (C1-C11), the binary color test (BC1) and three binary strips (B1-B3).

– denotes values not analyzed for that sample.

Pb: lead; Al: aluminum; Fe: iron; Mn: manganese; Ni: nickel; Cu: copper; Zn: zinc; Sn: tin; P: phosphorous

\*Digestion for dissolved lead samples was for >16 hours, but for 1 week for total recovered samples

NA: Not analyzed

Table S5. Lead measurements reported by participants for test kits during Phase 1

Kit type	Participant	Lead sample					Blank sample				
		Measured lead (mg/L)	Min (mg/L)	Mean (mg/L)	SD (mg/L)	Max (mg/L)	Measured lead (mg/L)	Min (mg/L)	Mean (mg/L)	SD (mg/L)	Max (mg/L)
V	1	0.10 ± <0.01	0.05	0.12	0.05	0.20	0.10	0.01	0.09	0.07	0.20
	2	0.07 ± 0.03					0.01				
	3	0.10 ± <0.01					0.05				
	4	0.10 ± <0.01					0.10				
	5	0.20 ± <0.01					0.20				
	6	0.17 ± 0.06					0.05				
C1	1	20 ± <1	0	24	10	50	20	20	30	15	50
	2	20 ± <1					20				
	3	20 ± <1					20				
	4	40 ± 17					50				
	5	30 ± 17					50				
	6	13 ± 12					20				
C2	1	0 ± <1	0	2	4	10	0	0	2	4	10
	2	10 ± <1					10				
	3	0 ± <1					0				
	4	0 ± <1					0				
	5	0 ± <1					0				
	6	0 ± <1					0				
C3	1	0 ± <1	0	4	8	20	0	0	0	0	0
	2	7 ± 12					0				
	3	0 ± <1					0				
	4	0 ± <1					0				
	5	20 ± <1					0				
	6	0 ± <1					0				
C4	1	50 ± <1	20	45	12	50	50	20	45	12	50
	2	50 ± <1					50				
	3	50 ± <1					50				
	4	20 ± <1					20				
	5	50 ± <1					50				
	6	50 ± <1					50				
C5	1	0 ± <1	0	0	0	0	0	0	0	0	0
	2	0 ± <1					0				
	3	0 ± <1					0				
	4	0 ± <1					0				
	5	0 ± <1					0				
	6	0 ± <1					0				
C6	1	0 ± <1	0	0	0	0	0	0	0	0	0
	2	0 ± <1					0				
	3	0 ± <1					0				
	4	0 ± <1					0				
	5	0 ± <1					0				
	6	0 ± <1					0				
C7	1	0 ± <1	0	7	9	20	0	0	4	9	20
	2	0 ± <1					0				
	3	0 ± <1					0				
	4	20 ± <1					20				
	5	13 ± <12					0				
C8	1	20 ± <1	0	12	11	20	20	0	12	11	20
	2	20 ± <1					20				
	3	0 ± <1					0				
	4	0 ± <1					0				
	5	20 ± <1					20				
C9	1	0 ± <1	0	5	9	20	0	0	4	9	20

	2	$0 \pm <1$					0				
	3	$20 \pm <1$					20				
	4	$7 \pm <12$					0				
	5	$0 \pm <1$					0				
C10	1	$0 \pm <1$	0	0	0	0	0	0	0	0	0
	2	$0 \pm <1$					0				
	3	$0 \pm <1$					0				
	4	$0 \pm <1$					0				
	5	$0 \pm <1$					0				
	6	$0 \pm <1$					0				
C11	1	$13 \pm <12$	0	6	9	20	0	0	0	0	0
	2	$0 \pm <1$					0				
	3	$20 \pm <1$					0				
	4	$0 \pm <1$					0				
	5	$0 \pm <1$					0				
	6	$0 \pm <1$					0				

Test kits include the vial test (V) and 11 color strips (C1-C11).SD: standard deviation



Table S6. Size distributions of lead particles determined with Raman atomic force microscopy at a 40x zoom.

Size	Pb		Pb-Sn		Pb-Fe		Lead solder	
	# of particles	% of total particles	# of particles	% of total particles	# of particles	% of total particles	# of particles	% of total particles
0.5-1 $\mu\text{m}$	1593	20%	333	20%	189	22%	707	16%
1-2 $\mu\text{m}$	2488	31%	471	28%	239	28%	1140	25%
2-5 $\mu\text{m}$	2809	35%	581	35%	265	31%	1709	38%
5-10 $\mu\text{m}$	886	11%	193	12%	95	11%	720	16%
10-15 $\mu\text{m}$	211	3%	41	2%	33	4%	132	3%
15-50 $\mu\text{m}$	93	1%	38	2%	41	5%	103	2%
50+ $\mu\text{m}$	21	0%	3	0%	1	0%	40	1%
Total	8101	-	1660	-	863	-	4551	-

Pb: lead; Fe: iron; Sn: tin

Table S7. Size distributions of lead particles determined with Raman atomic force microscopy at a 4x zoom.

Size	Al-Pb-1		Al-Pb-2		Zn-Fe	
	# of particles	% of total particles	# of particles	% of total particles	# of particles	% of total particles
5-10 $\mu\text{m}$	3526	38%	6961	53%	9913	42%
10-20 $\mu\text{m}$	3371	36%	4143	32%	8461	36%
20-40 $\mu\text{m}$	1604	17%	1813	14%	3616	15%
40-100 $\mu\text{m}$	515	6%	166	1%	1018	4%
100+ $\mu\text{m}$	262	3%	60	0%	404	2%
Total	9,278	-	13,143	-	23,412	-

Pb: lead; Al: aluminum; Fe: iron; Zn: Zinc

Table S8. Particulate lead detection and dissolution when exposed to various corrosion control treatments

Treatment	Time	Water conditions	Total lead (µg/L)	Dissolved lead (µg/L)	% improved	# Positive Tests
No Treatment	<30 min	Polyphosphate	243.6	<b>148.4 (61%)</b>	-	3/3
		Polyphosphate with nitrate	689.6	<b>378.0 (55%)</b>	-	3/3
		Orthophosphate	20.1	2.5 (13%)	-	0/3
		Orthophosphate/polyphosphate blend	17.2	4.8 (28%)	-	0/3
		Zinc orthophosphate	12.0	0.4 (3%)	-	0/3
		Amended Control	706.8	<b>443.6 (63%)</b>	-	3/3
		Unamended Control	1,347.9	<b>130.2 (10%)</b>	-	3/3
Lemon Juice	24 hr	Polyphosphate	203.2	<b>185.5 (91%)</b>	30%	3/3
		Polyphosphate with nitrate	548.9	<b>521.9 (95%)</b>	40%	2/3
		Orthophosphate	14.2	12.1 (85%)	72%	0/3
		Orthophosphate/polyphosphate blend	12.5	8.4 (67%)	39%	0/3
		Zinc orthophosphate	2.6	2.0 (78%)	75%	0/3
		Amended Control	574.8	<b>530.3 (92%)</b>	29%	3/3
		Unamended Control	425.4	<b>392.4 (92%)</b>	82%	3/3

- denotes no percent improvement calculated for cases with no treatment

Bold denote dissolved lead >15 µg/L

Table S9. Metals and phosphorous analysis for samples and blanks in Phase 5

	Sample	Sample*	Pb (µg/L)	Al (µg/L)	Fe (µg/L)	Mn (µg/L)	Ni (µg/L)	Cu (µg/L)	Zn (µg/L)	Sn (µg/L)	P (µg/L)
No treatment	Polyphosphate	Dissolved	148.4	25.0	<5.0	0.2	0.8	26.9	73.4	1.0	477.8
		Total	243.6	35.8	13.2	2.2	0.8	54.4	79.5	1.9	510.6
	Polyphosphate with nitrate	Dissolved	378.0	21.2	<5.0	0.2	0.7	13.6	3.3	2.2	439.6
		Total	689.6	20.3	7.3	0.3	0.8	27.9	4.7	51.3	473.1
	Orthophosphate	Dissolved	2.5	21.1	<5.0	0.2	0.7	71.4	123.1	0.9	931.2
		Total	20.1	22.8	6.5	0.4	0.7	126.5	135.1	4.3	978.3
	Orthophosphate/ polyphosphate blend	Dissolved	4.8	21.6	<5.0	0.2	0.8	145.4	159.2	0.7	1,050.6
		Total	17.2	19.1	9.2	0.4	0.9	194.7	155.8	20.7	1,035.2
	Zinc orthophosphate	Dissolved	0.4	21.0	<5.0	0.2	0.7	56.6	451.5	0.2	915.2
		Total	12.0	32.0	6.0	0.4	0.8	96.4	512.2	1.6	980.1
	Amended Control	Dissolved	443.6	22.1	<5.0	0.2	1.0	25.3	12.9	4.6	<5.0
		Total	706.8	21.4	18.2	0.5	1.1	46.0	14.5	130.0	<5.0
Lemon juice	Unamended Control	Dissolved	130.2	21.6	<5.0	0.2	0.7	9.4	13.9	1.7	<5.0
		Total	1,347.9	20.4	11.8	0.6	1.4	65.5	100.3	3.3	10.7
	Polyphosphate	Dissolved	185.5	23.6	32.0	6.3	1.3	41.0	128.7	0.9	3,661.9
		Total	203.2	39.5	60.7	7.6	1.5	45.3	93.5	1.1	4,141.1
	Polyphosphate with nitrate	Dissolved	521.9	26.3	34.4	6.8	1.3	27.3	31.1	18.5	3,955.8
		Total	548.9	29.5	45.1	7.6	1.4	29.4	21.9	27.1	4,288.3
	Orthophosphate	Dissolved	12.1	26.3	38.2	6.7	1.3	104.2	148.4	2.3	4,610.2
		Total	14.2	34.7	49.1	7.4	1.4	106.3	137.9	2.3	4,619.9
	Orthophosphate/ polyphosphate blend	Dissolved	8.4	25.2	35.7	6.5	1.4	161.9	170.7	6.5	4,358.0
		Total	12.5	34.8	49.9	7.6	1.3	180.2	169.2	8.1	4,873.0
	Zinc orthophosphate	Dissolved	2.0	24.2	35.0	6.4	1.3	76.3	488.3	1.1	4,247.5
		Total	2.6	36.1	51.8	7.3	1.3	82.9	486.2	1.2	4,610.7
	Amended Control	Dissolved	392.4	26.0	33.9	6.7	1.4	36.4	56.3	42.5	3,634.2
		Total	425.4	33.0	50.8	7.7	1.4	39.6	50.0	48.7	3,803.0
	Unamended Control	Dissolved	530.3	24.1	28.8	6.6	1.5	40.8	57.9	69.9	3,250.4
		Total	574.8	27.3	93.2	7.6	1.6	43.7	35.5	54.3	3,572.7

Pb: lead; Al: aluminum; Fe: iron; Mn: manganese; Ni: nickel; Cu: copper; Zn: zinc; Sn: tin; P: phosphorous

\*Digestion for dissolved lead samples was for 24 hours for both no treatment and lemon juice, but for 1 week for total recovered samples

Table S10. Accuracy, sensitivity, and specificity of binary strips

		Phases 1 & 2A		Phase 3		Phases 4 & 5		Phases 1-5			
		Dissolved lead		Particulate lead		Dissolved and particulate lead		Total lead		Dissolved lead	
		>15 µg/L	<15 µg/L	>15 µg/L	<15 µg/L	>15 µg/L	<15 µg/L	>15 µg/L	<15 µg/L	>15 µg/L	<15 µg/L
Binary Strip	Positive	18 46.2%	7 17.9%	6 28.6%	0 0.0%	54 73.0%	0 0.0%	78 58.2%	7 5.2%	78 58.2%	7 5.2%
	Negative	0 0.0%	14 35.9%	15 71.4%	0 0.0%	8 10.8%	12 16.2%	23 17.2%	26 19.4%	2 1.5%	47 35.1%
Accuracy		82.1%		28.6%		89.2%		77.6%		93.3%	
Sensitivity		100.0%		28.6%		87.1%		77.2%		97.5%	
Specificity		66.7%		-		100.0%		78.8%		87.0%	