Testing for Lead and Copper Levels in the University Residence Hall Water Refill Stations

Noemi Carrasco
Abbey Fields
Hailey Grubich
Isabelle Newsom
Dominika Szal

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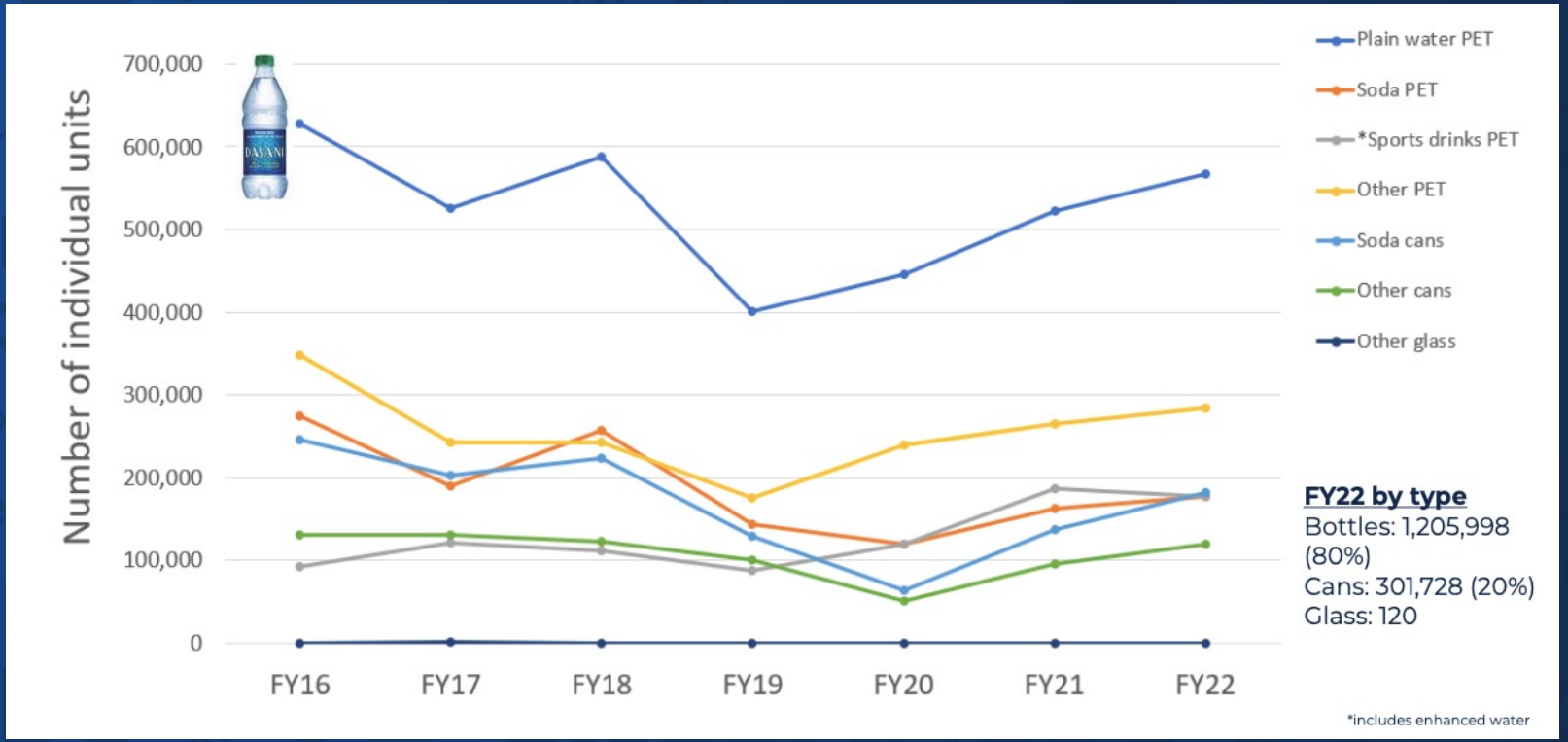

(iSEE, 2024)

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

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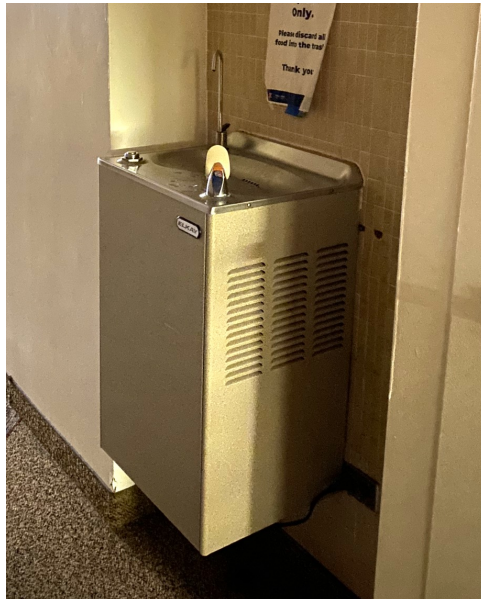
Background

- Types of water stations on campus
  - Filtered
  - Unfiltered
  - Glass filler
- 2022 survey by iSEE revealed an insight into student perceptions of filtered vs. unfiltered water
  - More than 50% of students think filtered is safer, with 83% of first-year students holding this perception
  - 56% of first year and 57% of second year students believe there is not enough convenient fountains



Glass Filling Station

Unfiltered Bottle Filling Station (iSEE)

Filtered Bottle Filling Station

Objectives

- **Problem:**
  - 35% of freshman and 51% of sophomores prefer bottled water over tap water on campus
  - iSEE created an initiative to address the use of single-use plastic water bottles on campus
- **Solution:** Convince students that tap water is just as safe as bottled water
  - Test lead and copper in hydrostations in the university residence halls

(CNN, 2023)

Methodology

Lead and Copper Rule: A Quick Reference Guide

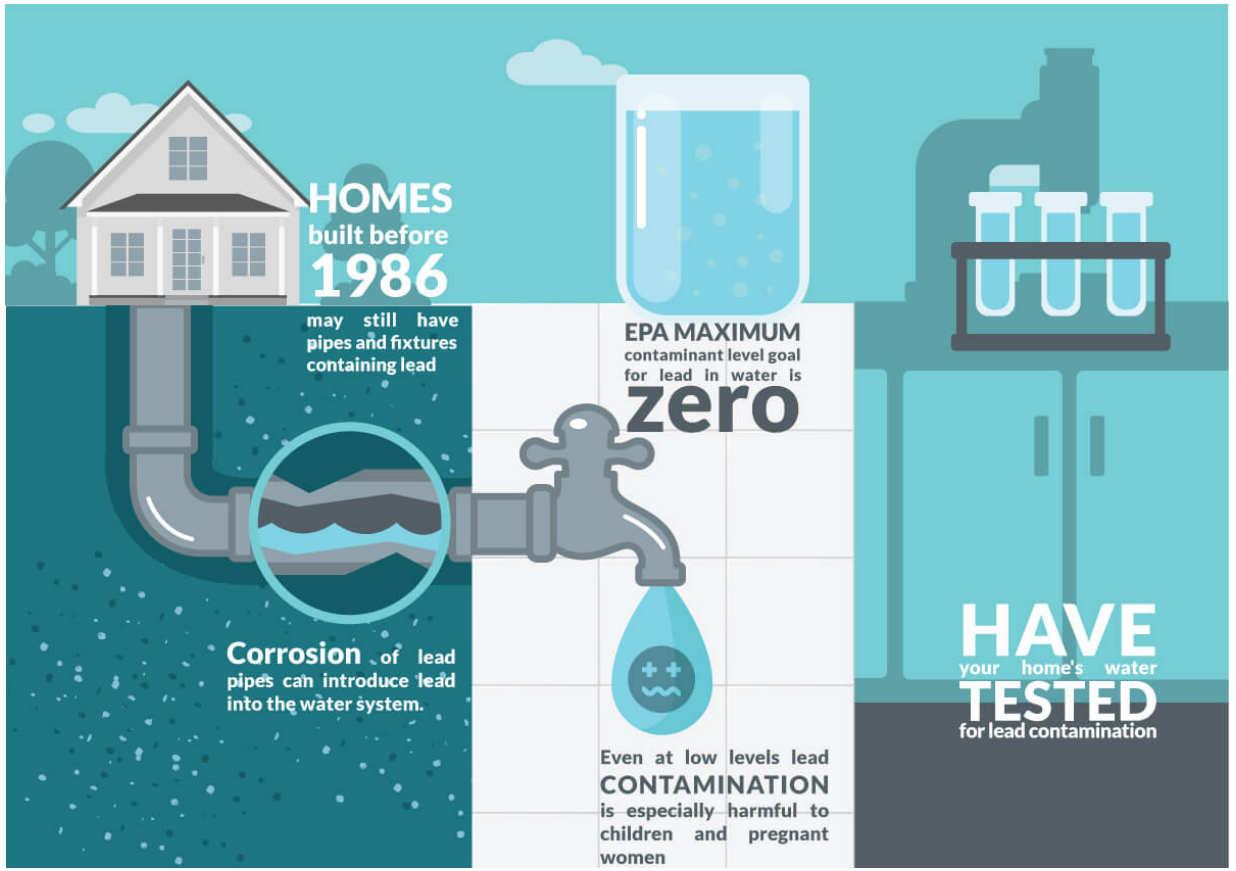
Overview of the Rule	
Title[1]	Lead and Copper Rule (LCR)[2], 56 FR 26460 - 26564, June 7, 1991
Purpose	Protect public health by minimizing lead (Pb) and copper (Cu) levels in drinking water, primarily by reducing water corrosivity. Pb and Cu enter drinking water mainly from corrosion of Pb and Cu containing plumbing materials.
General Description	Establishes action level (AL) of 0.015 mg/L for Pb and 1.3 mg/L for Cu based on 90th percentile level of tap water samples. An AL exceedance is not a violation but can trigger other requirements that include water quality parameter (WQP) monitoring, corrosion control treatment (CCT), source water monitoring/treatment, public education, and lead service line replacement (LSLR).
Utilities Covered	All community water systems (CWSs) and non-transient non-community water systems (NTNCWSs) are subject to the LCR requirements.

(EPA, 2023)

- EPA's Lead and Copper Rule created action levels for lead and copper
  - If levels are higher than these concentrations an intervention needs to take place (EPA, 2008)
- Compared our results with these action levels to see whether there is truly a concern about the water quality in UIUC university residence halls

Methodology

- The EPA health goal for lead levels is 0 ppb
- The American Academy of Pediatrics recommends water levels no greater than 1 ppb for children (Lanphear, 2016)
- Copper is a necessary micronutrient (Massachusetts Department of Environmental Protection)
- Copper levels under 1300 ppb should not cause any adverse health affects



https://www.drainservicesinc.com/ensure-water-lead-free/

Methodology

Why we chose FAR

- Believed to contain each filling station type
- Primarily a freshman dormitory
- Large population
- All samples have primarily the same plumbing system

(Daily Illini, 2015)

Methodology - Water Fountain Locations in FAR

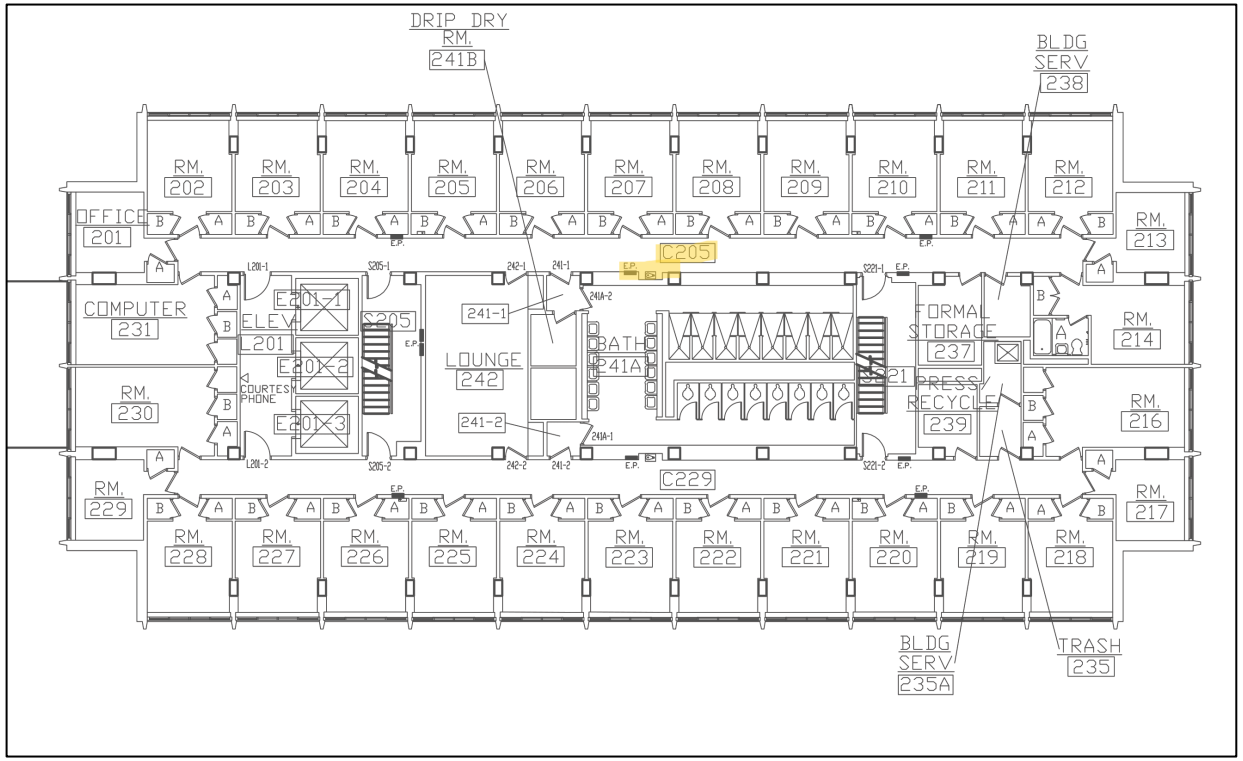
1. Unfiltered bottle filler in fitness center

2. Filtered bottle filler in basement hallway

Methodology - Water Fountain Locations in FAR

3. Filtered bottle filler outside the dining hall on the first floor

Methodology - Water Fountain Locations in FAR



(University Housing)

4. Unfiltered glass filler in the hallway on the second floor

Methodology - Sampling Plan

- Collected 12 total samples from each of the four fountains
  - Sampling occurred on 4/11, 4/16, and 4/18, collecting 4 samples from each filling station per day
    - 2 samples from first flush
    - 2 samples from second flush
- Collected 1 sample from a plastic water bottle
- TA Gemma Clark ran our samples through ICP-MS machine for 4/11 samples, SCS processed 4/16 and 4/18 samples

(Point of Use Water Quality Lecture Slides)

Results of Samples Analysis

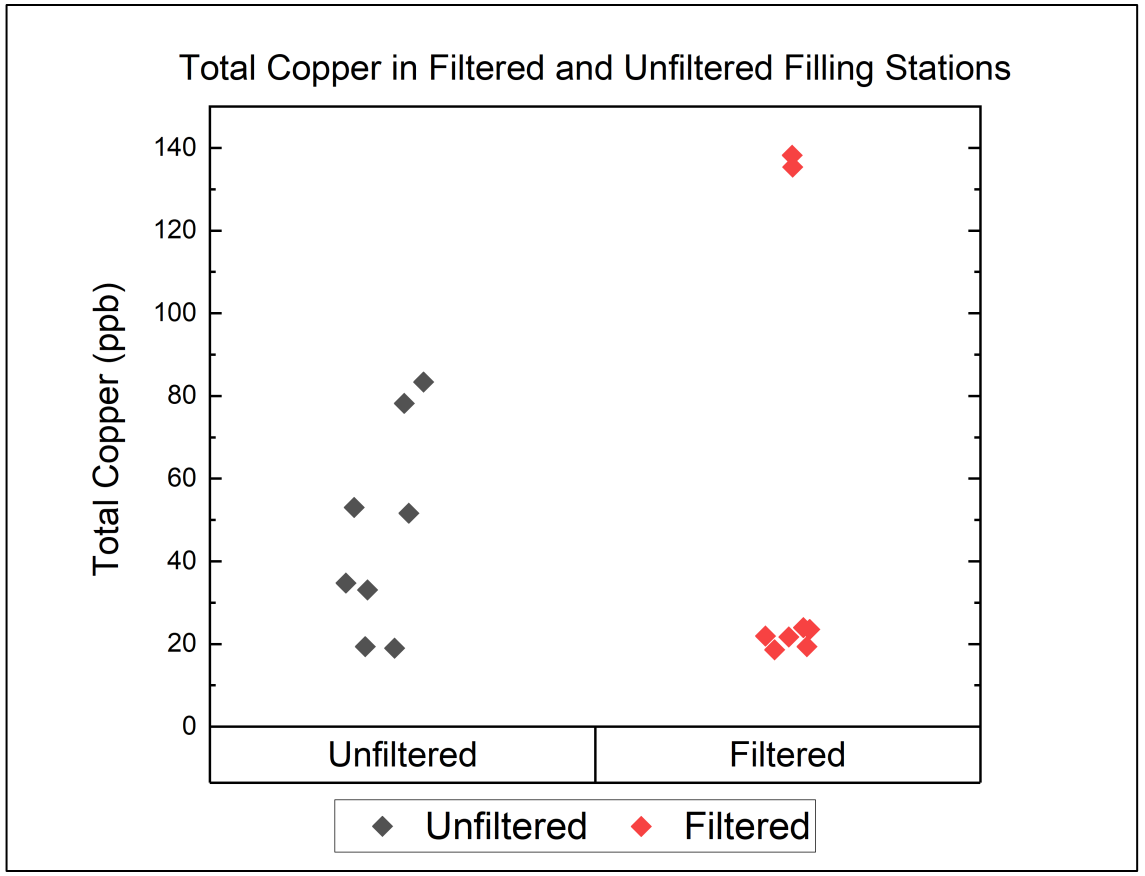
To determine the presence of a filter in each water bottle station, we tested the free chlorine levels of a sample from each location on 4/11 and 4/16

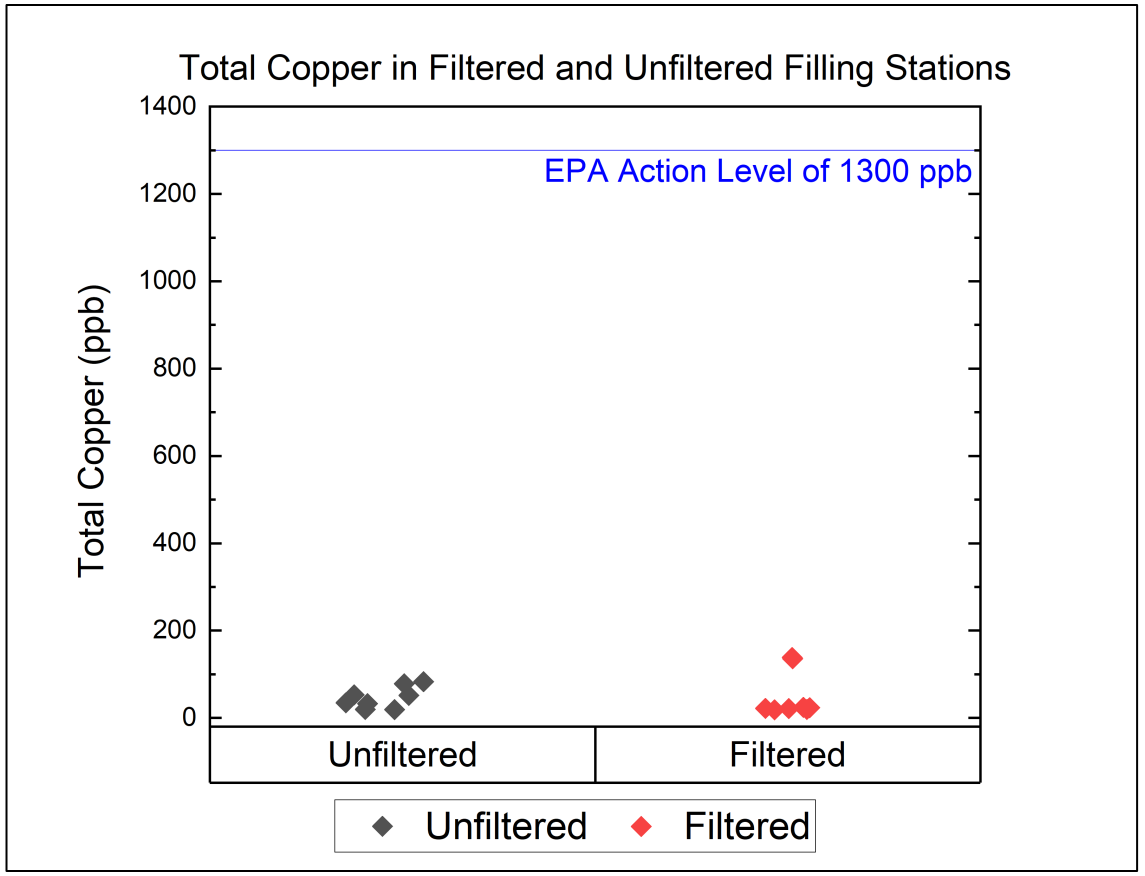
- Results show that only the FAR basement enhanced bottle filler has a working filter

Location	Filler Type	Free Chlorine Level (mg/L) Tested on 4/11
FAR Second Floor	Glass Filler	1.82
FAR Main Lobby	Filtered Bottle Filler (FLFS-C106)	1.48
FAR Basement	Filtered Bottle Filler (FLFS-C009)	0.01
FAR Gym	Unfiltered Bottle Filler	1.37

Location	Filler Type	Free Chlorine Level (mg/L) Tested on 4/16
FAR Second Floor	Glass Filler	1.37
FAR Main Lobby	Filtered Bottle Filler (FLFS-C106)	1.48
FAR Basement	Filtered Bottle Filler (FLFS-C009)	0.04
FAR Gym	Unfiltered Bottle Filler	1.44

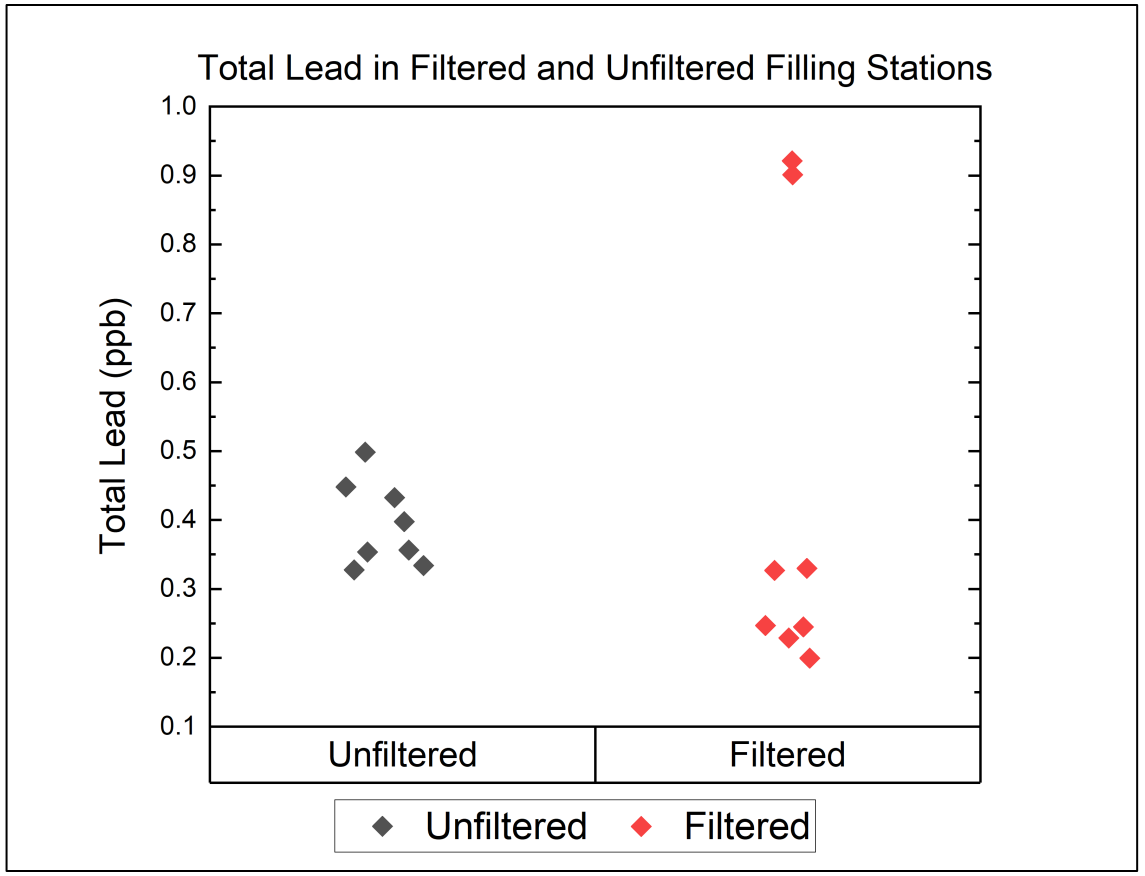
Results of Samples Analysis

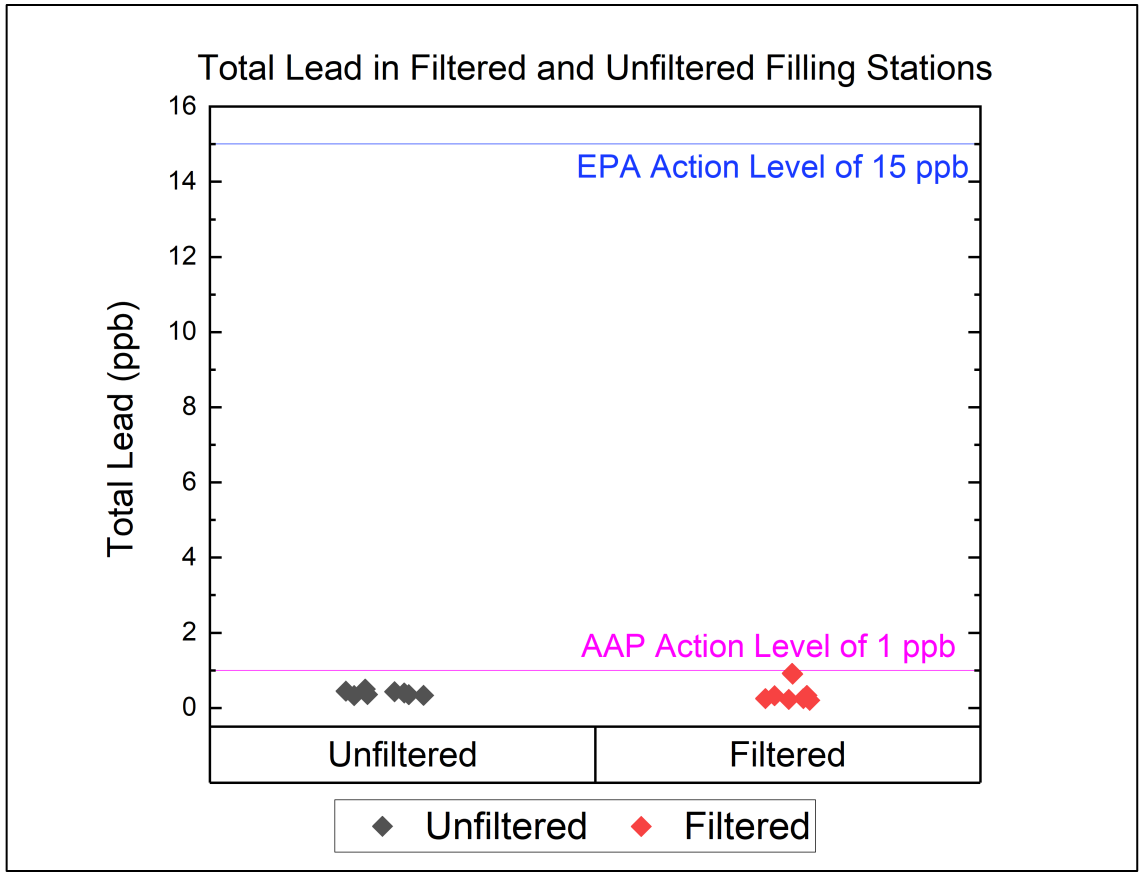




When comparing the filtered and unfiltered samples, the filtered first floor lobby samples yielded the highest copper levels

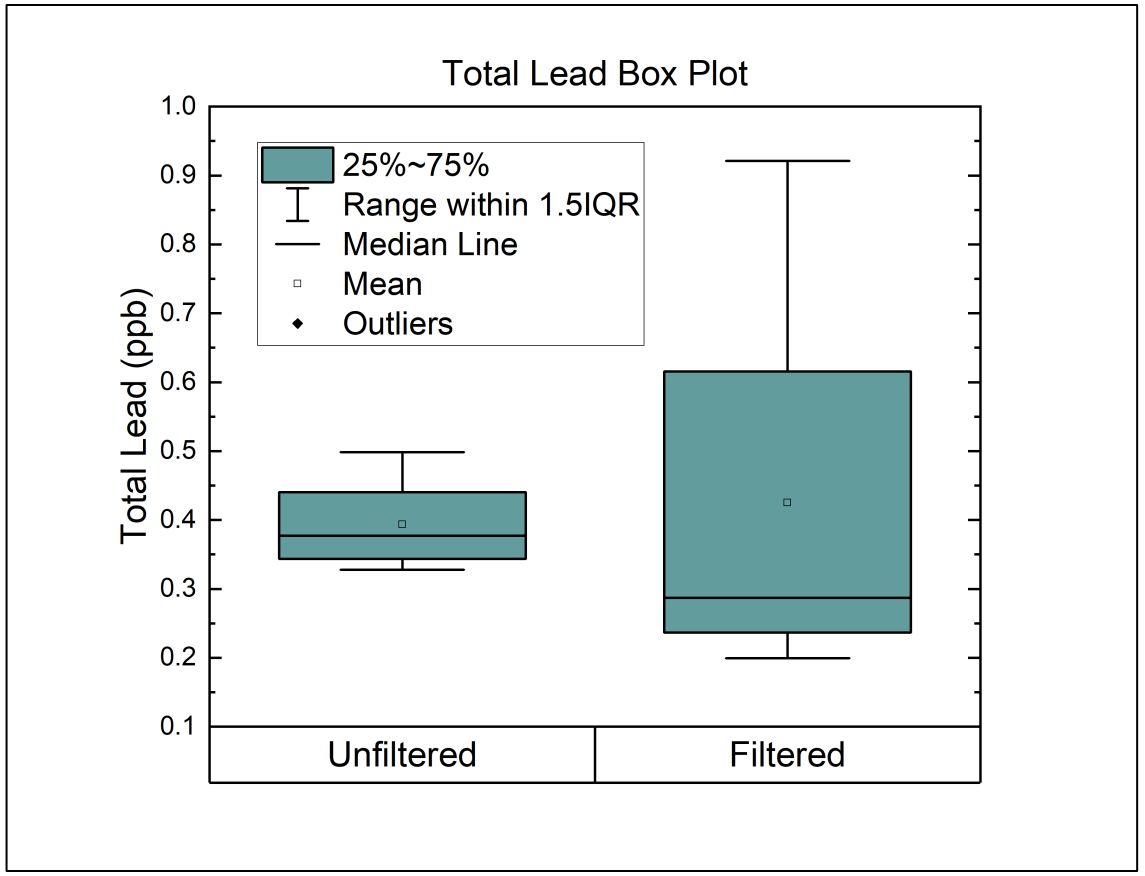
Results of Samples Analysis

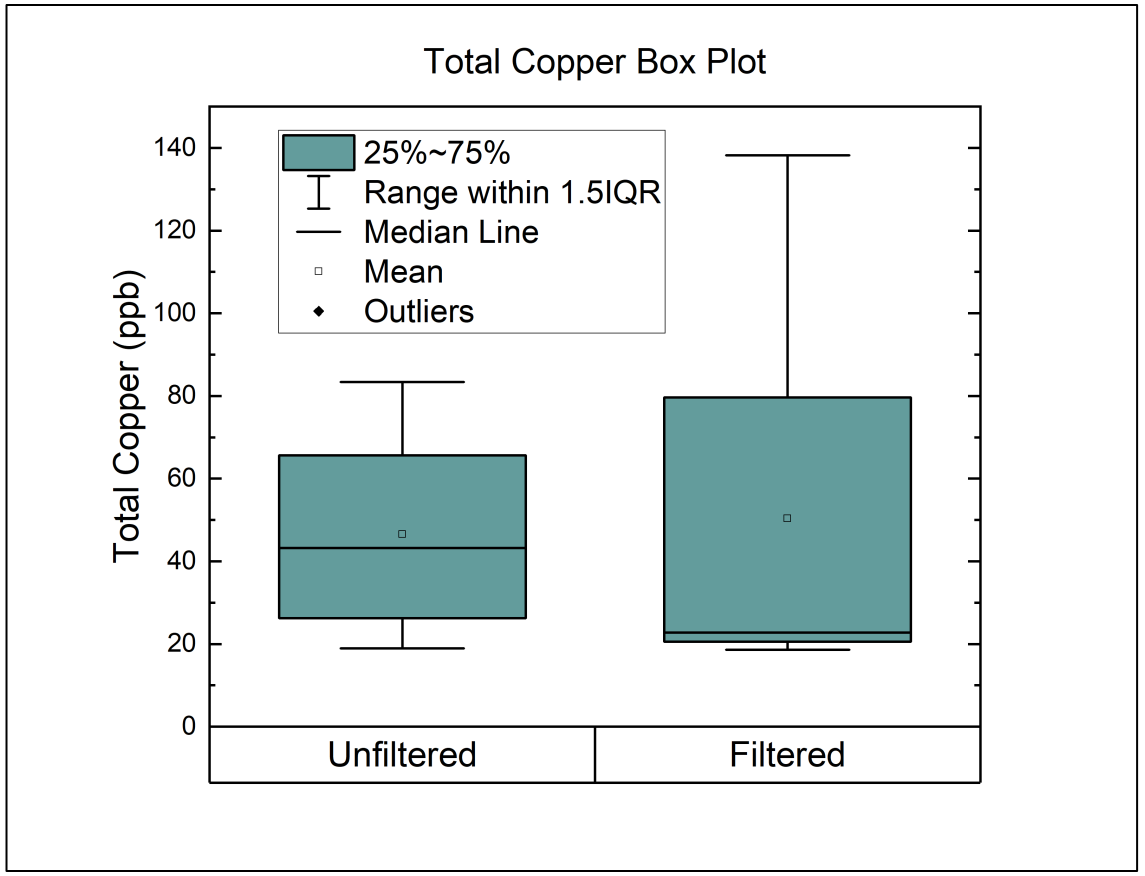




All of the samples measured a total lead content below the EPA action level of 15 ppb and the AAP action level of 1 ppb

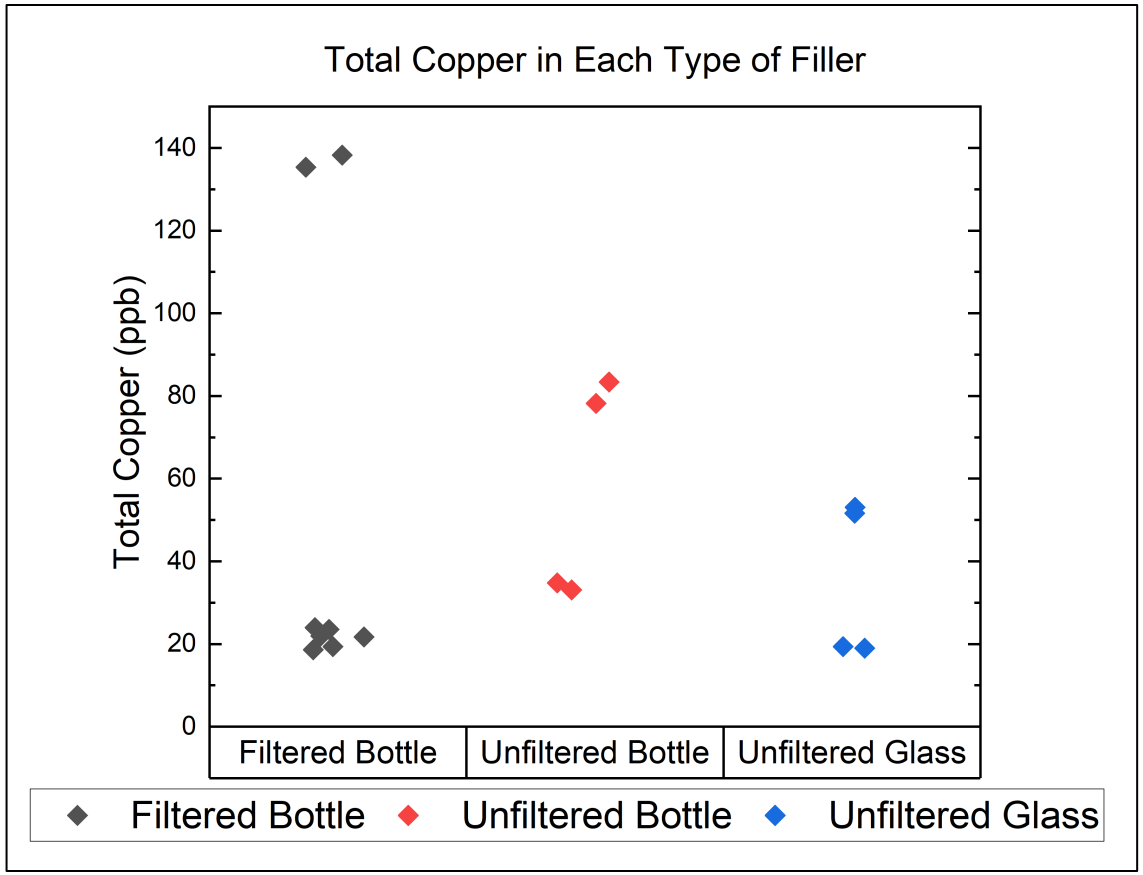
Results of Samples Analysis

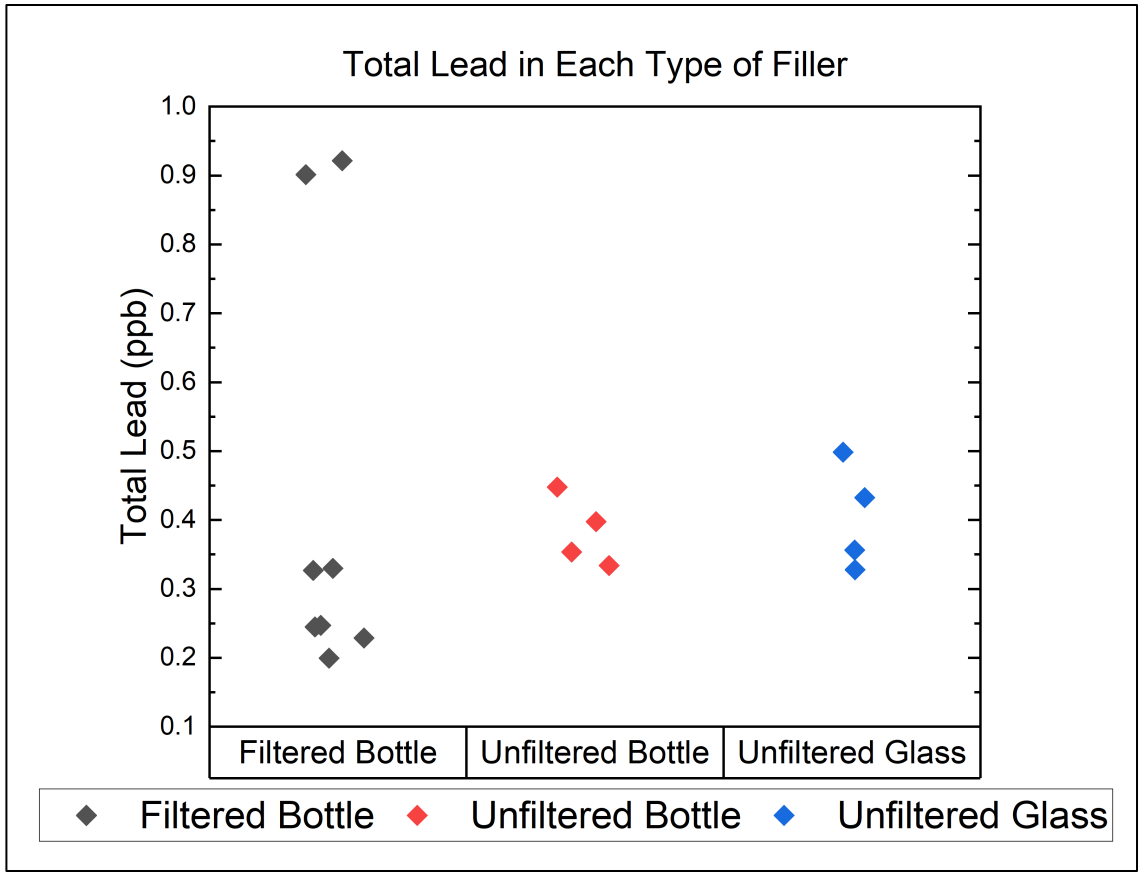




Utilizing box plots, our team can conclude that the unfiltered data is more precise than the filtered data for both lead and copper

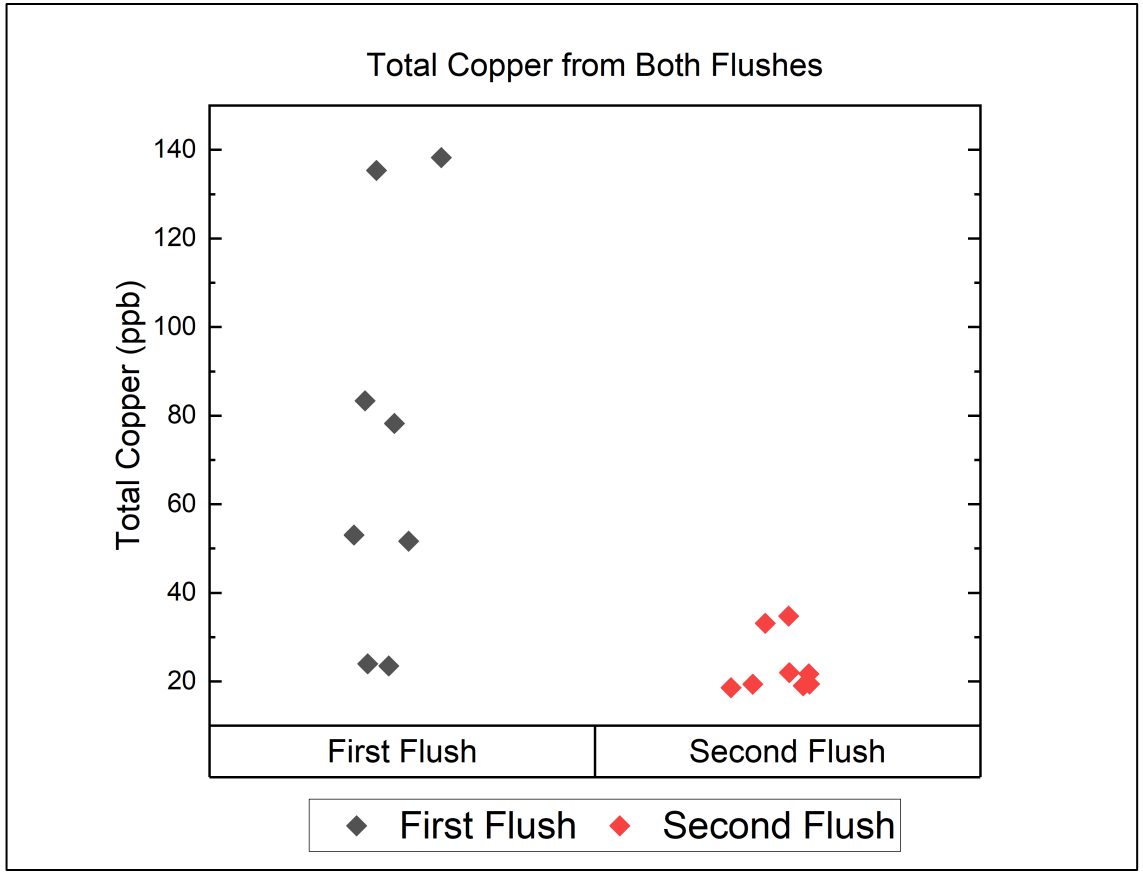
Results of Samples Analysis

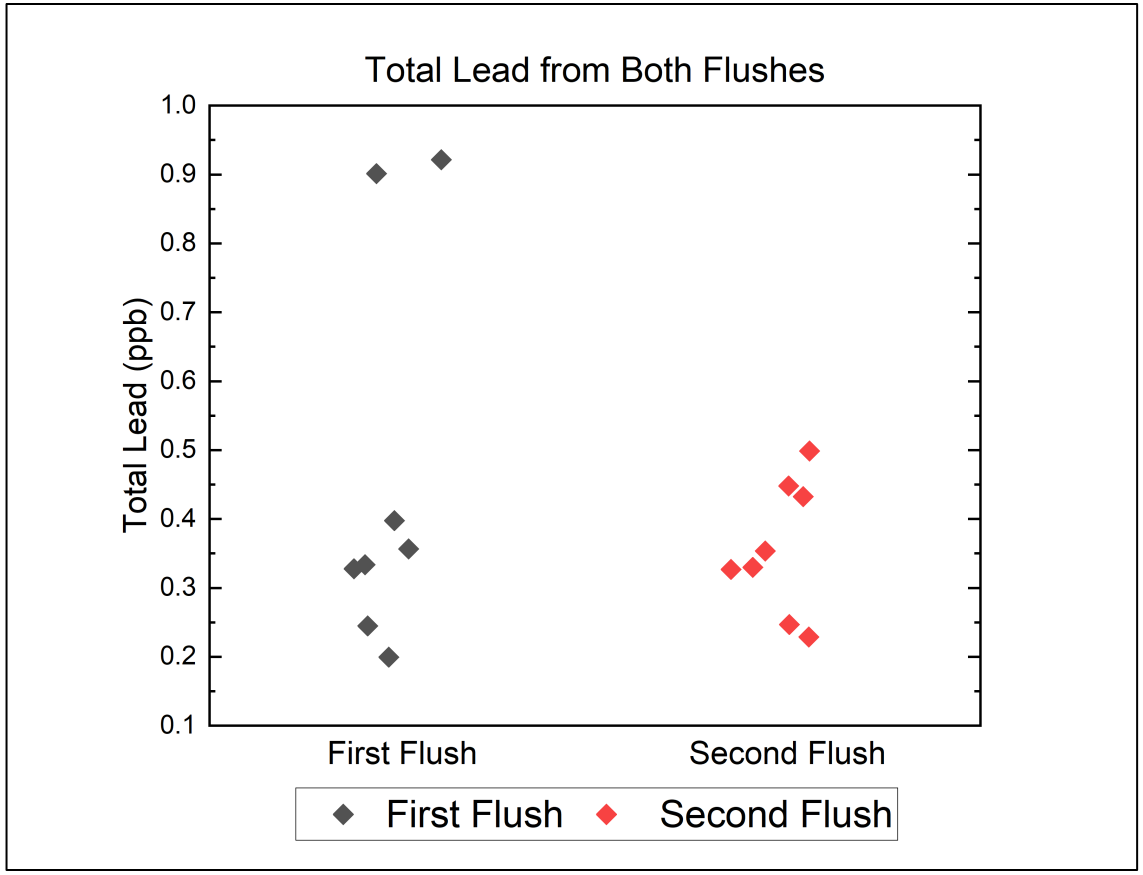




Comparing the three types of water filling stations, the filtered enhanced bottle filler had the highest lead and copper levels

Results of Samples Analysis





Comparing first and second flush, the first flush had slightly higher total copper and lead levels

Statistical Analysis – Errors For Each Sample Date

	% Error Copper	% Error Lead
Sample Date 4/11	1.73%	3.59%
Sample Date 4/16	54.5%	24.4%
Sample Date 4/18	54.5%	24.4%

Design Results

Assuming:

- $1,500 for filtered hydrostations
- $1,000 for unfiltered hydrostations
- $250-$500 installation
- $65-75 for filters
- $500 annual labor costs
- 10 year design life
- 6% interest rate
- Replacing filters twice a year

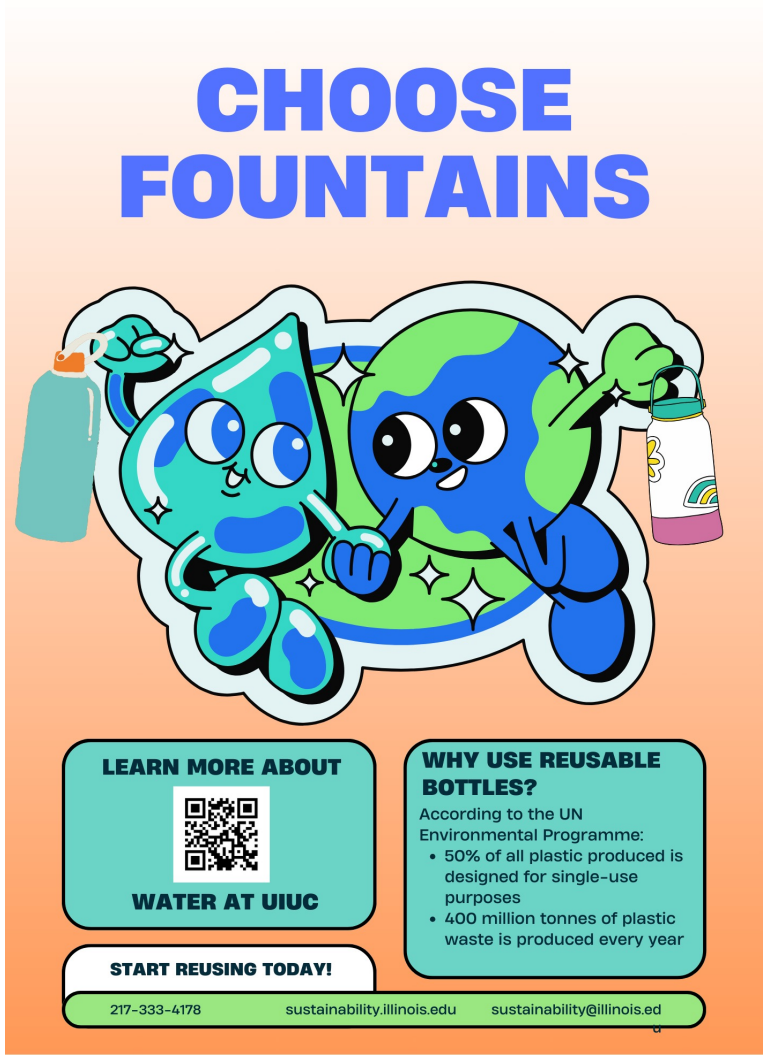
Unfiltered Hydrostation Total Cost	Filtered Hydrostation Total Cost
$5,055	$6,596

Design Results

- Posters around campus
- Reusable water bottle during move-in
- Installation of more unfiltered hydrostations

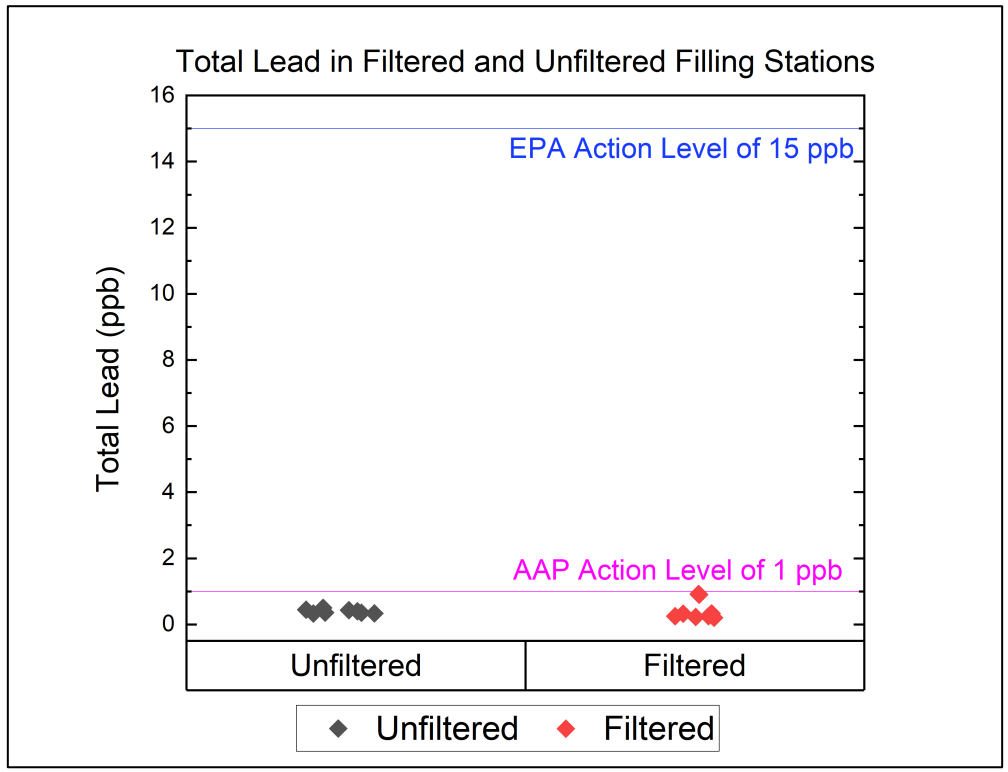
https://hvacdirect.com/elkay-indoor-ezh2o-bottle-filling-station-with-single-ada-cooler-non-filtered

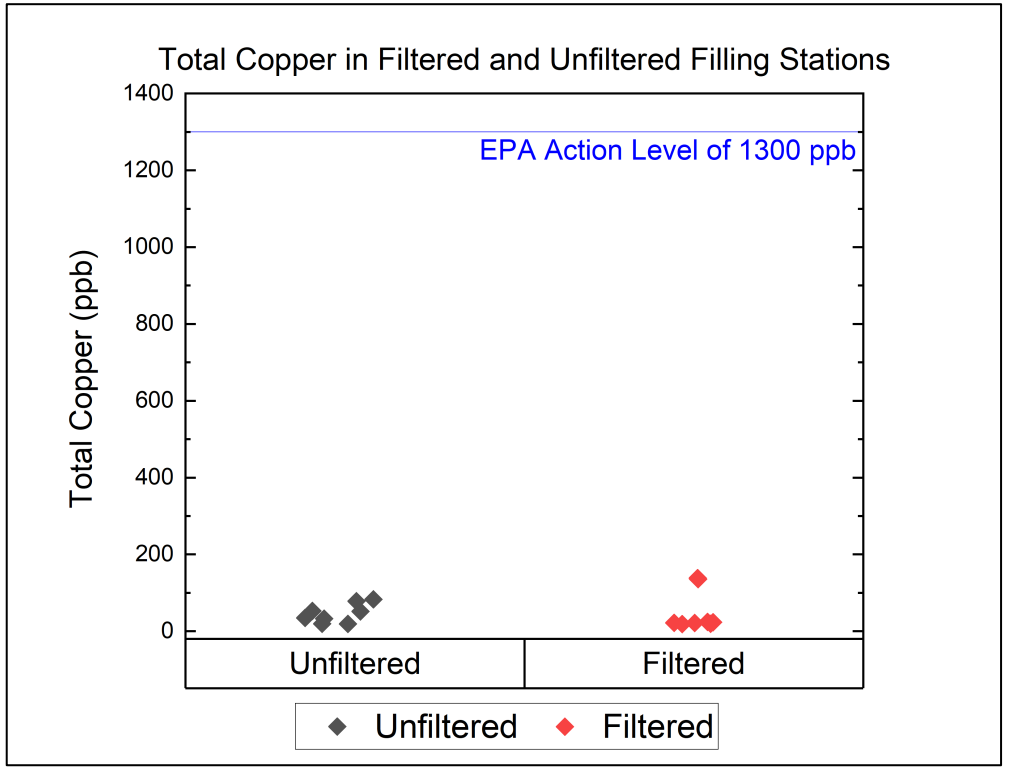
https://profootballstuff.com/products/illinois-fighting-illini-quencher-water-bottle



Conclusion

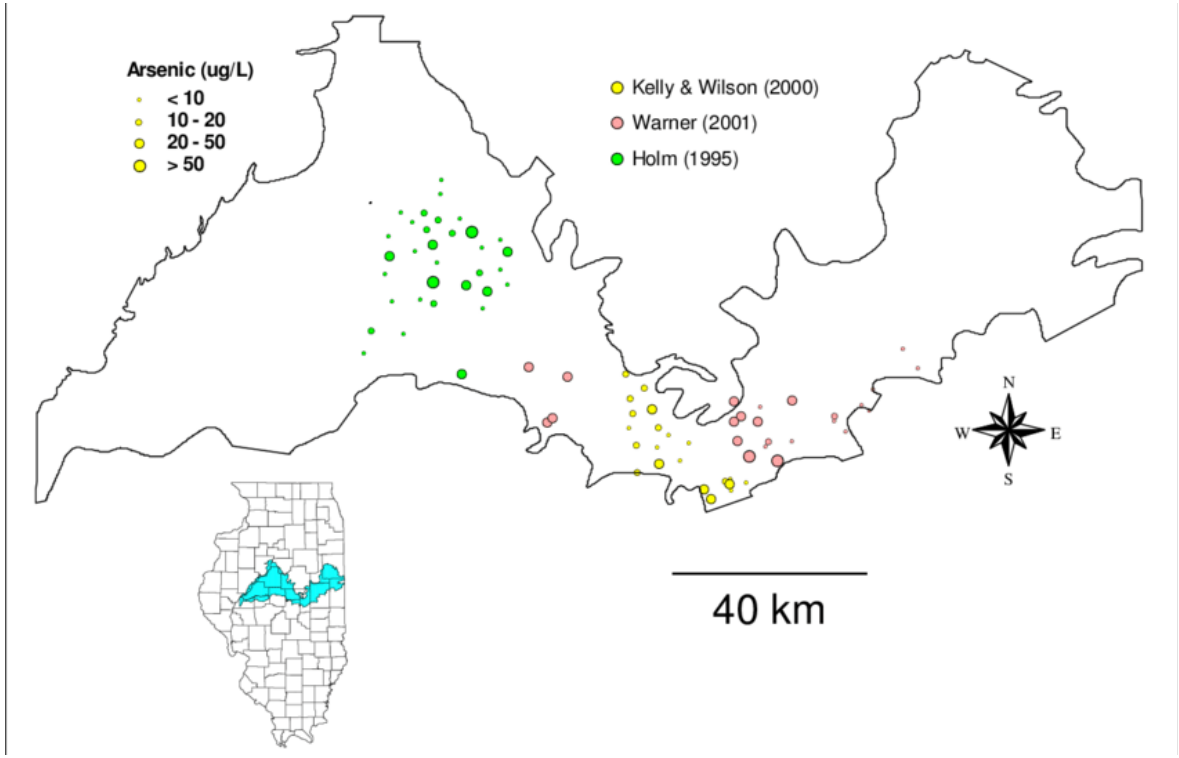
- Filling stations are all well within safe drinking water standards
- Recommend installing unfiltered hydrostations
- Promote the use of hydrostations through poster and reuseable bottles





Recommendations for Future Investigations

- Larger sample volume would give us more accurate results
- Test more glass fillers
- Test for different substances found in water to alleviate student concerns
  - Arsenic is a naturally occurring substance found in central Illinois water supplies



https://www.researchgate.net/publication/32966775_Spatial_Variability_of_Arsenic_in_Groundwater

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