

Arsenic and Isotope Concentrations in the Lower Platte River Valley of Eastern Nebraska, early 1970s to 2023



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U.S. Geological Survey



Outline

- Surface Water Arsenic Results
- Groundwater Arsenic Results
- Isotope Data Results

- Thank you for supporting this collaborative study:
 - City of Lincoln Water System
 - Nebraska Water Sustainability Fund

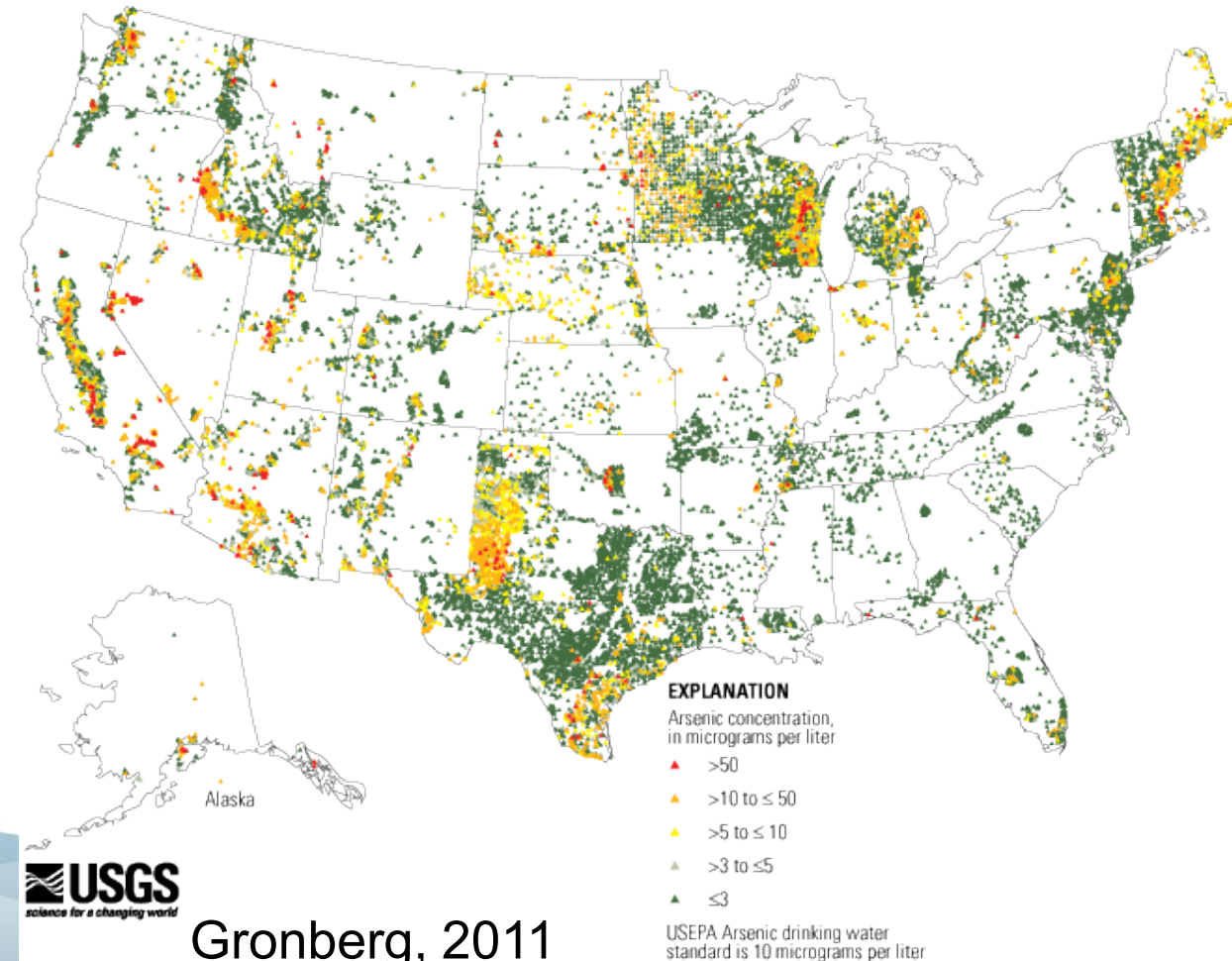
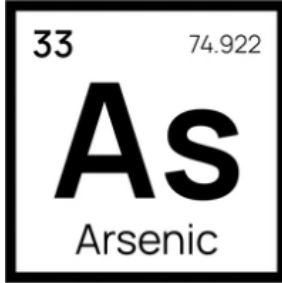
- USGS coauthors: Mikaela Cherry and Brent Hall





Arsenic:

- Arsenic is a naturally occurring metal that can be found in both surface water and groundwater.
- Originates from natural sources, such as the dissolution of minerals found in sediment and bedrock.
- Arsenic concentrations in groundwater can change and become mobile as the result of redox processes.
- Long-term exposure in drinking water is shown to cause certain types of cancer and other health problems.
- In 2002, the EPA moved the MCL from 50 micrograms per liter ($\mu\text{g/L}$) to 10 $\mu\text{g/L}$.



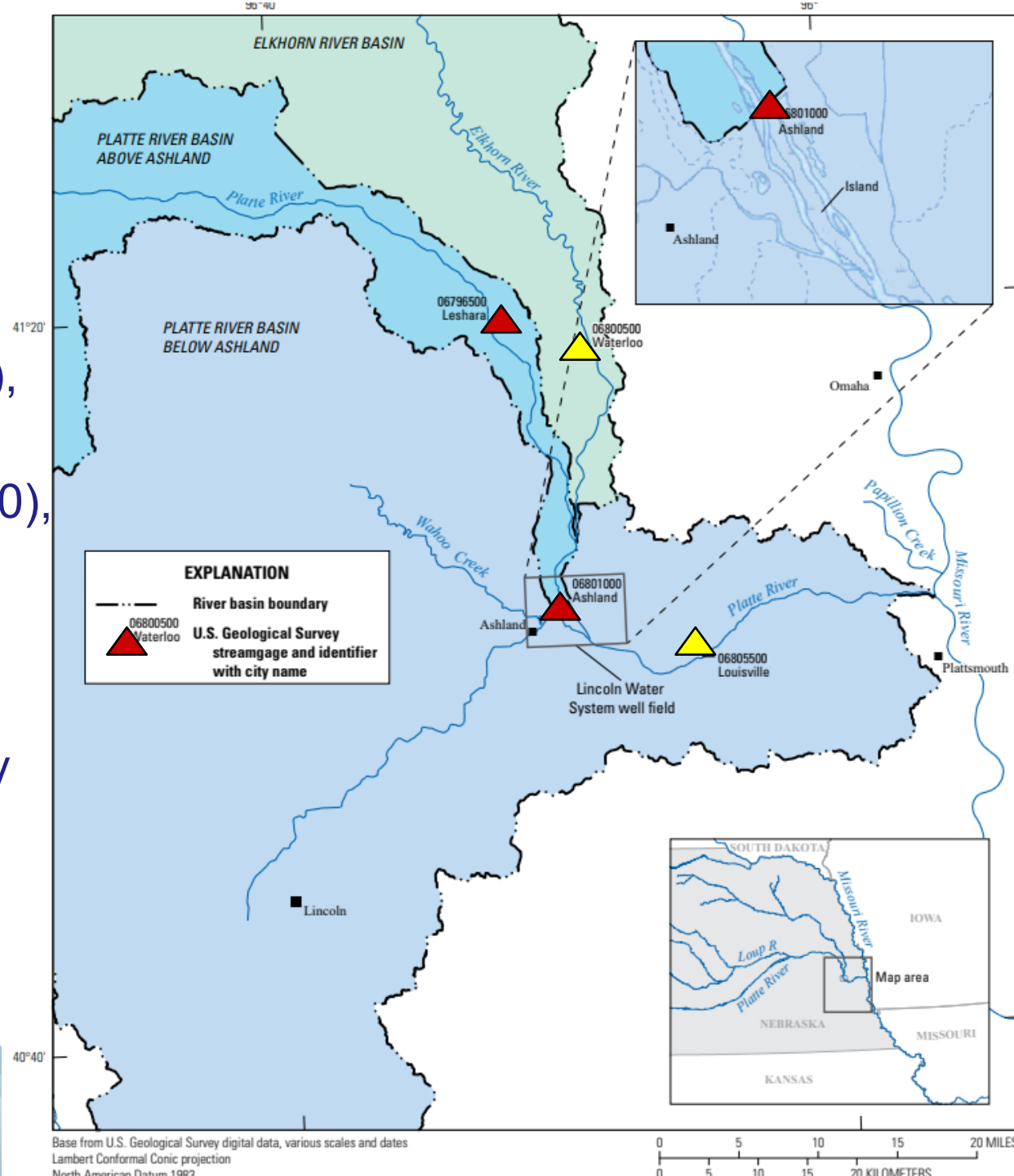
City of Lincoln

- The City of Lincoln Water Systems (LWS) has been monitoring concentrations of arsenic in their source water and evaluating their options for treatment and removal.
- LWS meets the Environmental Protection Agency (EPA) requirement of less than 10 $\mu\text{g/L}$ arsenic with arsenic concentrations of 6.4 to 6.5 $\mu\text{g/L}$ in LWS tap water.
- Monitoring wells around the LWS wellfield since 1991 show arsenic concentrations as high as 18 $\mu\text{g/L}$.
- With the high cost to treat or blend source water, additional knowledge about the sources of arsenic, trends in arsenic concentrations, and contributions to the LWS water supply is valuable for their operation and planning.



Data Collection

- USGS surface water sampling has been collected at two locations:
 - ▲ Platte River at Louisville, Nebr. (06805500), collected intermittently since 1974.
 - ▲ Elkhorn River at Waterloo, Nebr. (06800500), collected intermittently since 1970.
- USGS and LWS groundwater sampling:
 - Monitoring well sampling began in the early 1990s at select sites.
 - Collected from 8 monitoring wells approximately every 4 months.



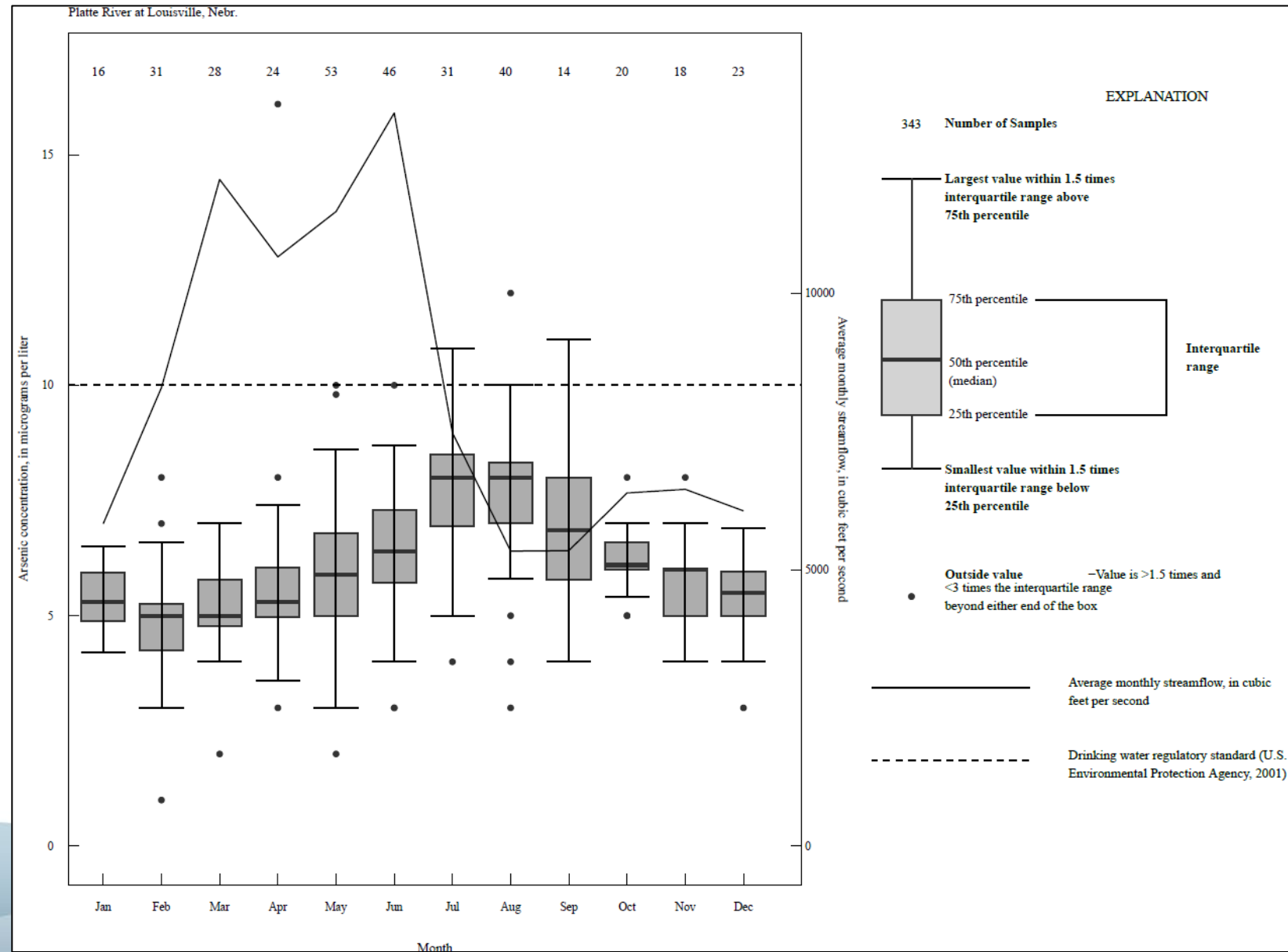
Data Collection

- As part of this study, additional paired samples were collected during 2022 and 2023.
 - Stream samples from the Platte River sites of Leshara and Ashland were collected at similar times as the scheduled USGS sampling of the Elkhorn River and Platte River Louisville.
 - Results of these samples were used to compare contributions from the stream basins.



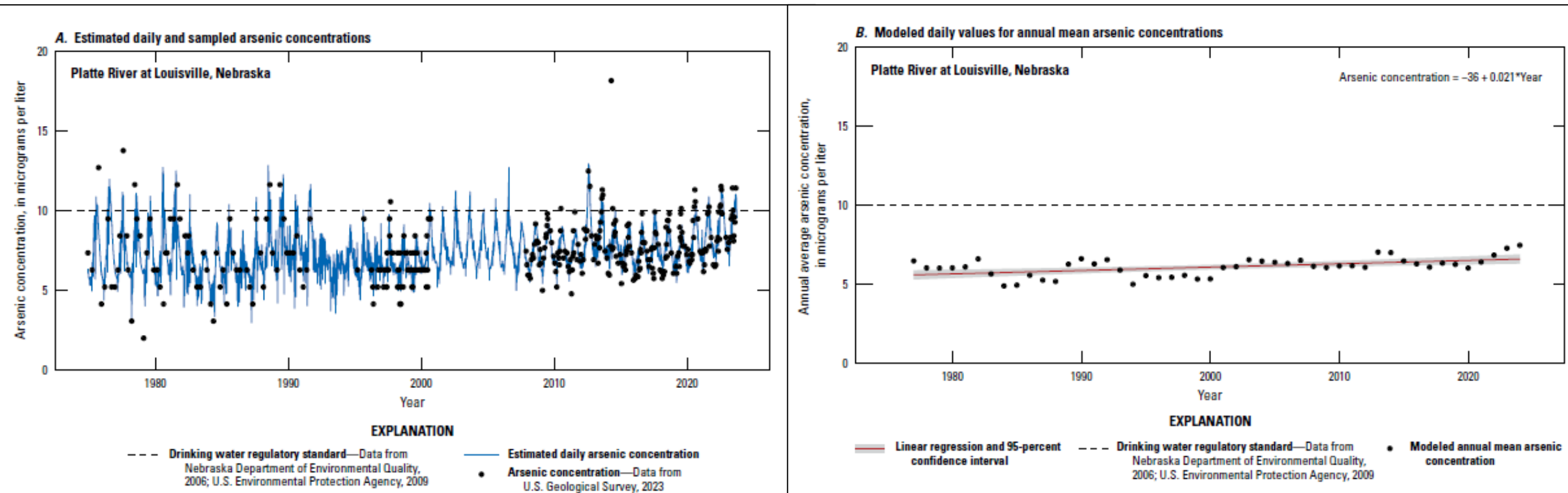
Surface Water Arsenic Results

- Platte River at Louisville:
 - Site located downstream of LWS wellfield.
 - 343 arsenic samples collected from 1974 to 2023.
 - Strong seasonal component to arsenic in stream water.
 - Concentrations were highest in the summer months.



Surface Water Arsenic Results

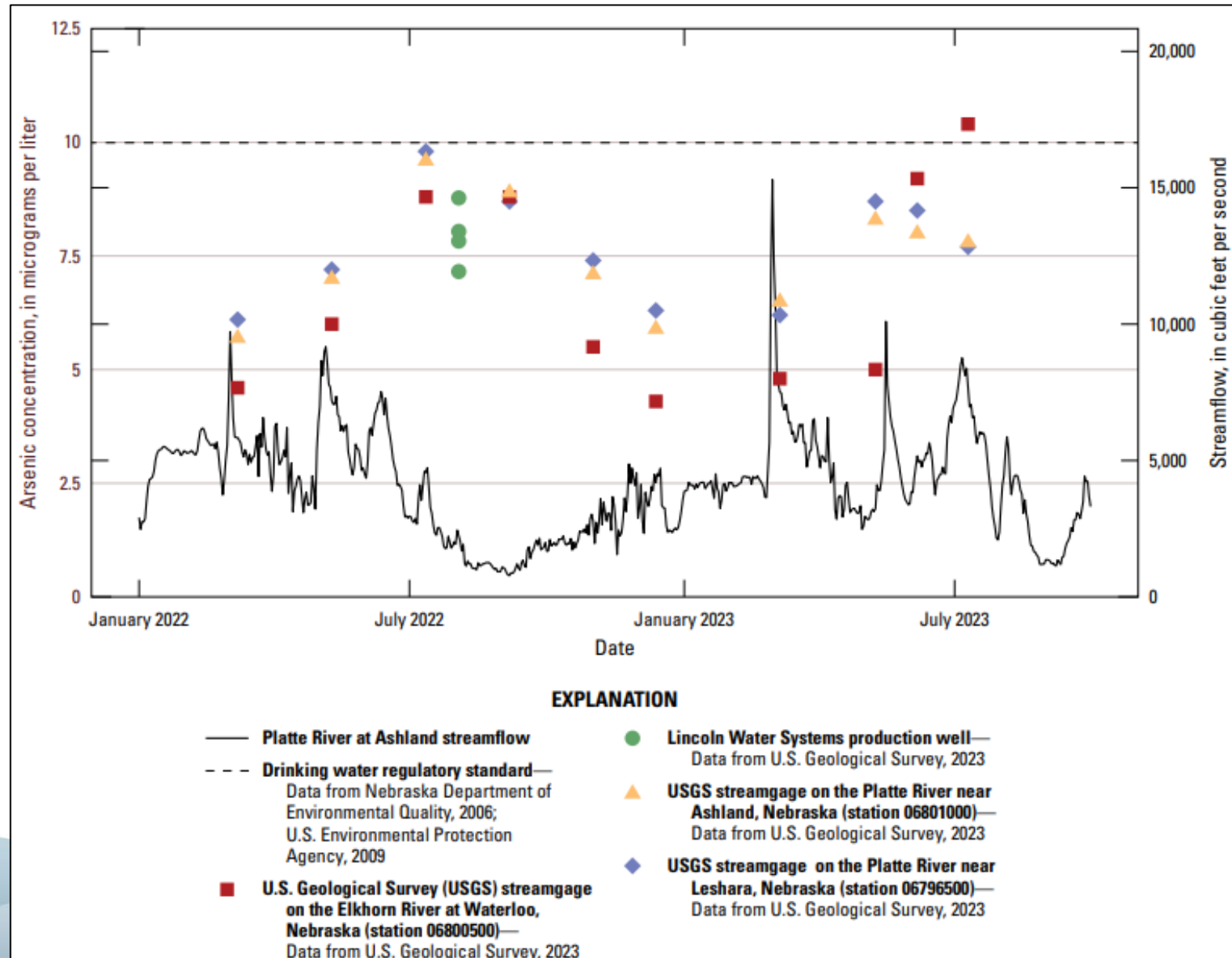
- Using those 343 samples, a weighted regression model was applied that incorporated time, discharge, and season to model daily values.
- From those modeled daily values, arsenic concentrations have been found to be increasing in the Platte River at Louisville over the past 50 years.



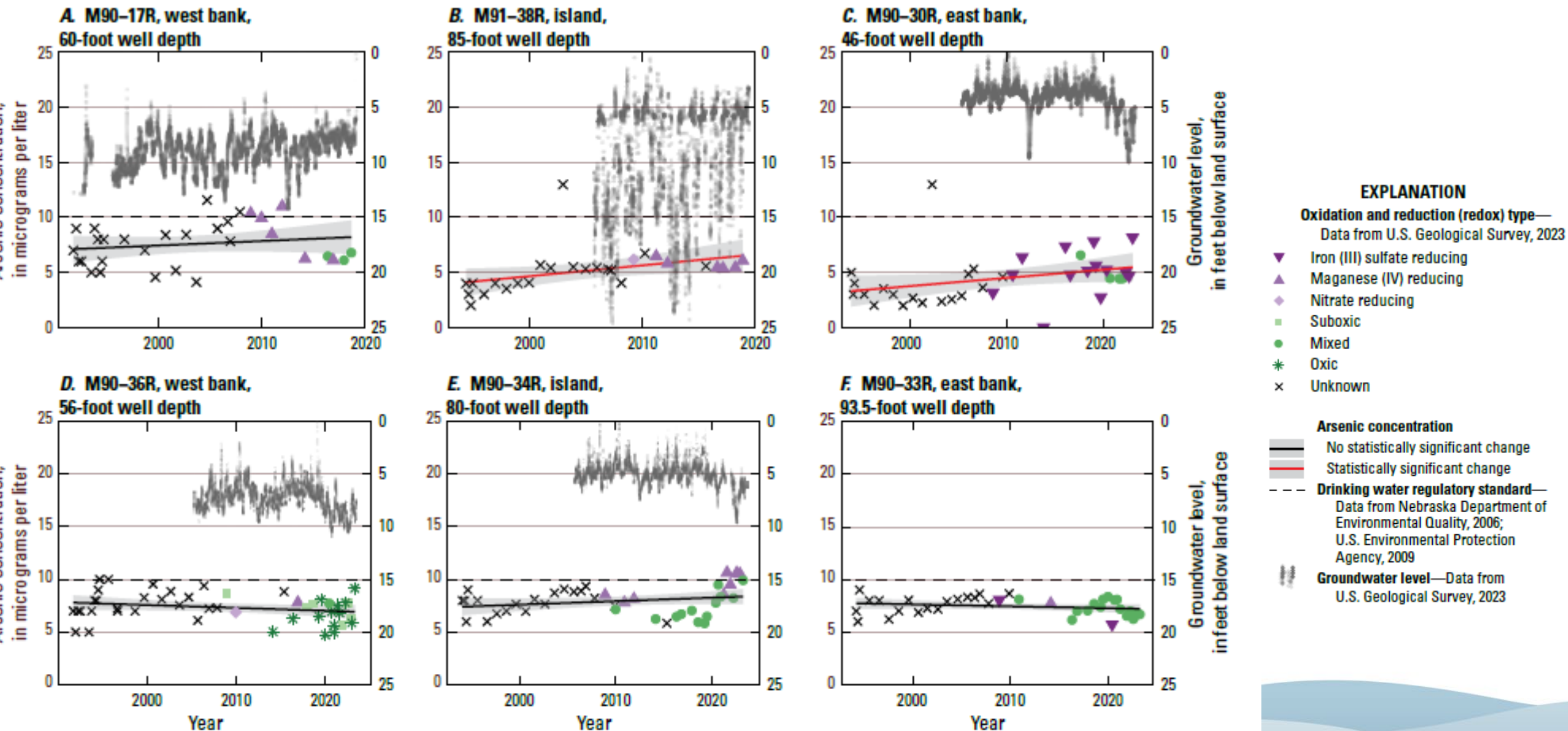
Surface Water Arsenic Results

- Paired stream samples show that the Platte River generally has higher arsenic concentrations than the Elkhorn Basin.

Sites compared	Arsenic concentrations mean difference (µg/L)
Platte River near Leshara, Nebr. and Elkhorn River at Waterloo, Nebr.	0.92
Platte River near Ashland, Nebr. and Elkhorn River at Waterloo, Nebr.	0.74
Platte River near Leshara, Nebr. and Platte River near Ashland, Nebr.	0.18

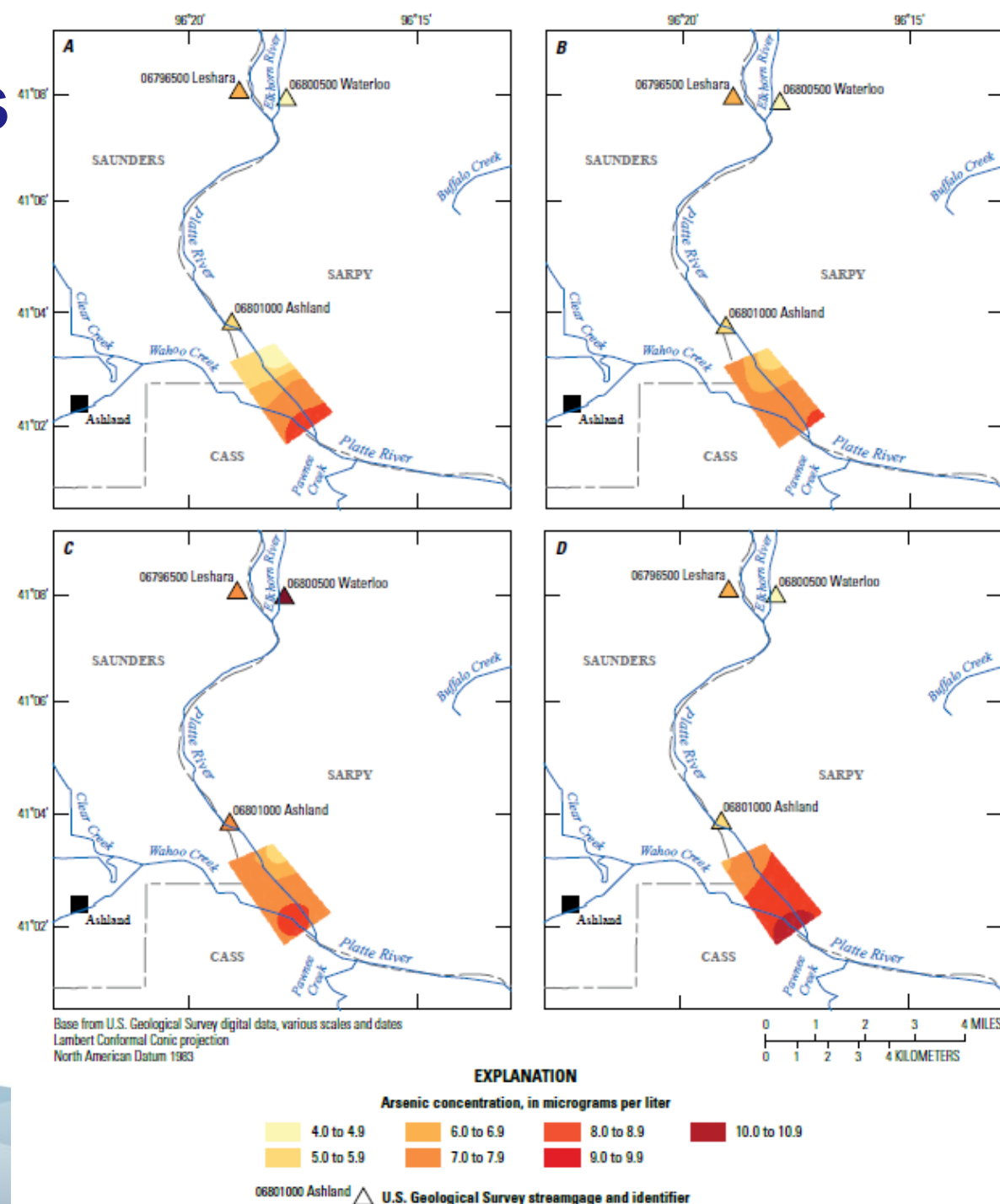


Groundwater Arsenic Results



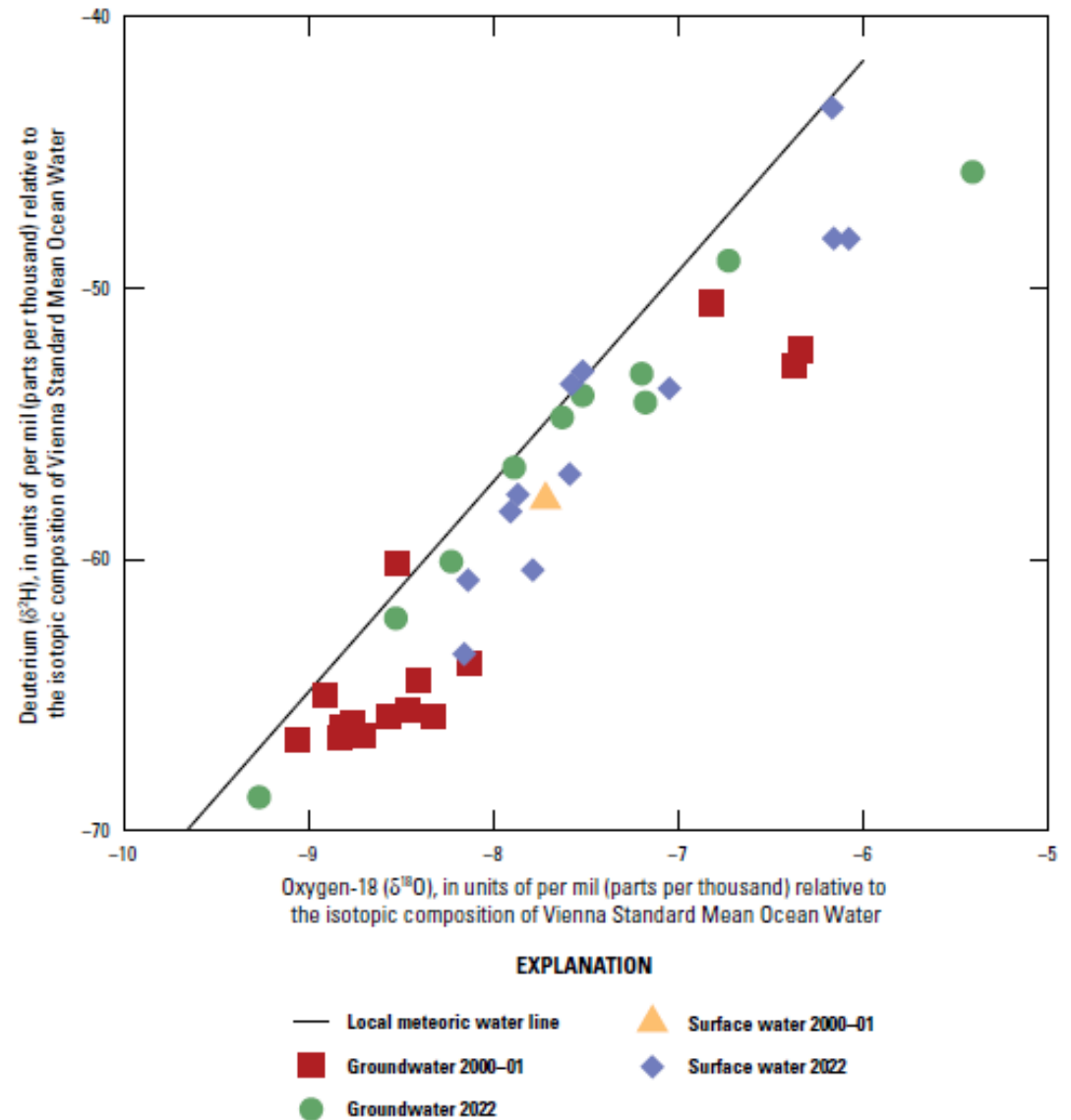
Groundwater Arsenic Results

- Seasonal groundwater arsenic concentrations were paired with mean surface water samples.
- Groundwater arsenic concentrations were approximately 1-2 $\mu\text{g/L}$ higher in the summer and fall months when compared against the winter and spring months.
- Groundwater arsenic concentrations were higher downstream compared to upstream samples.



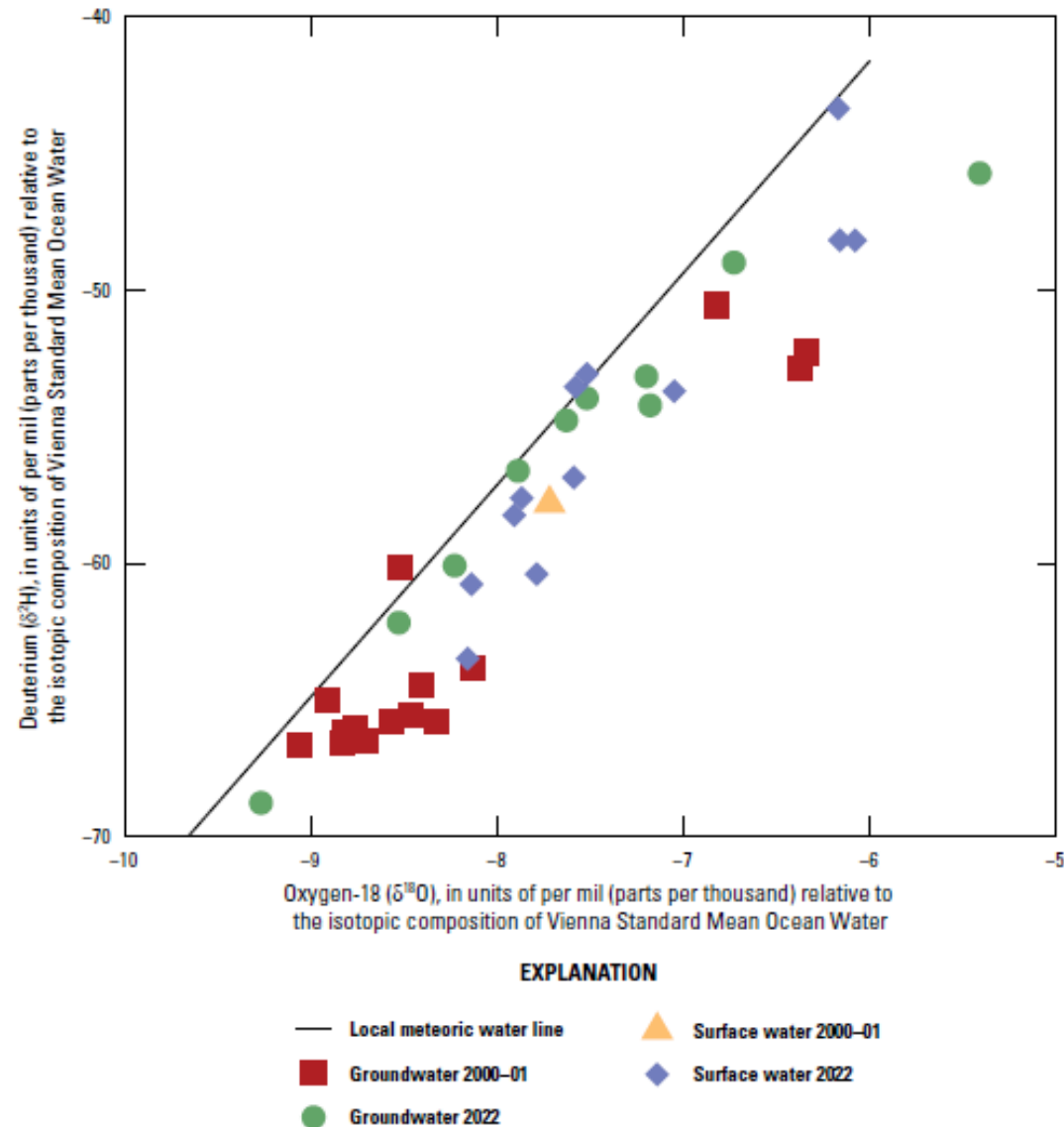
Isotope Data

- In 2022, 13 surface water and 11 groundwater isotope samples were collected, groundwater samples included both monitoring and LWS production wells. The samples were compared to samples from 2001.
- As surface water evaporates, it leaves behind different isotopic ratios of the remaining surface water. ($\delta^2\text{H}$ and $\delta^{18}\text{O}$)
- These isotopic ratios can be used to observe different groundwater recharge compositions.



Isotope Data

- LWS production wells sampled in the spring show a higher percentage of stream water than those samples collected during the summer.
 - This correlates with decreased streamflow and increased pumping rates in summer.
 - Higher arsenic concentrations in the Platte River during the summer raises the potential for elevated arsenic levels in LWS source water.
- Isotopic composition observed in monitoring wells varied from well to well.
 - Evaporative signals in monitoring wells were stronger in 2022 compared to 2001.



Summary

- Surface water arsenic concentrations were found to be very likely increasing in the lower Platte River Valley over the past 50 years with highest concentrations in streams occurring during the summer months.
- Groundwater arsenic concentrations were increasing in 2 of the 6 monitoring wells from the early 1990s to 2023. Concentration varies by season, location, and redox condition.
- Isotope ratios show a seasonal contribution of surface water to groundwater in the LWS production wells, with more groundwater contributions occurring during the summer.



Report Recently Posted

- Moser, M.T., Cherry, M.L., and Hall, B.M., 2026, Arsenic and isotope concentrations in the lower Platte River valley of eastern Nebraska, early 1970s to 2023: U.S. Geological Survey Scientific Investigations Report 2026–5138, 23 p., [https://doi.org/ 10.3133/ sir20265138](https://doi.org/10.3133/sir20265138).
- Available at: <https://pubs.usgs.gov/publication/sir20265138>
- All data utilized in this study are publicly available via USGS WDFN (waterdata.usgs.gov).

Questions?

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www.usgs.gov/centers/central-plains-water-science-center

Report available online at: <https://pubs.usgs.gov/publication/sir20265138>

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