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Volume 2022 Article 17

4-20-2022

Contaminant Analysis of Domestic Well Water in Norton and Phillips Counties, Kansas

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Contaminant Analysis of Domestic Well Water in Norton and Phillips Counties, Kansas

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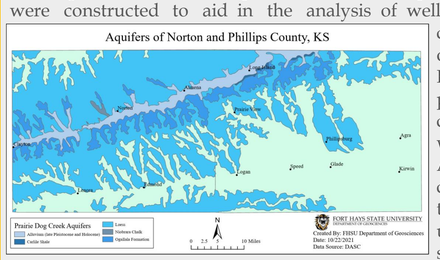
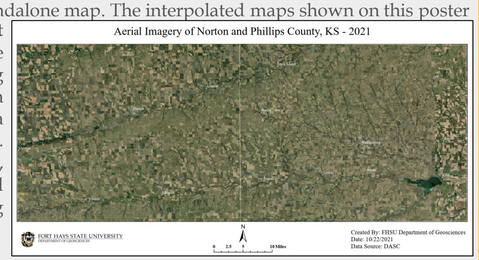
Abstract

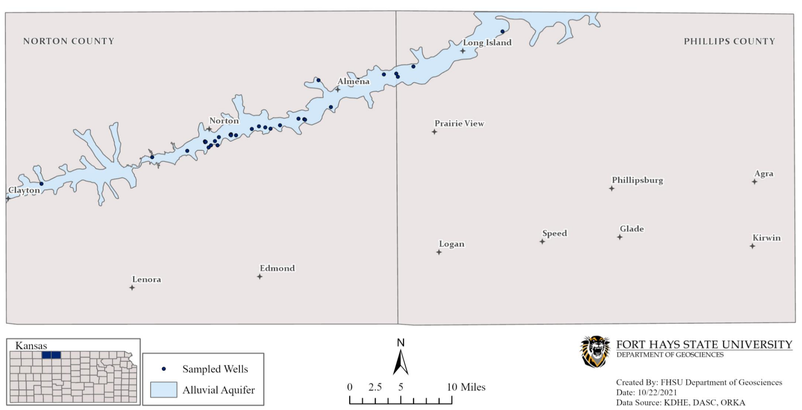
The Alluvial aquifer in Kansas is responsible for supplying much of western Kansas with fresh domestic well water. Samples from these domestic wells were collected from participating landowners along the Alluvial aquifer of Norton and Phillips counties, Kansas. The collected samples were shipped to the Kansas Department of Health and Environment (KDHE) Laboratories for analysis of various regulated contaminants. The following parameters were measured from each water sample: uranium, nitrate, sulfate, iron, selenium, manganese, chloride, arsenic, and conductivity. Using ArcGIS Pro, the locations of the sampled wells were converted into point data with their respective parameter data attached. Several cartographic maps were constructed to represent the concentration of each contaminant along the length of the Alluvial aquifer. Additional maps representing soil type, land use, and local geology were constructed to aid in the analysis of wells containing contaminants over the maximum contamination level (MCL). The resulting collection of attribute data and maps were returned to the KDHE for future purposes. This is an ongoing project with an aim to express the importance of consistent monitoring of contaminants in domestic wells. This summer, we will continue analysis of the Alluvial aquifer traveling westward into the Kansas counties of Rawlins and Decatur. We look forward to gathering more data to help us determine if land use and local geology could be a contributing source of contamination.



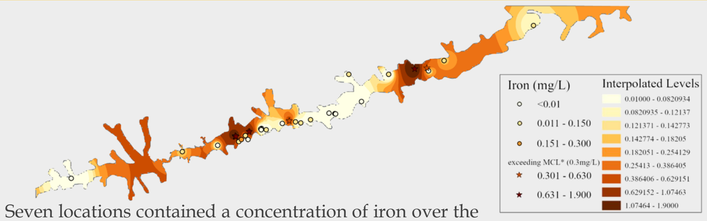
Methods

The registered domestic wells of Norton and Phillips counties were documented in an excel spreadsheet with their locations entered in decimal degrees. There were additional unregistered tested wells; their coordinates were recorded and entered manually. Once all wells were accounted for, the coordinates were used to create point data in ArcGIS Pro. After the parameter data for each sample was received from the KDHE laboratories, the point data could be joined to the excel file using the coordinates as the relationship. With the results contained within the point data, a variety of analyses were run to produce the most accurate portrayal of the data in a standalone map. The interpolated maps shown on this poster were created by using the spatial analyst kriging tool with 9 geometric intervals. Before running the kriging tool, the following settings were selected: ordinary kriging with a spherical semi-variogram model and a variable search radius of 10 points. Complimentary maps depicting local geology, land use, and aerial imagery were also created to aid in analysis of wells containing contaminants over the MCL.

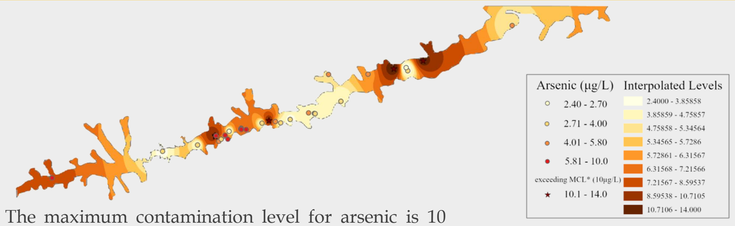




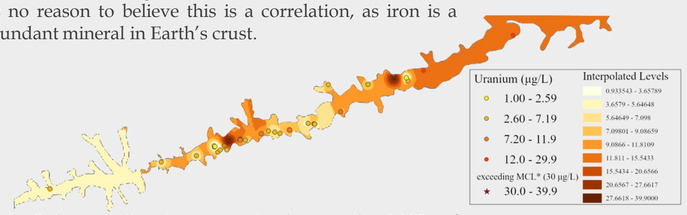
Mineral Concentration



Iron: Seven locations contained a concentration of iron over the maximum contamination level of 0.30 mg/L. This is the only contaminant that shows an increase in concentration around municipalities. Specifically, the tested wells around the city of Norton, KS, show the highest concentration of iron. However, there is no reason to believe this is a correlation, as iron is a very abundant mineral in Earth's crust.

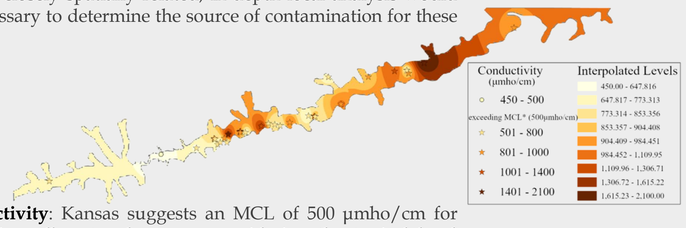


Arsenic: The maximum contamination level for arsenic is 10 µg/L. Five locations tested above this level. Since two of these locations were in very close radius to each other, it is possible both wells are contaminated with the same source. Arsenic can enter the water supply from dissolution of natural deposits in the crust, but it is more likely from runoff collecting certain arsenic-bearing fertilizers.

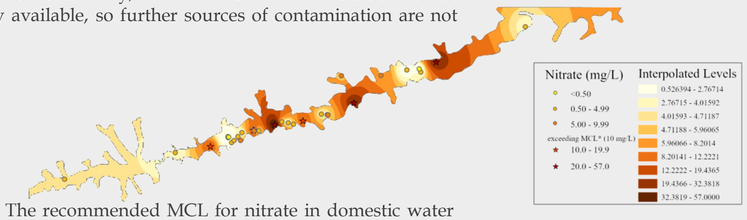


Uranium: Only two locations contained over the MCL of uranium at 37 µg/L and 39 µg/L. Uranium is a common naturally occurring substance that can leach into the water supply from soil and geologic formations. These two locations are not closely spatially related; in-depth local analysis would be necessary to determine the source of contamination for these wells.

Sulfate: The maximum contamination level in Kansas for sulfate is 250 mg/L. Only one location tested above this level at 370 mg/L. Dissolution of any sulfate mineral can contaminate the groundwater, and further mining practices can expedite this process. Unfortunately, the land use for this location is not publicly available, so further sources of contamination are not known.

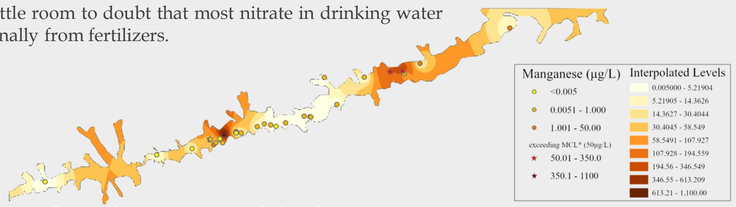


Conductivity: Kansas suggests an MCL of 500 µmho/cm for domestic well water; however, considering the typical hard water in western Kansas, it is no surprise to see most wells over the MCL for conductivity. Only one well tested under the MCL at 450 µmho/cm.

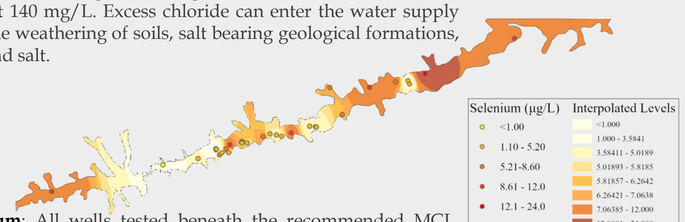


Nitrate: The recommended MCL for nitrate in domestic water is 10 mg/L. Six wells tested over the MCL with the highest at 57 mg/L. Nitrate is often introduced into surface water and groundwater due to runoff collecting nitrates from fertilizers on nearby fields. Rural Kansas has an abundance of farmland, leaving little room to doubt that most nitrate in drinking water was originally from fertilizers.

Chloride: No wells in our sample area tested over the MCL of 250 mg/L. The highest testing well was still well under the MCL at 140 mg/L. Excess chloride can enter the water supply from the weathering of soils, salt bearing geological formations, and road salt.



Manganese: Four locations exceeded the maximum contamination level at 88, 200, 350, and 1100 µg/L. Since the MCL for manganese is 50µg/L, these locations should consider switching water sources or treating their water. The location testing at 1100 µg/L was resampled and analyzed several times to ensure there was no mechanical error, but the result remained the same.



Selenium: All wells tested beneath the recommended MCL, with the highest concentration at 24 µg/L.

Kansas Department of Health and Environment

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