Analyzing Nitrate Pollution in Domestic Wells Across Western Kansas

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Abstract

Rural homes across Western Kansas have historically relied on the use of well water for drinking. These wells draw upon many different sources of water but usually remain relatively shallow at less than 100 feet (Buchanan et al., 2023). Domestic wells typically draw from alluvial aquifers, but some may tap into the Ogallala or Dakota aquifer at much greater depths, ~400 feet or less (Buchanan et al., 2023), or ~2,000 feet or less, respectively (Macfarlane, 1995). To access these sources, wells are drilled into various rock layers. These range from the unconsolidated sand and gravel of the alluvial and Ogallala aquifers to the deeper sandstone formations of the Dakota aquifer (Buchanan et al., 2023). These domestic wells are privately owned and thus are not subject to routine tests and regulations like public water systems. This leads to an increased risk of unknown contamination. Common potential contaminants include nitrates, which routinely get into wells through septic systems and agricultural drainage (Young & Townsend, 1999). High levels of nitrates can cause serious health defects, especially to young children and pregnant women (Sedgwick County Health Department, n.d.). Solving this issue requires regular testing of the water, better management of the land around the well, and an increase in public knowledge. To stop the potential harmful effects of excess dissolved nitrates, well owners must understand the danger nitrates pose and implement regular water testing habits, filtration systems, or alternate sources of clean, safe drinking water.

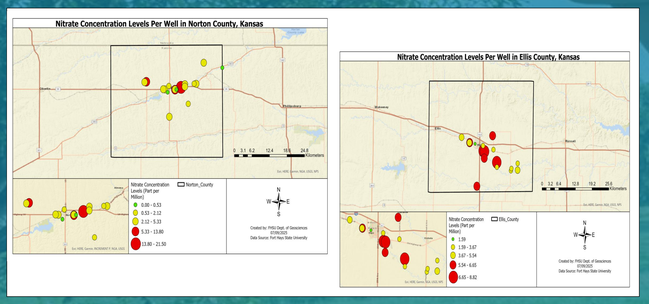

Figure 2. Geographical Maps Showcasing Locations of Private Wells Tested and their Corresponding Nitrate Concentrations in Norton and Ellis County.

Introduction

- Rural households across western Kansas depend heavily on private wells for drinking water. Conservation efforts have traditionally prioritized aquifer longevity over immediate water quality and safety.
- Unlike public systems, private wells are not subject to routine regulation or oversight, making them vulnerable to contamination.
- Agricultural runoff and septic system drainage are key contributors to elevated nitrate levels in groundwater.
- Limited public awareness and infrequent testing increase the risk of prolonged exposure to unsafe water.
- Protecting rural water quality requires a shift from conservation-only approaches to proactive, informed protection strategies.
- Homeowners need access to education, regular testing protocols, and practical management tools to safeguard their water.
- This study was conducted to assess the extent of nitrate contamination in domestic wells across western Kansas.
- Sampled wells draw from diverse aquifer systems, including shallow alluvial deposits and deeper formations like the Ogallala and Dakota aquifers.
- Domestic wells, unlike municipal systems, are rarely monitored—posing a serious risk of undetected pollutants such as nitrates.
- Elevated nitrate levels in drinking water can cause severe health effects, especially for infants and pregnant women.
- Unnoticed contamination can lead to long-term community exposure, rising healthcare costs, and increased uncertainty.
- This project aligns with the Phase II grant's mission to advance community-driven water protection through sampling, education, and outreach.
- Findings from this study highlight the urgent need for expanded testing, improved filtration access, and public engagement to ensure safe drinking water in rural Kansas.

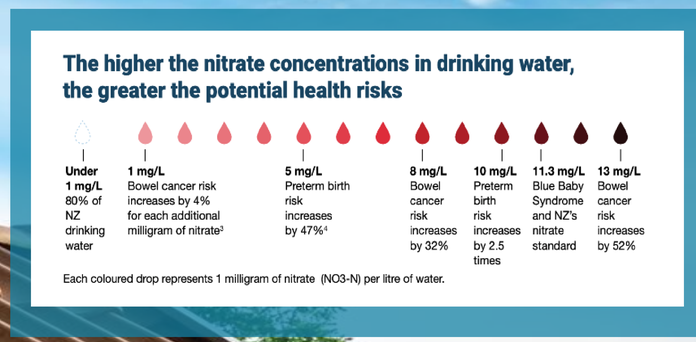

Figure 1. Average Effects of Nitrate Concentrations in Drinking Water Concerning Health Risks
Retrieved from https://www.greenpeace.org/aotearoa/freshwater/nitrate-contamination-in-drinking-water-what-you-need-to-know-and-some-frequently-asked-questions/ (n.d).

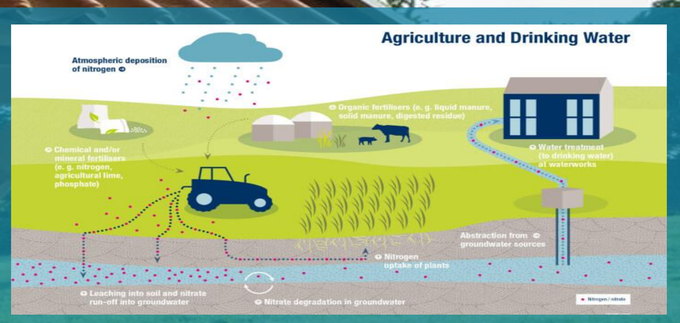

Figure 4. Graphic Showing How Nitrates Find Their Way Into Well Water Systems and Eventually the House Retrieved from . https://www.pickcomfort.com/water-quality/nitrates-in-water/ (n.d.).

References and Acknowledgements

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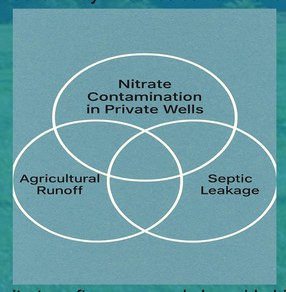
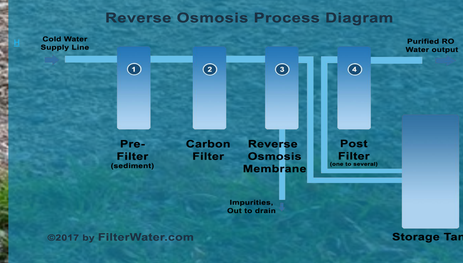
Discussion

- Nitrate contamination in western Kansas private wells is regionally variable and sometimes severe.
- Most wells tested below the EPA's 10 ppm limit, but some exceeded it—occasionally by more than double.
- Ellis and Norton counties showed the widest range, from 0.1 ppm to over 25 ppm.
- Local factors like agricultural runoff, septic leakage, and well construction may influence contamination levels.

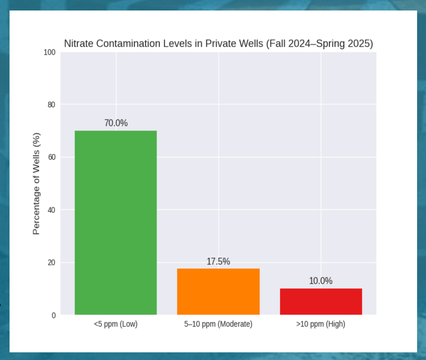


- Elevated nitrates often appeared alongside high conductivity and hardness, suggesting land use and soil chemistry play a role.
- No consistent link was found between nitrate levels and microbial contamination (e.g., coliform or E. coli).
- This highlights that chemical risks can exist even when microbial tests appear safe.
- Many high-nitrate wells are outside municipal systems and lack routine monitoring.
- Rural residents need better access to testing and affordable treatment options.
- Reverse osmosis and ion exchange systems can help but may be costly or hard to maintain.



Results

- Over 80 private wells were tested across Ellis, Norton, Hays, Victoria, and Geneseo between Fall 2024 and Spring 2025.
- Wells included both domestic and landscape irrigation systems.
- EPA's maximum contaminant level (MCL) for nitrates is 10 ppm.
- Nitrate levels ranged from <0.1 ppm to 28.3 ppm.
- Several wells exceeded the EPA limit.
- About 10% of wells were above the safe drinking water threshold.
- Approximately 70% of wells had nitrate levels below 5 ppm.
- 17.5% of wells fell into the moderate range of 5–10 ppm.
- 2.5% of remaining wells failed to output a value.
- High nitrate levels often coincided with elevated conductivity, hardness, and sulfate.
- Possible causes include agricultural runoff and aging infrastructure.
- No consistent correlation between nitrate levels and microbial contamination.
- Ellis and Norton counties showed the greatest variability in results.
- Victoria and Hays had better microbial quality but still showed clusters of -high-nitrate wells.
- Nitrate contamination may depend on land use, well depth, and maintenance—not just geography.
- Regular testing and public awareness are essential, especially for rural well users.
- Mitigation strategies include reverse osmosis systems or alternative water sources.
- Continued monitoring and targeted interventions are needed to ensure safe drinking water.



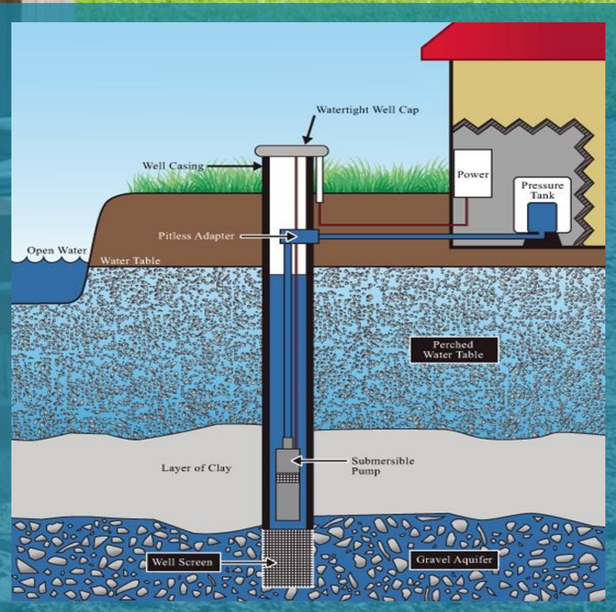


Figure 3. Image Showcasing How Well Water is Transported from within the Ground to the House. There's a Screen at the Bottom to Remove Impurities Before it's Pumped into the House into a Holding Tank.
Retrieved from *Peter Snelten & Sons*. (2025, January 23)