

▶ DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES



Crystal Lee Pow Jackson, PhD
North Carolina
Department
of Health and
Human Services



Max Zarate-Bermudez, MSc,
MPH, PhD
Centers for
Disease Control
and Prevention

Exposure to Contaminants Among Private Well Users in North Carolina: Enhancing the Role of Public Health

Editor's Note: NEHA strives to provide up-to-date and relevant information on environmental health and to build partnerships in the profession. In pursuit of these goals, we feature this column on environmental health services from the Centers for Disease Control and Prevention (CDC) in every issue of the *Journal*.

In these columns, authors from CDC's Water, Food, and Environmental Health Services Branch, as well as guest authors, will share insights and information about environmental health programs, trends, issues, and resources. The conclusions in these columns are those of the author(s) and do not necessarily represent the official position of CDC.

Crystal Lee Pow Jackson is an environmental toxicologist at the North Carolina Department of Health and Human Services. She works in the Occupational and Environmental Epidemiology Branch and manages the Private Well and Health Program within the Division of Public Health. Max Zarate-Bermudez has been an environmental epidemiologist at CDC's National Center for Environmental Health since 2008. He works with 7 of the 19 grantees in the Safe Water for Community Health (Safe WATCH) Program.

In the U.S., North Carolina has the second highest number of residents who rely on private wells for their drinking water supply. Maupin and coauthors (2014) reported that about 3.3 million North Carolina residents (35% of the population) used private wells in 2010. Percentages varied by county, with the highest county having 85.4% of the residents using private wells (Figure 1). Unlike public water systems that benefit from the regulatory safeguards of the

Safe Drinking Water Act, there are no federal regulations for private wells in the U.S. Testing, treating, maintaining, and managing private wells are up to well owners, often with little to no technical or financial support.

The North Carolina General Assembly has passed statutes to protect groundwater and the health of residents who use private wells since the 1970s. Most of those statutes included construction regulations (e.g., offset distances to known sources of contamination and grout-

ing) and well disinfection. A statute enacted in 2008 gave exclusive authority to local health departments for permitting the repair and construction of wells, conducting well inspections, and testing new wells (North Carolina General Assembly, 2006). This statute helps in learning about water quality issues of new private wells in the state.

In 2015, the Private Well and Health Program (PWHP) of the North Carolina Department of Health and Human Services received funding from the Centers for Disease Control and Prevention's (CDC) Safe Water for Community Health (Safe WATCH) Program to enhance services to private well users. PWHP was understaffed, had limited access to water quality data, and lacked established partnerships, which prevented them from enhancing services for private well users and better protecting their health.

Vulnerability of Private Wells and Water Quality

PWHP used CDC funding to hire dedicated staff to identify and address threats to water quality in private wells. Staff found that urinary arsenic levels across the U.S. declined in users of public water systems but not in users of private wells after the U.S. Environmental Protection Agency (U.S. EPA) reduced the arsenic maximum contaminant level (MCL) from 0.05 mg/L to 0.01 mg/L in 2006 (Nigra et al., 2017; Welch, Smit, Cardenas, Hystad, & Kile, 2018). This finding created awareness for assessing the data available on arsenic and other contaminants in water samples of new private wells across North Carolina.

FIGURE 1

Estimated Proportion of North Carolina Residents Who Rely on Private Wells per County, 2010

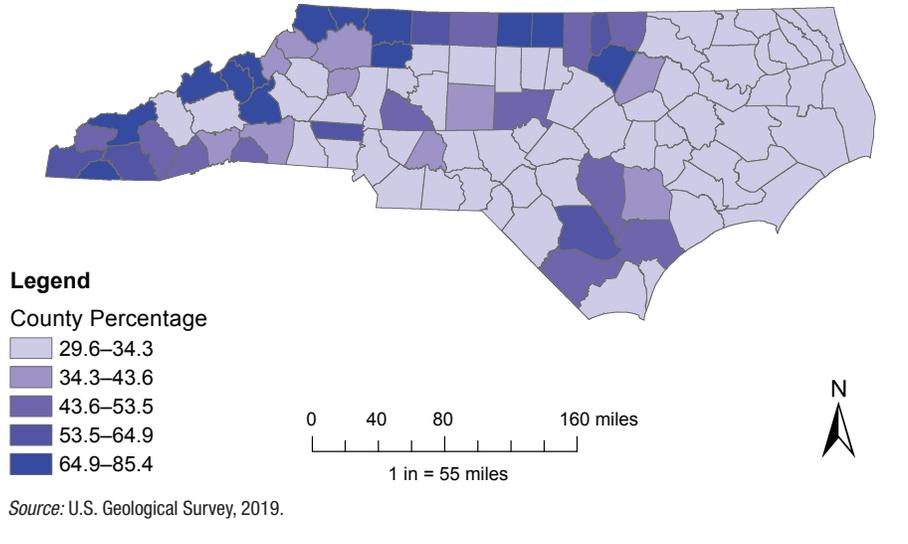
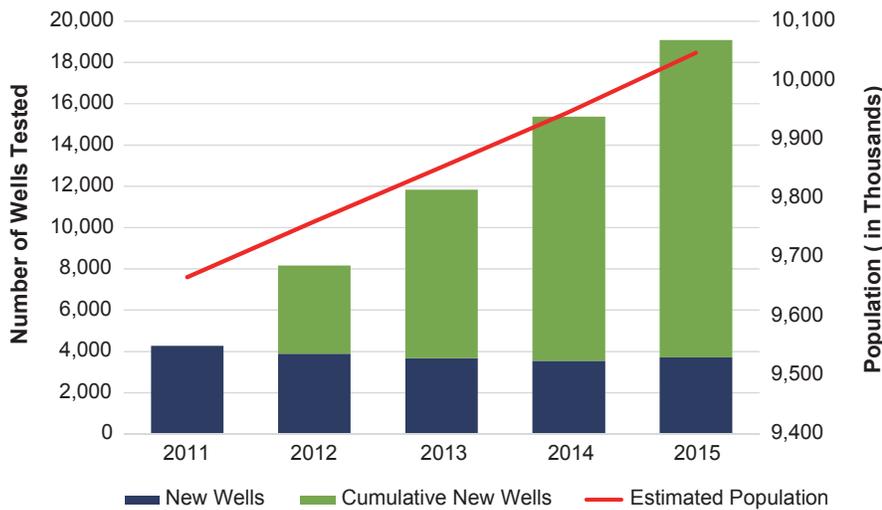


FIGURE 2

Number of New Wells Tested, Cumulative New Wells Tested, and Estimated Population in North Carolina, 2011–2015



The CDC grant helped PWHP establish partnerships to improve access to information in order to plan and prioritize actions aimed at enhancing services. The State Laboratory of Public Health (SLPH) receives and tests water samples of new wells from most

local health departments. Contaminants in groundwater vary by region, so tests focus on just suspect contaminants. PWHP established a partnership with SLPH that allowed the staff to gather test results from new wells electronically and analyze the data. Data

analyses of new private wells sampled during 2011–2015 revealed that

- 34% (3,159 of 9,423) tested positive for *E. coli* and/or total coliform bacteria;
- 33% (5,331 of 15,946) exceeded the U.S. EPA lifetime health advisory for manganese (0.3 mg/L); and
- 2% (238 of 16,171) exceeded the MCL for arsenic (0.01 mg/L) (two counties in central North Carolina exceeded the arsenic MCL in 16% and 20% of samples).

Analysis of SLPH data supports findings from other studies that focused on private wells in the state. Sanders and coauthors (2012) reported arsenic exceedances across the state during 1998–2010 that were similar to those in central North Carolina. Findings of two studies showed an association between manganese concentrations in water of North Carolina private wells and birth defects (Langley et al., 2015; Sanders et al., 2014). A recent analysis of emergency department visits in North Carolina during 2007–2013 found that an average of 29,200 visits per year for acute gastrointestinal illness might be attributed to microbial contamination of private wells (DeFelice, Johnston, & Gibson, 2016).

From 2011–2015, SLPH tested approximately 3,800 samples of new wells annually (Figure 2). During 2010–2015, North Carolina’s population grew from approximately 9.5 million to roughly 10.0 million (North Carolina Office of State Budget and Management [NC OSBM], 2018a) and the population is projected to grow to 11.2 million by 2025 (NC OSBM, 2018b). Private wells will continue to be a major source of drinking water in the state.

Closing the Gap

Given the potential hazards posed by contaminants found in private wells, it is important to ensure the safety of private well water throughout the state. Safe WATCH is supporting PWHP to

- develop partnerships to provide well water outreach and education to underserved populations;
- establish a surveillance system that maps private well contaminants;
- develop an online tool to interpret testing results, provide guidance, and share resources to take corrective actions;
- develop tool kits and feedback mechanism to support the 84 local health department private well programs; and

- identify factors that influence private well user abilities to routinely test, treat, and maintain the quality of their drinking water. PWHP staff are committed to continue enhancing services for private well users and increasing the resources available to them. In turn, staff hope to motivate private well users to maintain their wells and test their water. Established collaborations with academic institutions, county health departments, and other public health partners have contributed to improved private well services. 🐼

Corresponding Author: Crystal Lee Pow Jackson, Environmental Toxicologist, Occupational and Environmental Epidemiology Branch, Division of Public Health, North Carolina Department of Health and Human Services, 5505 Six Forks Road, 1912 Mail Service Center, Raleigh, NC 27699-1912. E-mail: crystal.lee-pow@dhhs.nc.gov.

References

DeFelice, N.B., Johnston, J.E., & Gibson, J.M. (2016). Reducing emergency department visits for acute gastrointestinal illnesses in North Carolina (USA) by extending community water service. *Environmental Health Perspectives*, 124(10), 1583–1591.

Langley, R.L., Kao, Y., Mort, S.A., Bateman, A., Simpson, B.D., & Reich, B.J. (2015). Adverse neurodevelopmental effects and hearing loss in children associated with manganese in well water, North Carolina, USA. *Journal of Environmental and Occupational Science*, 4(2), 62–69.

Maupin, M.A., Kenny, J.F., Hutson, S.S., Lovelace, J.K., Barber, N.L., & Linsey, K.S. (2014). Estimated use of water in the United States in 2010. *U.S. Geological Survey Circular 1405*. Retrieved from <https://pubs.usgs.gov/circ/1405/>

Nigra, A.E., Sanchez, T.R., Nachman, K.E., Harvey, D., Chillrud, S.N., Graziano, J.H., & Navas-Acien, A. (2017). The effect of the Environmental Protection Agency maximum contaminant level on arsenic exposure in the USA from 2003 to 2014: An analysis of the National Health and Nutrition Examination Survey (NHANES). *The Lancet Public Health*, 2(11), e513–e521.

North Carolina General Assembly. (2006). § 87–97. *Permitting, inspection, and testing of private drinking water wells*. Retrieved from https://www.ncleg.net/EnactedLegislation/Statutes/PDF/BySection/Chapter_87/GS_87-97.pdf

North Carolina Office of State Budget and Management. (2018a). *2015 revised county*

population estimates. Retrieved from https://files.nc.gov/ncosbm/demog/countygrowth_2015.html

North Carolina Office of State Budget and Management. (2018b). *Population overview, 2010–2037*. Retrieved from https://files.nc.gov/ncosbm/demog/countytotals_populationoverview.html

Sanders, A.P., Desrosiers, T.A., Warren, J.L., Herring, A.H., Enright, D., Olshan, A.F., . . . Fry, R.C. (2014). Association between arsenic, cadmium, manganese, and lead levels in private wells and birth defects prevalence in North Carolina: A semi-ecologic study. *BMC Public Health*, 14, 955.

Sanders, A.P., Messier, K.P., Shehee, M., Rudo, K., Serre, M.L. & Fry, R.C. (2012). Arsenic in North Carolina: Public health implications. *Environment International*, 38(1), 10–16.

U.S. Geological Survey. (2019). *Water use data for North Carolina, 2010*. Retrieved from https://waterdata.usgs.gov/nc/nwis/water_use

Welch, B., Smit, E., Cardenas, A., Hystad, P., & Kile, M.L. (2018). Trends in urinary arsenic among the U.S. population by drinking water source: Results from the National Health and Nutritional Examinations Survey 2003–2014. *Environmental Research*, 162, 8–17.



CP-FS/CCFS

Join the growing ranks of professionals who have attained NEHA's most in-demand credentials in food safety. Whether your focus is retail foodservice or food manufacturing and processing, NEHA's Certified Professional–Food Safety (CP-FS) and Certified in Comprehensive Food Safety (CCFS) credentials demonstrate you went the extra mile to get specialized knowledge and training in food safety. Give yourself the edge that is quickly being recognized, required, and rewarded in the food industry.

Learn more at neha.org/professional-development/credentials.



A credential today can improve all your tomorrows.

