Compliance Evaluation of Community Water Systems in the United States using Data from the Safe Drinking Water Information System

REPORT TO CONGRESS

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This report provides information on the compliance of the nation's community water systems (CWSs) 1 with requirements of the Safe Drinking Water Act. It does not impose legally binding requirements on the United States Environmental Protection Agency (EPA), states, Tribes, other regulatory authorities, or the regulated community. This document does not confer legal rights or impose legal obligations upon any member of the public. This document does not constitute a regulation, nor does it change or substitute for any Safe Drinking Water Act (SDWA) provision or any EPA regulation. The EPA conducted this analysis using information available in the EPA's Safe Drinking Water Information System Federal Reporting Service (SDWIS Fed) at the time this report was drafted. The data used by the EPA for this report reflects the data reported by primacy agencies to the EPA. A public water system (PWS) without a reported violation does not necessarily mean the system is in full compliance with all SDWA requirements. The EPA may update this document as new information becomes available. The EPA and its employees do not endorse any products, services, or enterprises. Any mention of trade names or commercial products in this document does not constitute an endorsement or recommendation for use.

1 An acronym list can be found at the end of this document.

Executive Summary

As part of the Bipartisan Infrastructure Law (BIL), signed on November 15, 2021, the United States Environmental Protection Agency (EPA) is required to evaluate the compliance of community water systems (CWSs) with rules and report its findings to Congress. The Safe Drinking Water Act (SDWA) authorizes the EPA to develop National Primary Drinking Water Regulations (NPDWRs) to ensure consumers have access to safe drinking water. These regulations are legally enforceable and protect the drinking water provided to consumers across the United States. The NPDWRs protect public health by requiring treatment to limit the levels of contaminants in drinking water and informing the public about their water supply. All PWSs, including all CWSs, must comply with the SDWA and applicable parts of the NPDWRs.

Data management plays a critical role in helping the EPA evaluate drinking water quality and monitor CWS compliance with SDWA and NPDWRs. The EPA manages the Safe Drinking Water Information System Federal Reporting Service (SDWIS Fed) to house data including water system characteristics and violations as reported by primacy agencies. The BIL directs the EPA to use the information in SDWIS Fed to evaluate CWS compliance with SDWA's environmental, health, and safety requirements. This includes water quality sampling, testing, and reporting requirements, as well as CWS characteristics that correlate with trends in compliance.

In this analysis the EPA reviewed both health-based (HB) and non-health based (NHB) violations. An HB violation occurs when drinking water exceeds maximum contaminant levels (MCLs) or maximum residual disinfectant levels (MRDLs), or when a CWS fails to treat the water as required to address certain contaminants – also known as a treatment technique (TT) violation. An NHB violation involves a failure to meet requirements for monitoring, reporting, or notifying consumers of possible contamination. Importantly, a failure to monitor may mask a problem associated with an HB violation. In addition to reviewing SDWIS Fed data, the EPA conducted a sociodemographic analysis to determine whether CWSs within disadvantaged communities are more likely than others to incur HB or NHB violations. The EPA analyzed whether HB or NHB violations are related to sociodemographic factors like income, ethnicity/race, and/or geographic location.

Primacy agencies are states, territories, and Tribes that assume primary enforcement responsibility (i.e., "primacy") for their PWSs. Primacy agencies must meet specific requirements for the EPA to grant this responsibility. In areas where there is not a primacy agency (e.g., Wyoming, District of Columbia, and most tribes) the EPA Region directly implements the program.

The EPA analyzed data from the SDWIS Fed over the United States government's fiscal year (FY) 2021 as the base year for this report and conducted a trend analysis based on data from the previous five years (FY 2017–FY 2021). This included data from 49,738 CWSs serving 315.6 million persons, yielding the following findings:

- Ninety-one percent of CWSs are small systems serving 10,000 or fewer persons.
- Seventy-six percent of small systems use ground water (GW) as a primary water source. The total population served by these systems is roughly 68.9 million persons (21.8 percent of the total population).

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- In FY 2021, approximately 94 percent of CWSs reported no HB violations, and 69 percent of CWSs reported no NHB violations; the majority (90 percent) of violations were NHB violations.
- HB violation rates are higher for CWSs that use surface water (SW) (1.5 times that of GW sources); small systems (1.7 times that of large systems); and Tribal-owned systems (2.9 times that of all other ownership types such as private or local government).
- NHB violation rates are higher among small systems (1.3 times that of large systems) and Tribal-owned systems (1.7 times that of all other ownership types).
- Tribal-owned systems represent only 1 percent of CWSs, but they make up 4 percent of all CWSs with HB violations. Roughly 17 percent of Tribal-owned systems incurred an HB violation in this report's analysis period.
- Over the last five FYs (FY 2017–FY 2021), there has been a decline in the number of CWSs with violations. The number of CWSs with HB violations has declined by about 15 percent, and NHB violations have declined by about 10 percent.
- In that 5-year period, Lead and Copper Rule (LCR) HB violations have fallen by 19 percent. The number of lead action level exceedances (ALEs) remains steady at an average of roughly 1,200 CWSs (2.4 percent) incurring ALEs per year.
- Communities of color and low-income populations were approximately 1.3 times more likely to receive water from a CWS with a HB violation.
- Rural CWSs are more likely to have both HB (1.6 times) and NHB (1.1 times) violations than urban CWSs.
- There is an observed correlation between the type of source and the drinking water rules violated. SW systems have violations associated with the Stage 1 and 2 Disinfectants and Disinfection Byproducts Rules (DBPRs; 65.4 percent) and Suite of Surface Water Treatment Rules (SWTRs; 26.2 percent). GW systems have violations associated with the Chemical Contaminant Rules/Radionuclides Rule (Chem/Rad Rules) (36.3 percent) and the Ground Water Rule (GWR; 31.3 percent).

This report also evaluates asset management plans (AMPs) and the relationship between AMP implementation by CWSs and SDWA compliance. Asset management is the practice of managing infrastructure capital assets in a way that minimizes the total cost of their ownership and operation, while delivering a satisfactory level of service. AMPs can aid water systems by improving operations, which can help improve water quality and regulatory compliance. Because NPDWRs do not expressly require water systems to develop or implement AMPs, SDWIS Fed does not contain data on AMPs. Many primacy agencies have policies to encourage asset management planning as a best practice, but only four primacy agencies currently have regulations requiring at least some portion of their CWSs to develop AMPs. These state policies or regulations have not been in place long enough to have a directly measurable impact. A more detailed discussion of AMPs and their relationship to the SDWA compliance is discussed later in the Asset Management Plan section of this report.

This report to Congress documents the CWS compliance challenges for small, economically disadvantaged communities and those that predominantly serve persons of color. The EPA is currently implementing efforts to help close this gap and ensure safe drinking water for all:

- Congress through the BIL has provided increased funding for the Drinking Water State Revolving Fund (DWSRF) program with 49 percent of this funding specifically targeted for disadvantaged communities to help address this disparity.

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- The EPA, through implementing the requirements Congress passed in America's Water Infrastructure Act of 2018 (AWIA), has worked with states to update their capacity development programs to address this challenge and in particular, include as appropriate asset management.
- The EPA has focused on those rules that have the most HB violations, specifically the Stage 2 Disinfection Byproducts Rule and the Ground Water Rule, through In-Depth Analyses and targeted trainings on common issues contributing to noncompliance to help states and systems improve compliance.

Introduction

Section 50101 of the BIL amends SDWA Section 1442 (42 U.S.C. § 300j-1), directing the EPA to review CWS compliance data from SDWIS Fed; submit a report conveying its findings to Congress; and include information about whether CWSs are maintaining AMPs and the relationship these plans have to SDWA compliance. The EPA has developed this report to Congress as directed. This report presents compliance data from SDWIS Fed and describes trends found in the data. BIL Section 50101 discusses wastewater systems, but because SDWIS Fed does not contain information on compliance by wastewater systems, this report does not contain or evaluate wastewater system compliance data.

Public Water System Types

The Code of Federal Regulations (40 CFR Part 141.2) defines three classifications of PWSs. The definitions reflect the number of people served by the water system and whether the same consumers are served year-round or less frequent. The three PWS classifications are:

Community water system (CWS):

- A system that serves at least 15 connections used by year-round residents or regularly serves at least 25 year-round residents.

Non-transient non-community water system (NTNCWS):

- A PWS that is not a CWS and regularly serves 25 or more of the same people at least six months per year. Examples include daycares, schools, factories, hospitals, and office buildings with their own water systems.

Transient non-community water system (TNCWS):

- A PWS that is not a CWS and regularly serves 25 or more people per day for at least 60 days per year. The people served can change from day to day. Examples include gas stations, hotels, campgrounds, and restaurants with their own water systems.

SECTION 50101 TECHNICAL ASSISTANCE AND GRANTS FOR EMERGENCIES AFFECTING PUBLIC WATER SYSTEMS

11) Compliance Evaluation.

(A) In general. Not later than 1 year after November 15, 2021, the Administrator shall

(i) evaluate, based on the compliance data found in the Safe Drinking Water Information System of the Administrator, the compliance of community water systems and wastewater systems with environmental, health, and safety requirements under this subchapter, including water quality sampling, testing, and reporting requirements; and

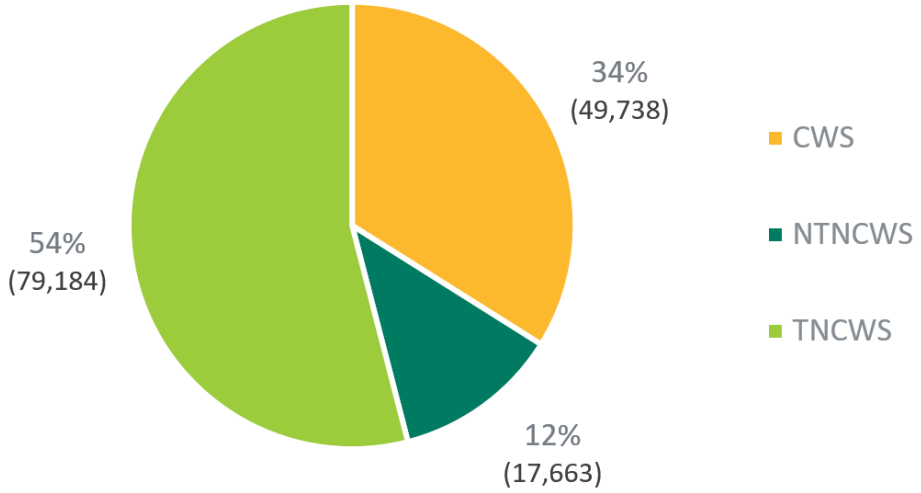
(ii) submit to Congress a report describing trends seen as a result of the evaluation under clause (i), including trends that demonstrate how the characteristics of community water systems and wastewater systems correlate to trends in compliance or noncompliance with the requirements described in that clause.

(B) Requirement. To the extent practicable, in carrying out subparagraph (A), the Administrator shall determine whether, in aggregate, CWSs and wastewater systems maintain AMPs.

Introduction

Figure 1 depicts the number of PWSs by type operating in the United States, based on FY 2021 data (from Q3 FY 2021). CWSs comprised 49,738 (34 percent) of the total 146,585 PWSs operating nationwide. This report only evaluates CWS compliance data, as specified by the amended Section 1442 of SDWA.

Figure 1. Number of PWSs by Water System Type, 2021 Q3. This report focuses on CWSs, which comprise 34 percent of PWSs.



Safe Drinking Water Act Compliance

The SDWA is the federal law that protects public health by regulating PWSs, including CWSs. The Act authorizes the EPA to set standards for drinking water quality and gives states, territories, and Tribes the opportunity to assume primacy – i.e., responsibility for primary enforcement. To ensure compliance with NPDWRs, primacy agencies conduct oversight of PWSs through the Public Water System Supervision Program (PWSS Program). The EPA maintains a federal oversight role and always retains its independent compliance oversight and enforcement authorities. For example, the EPA may inspect water systems located in primacy states and take federal enforcement measures to address non-compliance or emergencies at such systems. All states and territories have primacy, except for Wyoming, and the District of Columbia. The Navajo Nation is the only Tribe with primacy. For Wyoming, the District of Columbia, and Tribes that have not assumed primacy, the appropriate EPA regional office oversees SDWA implementation.

National Primary Drinking Water Regulations Overview

The NPDWRs are legally enforceable standards that apply to PWSs and protect public health against both naturally occurring and manmade drinking water contaminants. These standards are expressed as either a Maximum Contaminant Level (MCL), which is the maximum permissible level of a contaminant in water, Maximum Residual Disinfectant Level (MRDL), which is the maximum permissible level of a disinfectant in

water, or a Treatment technique (TT), which is a procedure or level of technological performance that PWSs must follow to ensure control of a contaminant. Currently, the EPA sets legal levels on more than 90 drinking water contaminants including microorganisms, disinfectants, disinfection byproducts (DBPs), inorganic chemicals, organic chemicals, and radionuclides. The NPDWRs include the following rules or rule groups:

- **The Suite of Surface Water Treatment Rules** [2] **(SWTRs)** aim to reduce illness related to microbiological pathogens in drinking water through filtration and disinfection. These rules consist of the SWTR, IESWTR, LT1ESWTR, LT2ESWTR, and FBRR.
- **The Ground Water Rule (GWR)** provides protection from disease-causing microorganisms for water systems whose source is GW.
- **Revised Total Coliform Rule (RTCR)** provides a risk-based, multi-barrier approach to controlling microbial pathogens in drinking water.
- **The Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules (DBPRs)** improve public health protection by reducing exposure to disinfectants and disinfection byproducts (DBPs).
- **The Chemical Contaminant Rules/Radionuclides Rule (Chem/Rad Rules)** were promulgated in phases and regulate more than 70 contaminants in three contaminant groups, including inorganic contaminants (IOCs) (including arsenic, nitrate, and nitrite), volatile organic contaminants (VOCs), and synthetic organic contaminants (SOCs). [3] The Radionuclides Rule reduces exposure to radionuclides in drinking water.
- **The Lead and Copper Rule (LCR)** [4] establishes treatment technique requirements to protect public health by minimizing lead and copper levels in drinking water. The rule requires systems to meet corrosion control and public education requirements. It also requires systems to monitor drinking water at customer taps. If lead concentrations exceed an action level of 15 ppb or copper concentrations exceed an action level of 1.3 parts per million (ppm) in more than 10 percent of customer taps sampled, the system must also inform the public about steps they should take to protect their health and may have to install corrosion control treatment or replace lead service lines under their control.

The legal limit set by the NPDWRs for a contaminant are set as close as feasible to health-based goals using the best available treatment technology and taking cost into consideration. The **Consumer Confidence Report Rule (CCR Rule)** and **Public Notification Rule (PN Rule)**, known as the "right-to-know" rules, require systems to provide consumers with important information about the quality of their drinking water. The CCR Rule requires all CWSs to develop and provide an annual water quality report summarizing information with respect to source water, detected contaminants, compliance, and educational information. The information contained in CCRs can raise consumers' awareness of where their water comes from, help them understand the process by which safe drinking water is delivered to their homes, and educate them about the importance of preventative

2 For this report, the Suite of Surface Water Treatment Rules include the Surface Water Treatment Rule (SWTR), Interim Enhanced SWTR (IESWTR) which is grouped in with the Long-term 1 Enhanced SWTR (LT1ESWTR) for this report, the Long-term 2 Enhanced SWTR (LT2ESWTR), and the Filtration Backwash Recycling Rule (FBRR).

3 This report groups the Asbestos Rule with IOCs in the Chemical Contaminant Rules. The Chemical Contaminant Rules and Radionuclides Rule are referred to in figures as "Chem/Rad Rules". Note the Control of Per- and Polyfluoroalkyl Substances (PFAS) was finalized in April of 2024 and data is not yet required to be reported to SDWIS

4 In this report, the LCR refers to the original LCR promulgated in 1991, the minor revisions promulgated in 2004, and the short-term revisions promulgated in 2007, but does not include the Lead and Copper Rule Revision (LCRR) requirements promulgated in 2021 or the Lead and Copper Rule Improvements (LCRI) promulgated in October 2024.

measures, such as source water protection, that ensure a safe drinking water supply. In addition, the CCRs allow consumers to make more informed decisions about their drinking water.

The PN Rule requires water systems to provide timely information to consumers following violations of NPDWRs or in other situations that may pose a risk to public health. The PN Rule uses a tiered approach with respect to the form, manner, and frequency of notices to account for the seriousness of any potential adverse health effects that may be involved.

The EPA's development of this report involved an evaluation of violations incurred by CWSs subject to the NPDWRs as reported by primacy agencies. The EPA reviewed violations against the following requirements and associated standards:

Health-Based (HB) Violations:

- Maximum contaminant level (MCL): The maximum permissible level of a contaminant in water that is delivered to any user of a PWS [40 CFR 141.2].
- Maximum residual disinfectant level (MRDL): The maximum level of a disinfectant added for water treatment that may not be exceeded at the consumer's tap without an unacceptable possibility of adverse health effects [40 CFR 141.2].
- Treatment technique (TT): An enforceable procedure or level of technological performance PWSs must follow to ensure control of a contaminant. (How EPA Regulates Drinking Water Contaminants)

Non-Health-Based (NHB) Violations:

- Monitoring (M): Failure to meet the NPDWR monitoring requirements.
- Reporting (R): Failure to report information to the primacy agency or failure to report the information within a certain timeframe.
- Other (O): Failure to complete required action(s) to comply with the CCR Rule or the PN Rule, as well as requirements for recordkeeping and developing monitoring plans.

Previous Evaluations Using SDWIS Fed Compliance Data

The primary source of data for this report was SDWIS Fed. SDWIS Fed is the database that EPA uses to manage and collect PWS information submitted by primacy agencies. Primacy agencies are required to submit to the EPA a subset of the data reported by PWSs to them – including HB and NHB violations and basic inventory information, such as water system location, type, and population served. Primacy agencies must submit this data to the EPA on a quarterly basis.

Previous studies have conducted evaluations of compliance data using SDWIS Fed data. In September 2022, the EPA released a report to Congress analyzing HB and NHB violations at intractable water systems – i.e., historically significant non-compliers (HSNCs). [5] That study defined HSNCs as small PWSs (serving populations fewer than 1,000) with NPDWR violations for at least three quarters in each of the years 2016 to 2018. The

5 EPA Office of Water. America's Water Infrastructure Act (AWIA) – Section 2003 Report to Congress, EPA 815-R-19-005, July 2022.

study identified 334 systems (0.23 percent of all PWSs) as HSNCs with HB violations, and 1,547 systems (1.2 percent of all PWSs) as HSNCs with NHB violations. The report summarized trends for HSNCs with HB violations based on the PWS types (i.e., CWS, NTNCWS, TNCWS) and ownership type, finding that CWSs make up 72 percent of these systems, and more than half of these systems are privately owned. Among CWSs, almost 90 percent of HB violations for HSNCs were MCL violations, while the remaining 10 percent were TT violations. Most of the violations reviewed in that study were related to the DBPRs, followed by compliance with the IOC rules. The study also reviewed technical, managerial, and financial (TMF) challenges faced by small PWSs. Of the systems that were considered HSNCs with HB violations, 80 percent had at least one TMF barrier identified in interview responses from the primacy agency.

The EPA recently performed In-Depth Analyses on the Stage 2 DBPR and the GWR. Both In-Depth Analyses reviewed data in SDWIS Fed to identify compliance challenges and trends. The analyses found these two rules generate the largest number of HB violations by CWSs. The In-Depth Analyses evaluated how HB violations changed over time for the specific NPDWRs, which system characteristics were most common among systems in violation, and the geographic distribution of systems in violation.

The Stage 2 DBPR In-Depth Analysis [6] found that more than half of CWSs with Stage 2 DBPR HB violations were consecutive systems. A consecutive system is a PWS that buys or otherwise receives at least some of its finished water, water intended for consumption without further treatment, from a wholesale system. As the water often travels further in this type of distribution system and takes longer to reach consumers, the formation of certain DBPs is more likely. Overall, the violation rate was 4.9 percent for consecutive CWSs, compared to a 1.4 percent rate for non-consecutive CWSs. Additionally, systems with total trihalomethane (TTHM) MCL violations comprised 80 percent of all Stage 2 DBPR MCL violations. Seventy percent of these violations occurred in systems served by SW, which is consistent with current requirements for all SW systems to disinfect the water. SW systems are also more likely than GW systems to contain more naturally occurring organics, leading to greater DBP formation.

The EPA analysis of the GWR, based on a 2019 review of SDWIS data, identified that HB violations of the GWR occur primarily at small water systems, which are more likely to rely on GW sources. Just six primacy agencies reported 68 percent of the GWR violations (Louisiana, New Mexico, Pennsylvania, Utah, Alaska, and Wisconsin), indicating that individual primacy agency implementation practices may play a key role in the occurrence of violations. In 2019, 83 percent of systems with GWR HB violations were cited for failing to correct a significant deficiency identified during a sanitary survey. A sanitary survey is an onsite review of eight elements: the source water; treatment practices; distribution system; finished water storage; pumps; monitoring, reporting, and data verification; system management and operations; and operator compliance with state and federal requirements. Sanitary surveys evaluate the adequacy of source water, facilities, equipment, and operation and maintenance for producing and distributing safe drinking water. The most common significant deficiency identified during a sanitary survey conducted under the GWR was related to source water (i.e., 28.4 percent of all significant deficiencies). Failure to maintain 4-log virus treatment

6 EPA Office of Water. Stage 2 Disinfectants and Disinfection Byproducts Rule (DBPR) and Consecutive System In-Depth Analysis, EPA 815-R-19-001, July 2019. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100X0T6.txt

(99.99 percent removal and/or inactivation of viruses) was the second most common factor leading to GWR HB violations. Other studies not conducted by the EPA have also used information from SDWIS Fed to investigate trends in drinking water violations. In 2017, a study conducted by Allaire et al. [7] analyzed data collected between 1982 and 2015, revealing spatial and temporal trends in water quality violations across the country. The analysis focused on CWSs serving more than 500 people and that began reporting violations by or before 1982. Summary statistics showed that, in any given year, between 9 million and 45 million people were served by CWSs with HB violations, representing 4 to 28 percent of the United States population. In 2015, 9 percent of CWSs in the study sample had HB violations, affecting almost 21 million people. The study cited numerous factors contributing to HB violations, including implementation of new federal regulations, which were often immediately followed by noticeable spikes in violations. The authors also noted that violation rates were substantially higher in rural areas than in urban areas.

A 2022 study by Scanlon et al.[8] evaluated various drivers of violations and their influence within various settings. The drivers examined in this study included environmental, operational, and sociodemographic factors. Some violation types were shown to be more common within areas of a specific regional climate (i.e., semi-arid), soil type, geology, and/or vegetative cover. Other factors included regional occurrence of DBPR violations (e.g., violations in the Southcentral United States). The study also reported that HB violations were common among small CWSs within rural and suburban settings.

Another study [9] used information from SDWIS Fed to evaluate HB violations incurred by water systems serving populations of 10,000 or more people under local government ownership and compared this information to the sociodemographic data for the primary cities served by the water systems. Results show that HB violations were greater in low-income communities with higher Black and Hispanic populations. The authors used this data to develop a model, which reports that increasing a simulated community's population to 80 percent Black or Hispanic, would not significantly increase the predicted number of HB violations; but when 40 percent of the community's population was also below the federal poverty level, the model predicts a statistically significant increase in the predicted number of HB violations.

7 Allaire, M., Wu H., and Lall, U. National Trends in Drinking Water Quality Violations, Proceedings of the National Academy of Sciences of the United States of America (PNAS), 115, 2078-2083, 2017. www.pnas.org/cgi/doi/10.1073/pnas.1719805115

8 Scanlon, B., Fakhreddine, S., Reedy, R., Yang, Q., and Malito, J., Drivers of Spatiotemporal Variability in Drinking Water Quality in the United States, Environmental Science and Technology, 2022. https://doi.org/10.1021/acs.est.1c08697

9 Switzer, David, and Teodoro, P., Manuel, The Color of Drinking Water: Class, Race, Ethnicity, and Safe Drinking Water Act Compliances, American Water Works Association, 2017. https://awwa.onlinelibrary.wiley.com/doi/abs/10.5942/jawwa.2017.109.0128

Introduction

California's 2022 Drinking Water Needs Assessment [10] evaluated risks posed to PWSs across the state. The Needs Assessment used risk indicator information housed in California's SDWIS State, the database used to track activities and compliance of the PWSs they oversee. The Needs Assessment pulled several risk indicators from CA's database including E. coli occurrence data, MCL violations, TT violations, and data related to constituents of emerging concern. They combined these water quality risk indicators with accessibility, affordability, and TMF capacity indicators to create a weighted risk index. The Needs Assessment then used these indicators to assess the risk status for 3,066 PWSs in the state. The study found that 11 percent of the systems were consistently out of compliance and failing to meet the primary drinking water standards, while an additional 17 percent were at-risk based on their risk index score.

10 California State Water Resources Control Board. 2022 Drinking Water Needs Assessment, April 2022. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2022needsassessment.pdf

Compliance Data Analysis

Primacy agencies collect detailed inventory and monitoring data from water systems in their jurisdictions and submit a portion of that data quarterly to the EPA. As specified in 40 CFR 142.15, primacy agencies are required to report data to the EPA, including inventory information about each system, such as name and water system type (CWS, TNCWS, or NTNCWS), population served, source water type, violations, and enforcement actions.

The EPA hosts two sites for sharing PWS data with the public: SDWIS Fed and the EPA's Enforcement and Compliance History Online website (ECHO). The EPA primarily uses SDWIS Fed for oversight of primacy agencies, for national implementation efforts, and for informing the public about the reported compliance status of their PWSs – and by extension, the safety of their drinking water. Information in SDWIS Fed is accessible to the public through a portal located at SDWIS Federal Reports.

ECHO extracts violations data from SDWIS Fed and calculates the associated Enforcement Targeting Tool (ETT) score reflecting the relative severity of compliance problems at a PWS. Using the ECHO portal, the EPA, primacy agencies, and the public can access SDWIS Fed and ETT data as well as links to other regulatory program information. The ECHO portal provides at-a-glance answers to questions like:

- What is the inventory of PWSs being regulated?
- How many PWSs have been inspected?
- How many systems have had documented violations and been subject to enforcement actions?
- How many systems have returned to compliance (RTC)?

The information available in SDWIS Fed relies on the quality, completeness, and timeliness of the data provided by primacy agencies. AWIA Section 2011 amended SDWA Section 1414 to direct the EPA to develop and provide to Congress a Drinking Water Compliance Monitoring Data Strategic Plan [11] for improving the accuracy and availability of monitoring data collected and submitted by PWSs to primacy agencies, or by primacy agencies to the EPA, to demonstrate compliance with the NPDWRs. AWIA directed the EPA to identify any challenges faced in ensuring the accuracy and integrity of submitted data, challenges faced by primacy agencies and PWSs in submitting data electronically, and barriers to public access of the data. Challenges of using SDWIS Fed include but are not limited to:

- SDWIS Fed data fields can be overly broad, often encompassing multiple pieces of information within a single entry. For instance, both monitoring failures and reporting failures are contained within the same data field for most NPDWRs, posing a challenge in distinguishing whether a violation pertains to monitoring or reporting.
- Primacy agencies submitting the data to SDWIS Fed have various data collection methodologies and approaches for transferring information from field staff and laboratories, which can cause inconsistencies among violations reported.

Primacy agencies are required to collect and record information on contaminant concentrations, but only violations must be reported to SDWIS Fed.

11 EPA Office of Water, Drinking Water Compliance Monitoring Data Strategic Plan, EPA 810-R-19-002, July 2022. https://www.epa.gov/system/files/documents/2022-09/7967_AWIA%20Compliance%20Monitoring%20Strategic%20Plan%20RtC_20220812_ADMIN.pdf

Compliance Data Analysis

As part of the Strategic Plan developed in response to AWIA, the EPA included a summary of findings and recommendations for practical, cost-effective methods for improving data accuracy and availability. One notable recommendation was for the EPA to establish a SDWIS Modernization Board (the Board) that includes representatives from primacy agency drinking water sections and information technology programs. The Board, formed in response to this recommendation, ensures that improvements to the suite of SDWIS applications meet programmatic and data quality needs, including facilitation of electronic reporting of compliance monitoring data from water systems to primacy agencies.

The Strategic Plan also identified a need for the EPA to obtain and evaluate compliance monitoring data (CMD) regularly collected by states as required under the NPDWRs. The EPA has considered the accuracy and completeness of compliance information available to the agency and determined that annual reporting of CMD will provide the agency a more complete and accurate understanding of water system compliance: currently, the EPA only receives state data on water system violations, water system inventory, and other information such as enforcement actions, which does not allow the EPA to fully assess trends in water system compliance with NPDWRs. The annual reporting of CMD from states as required by the Consumer Confidence Report Rule Revisions [12] will therefore strengthen the agency's ability to conduct oversight of PWS compliance with NPDWRs and primacy States' implementation of the Public Water System Supervision (PWSS) program.

To produce this Report to Congress, the EPA exported information from SDWIS Fed and used Microsoft Excel to develop charts and graphs reflecting trends in compliance among CWSs throughout the United States. The EPA used the following data sources, except where otherwise noted:

- Inventory information reflects information from SDWIS Fed reported in 2021 Q3.
- HB and NHB violation data reflects information from SDWIS Fed reported in 2021 Q3 and includes all open violations that occurred within the previous four quarters (2020 Q4 through 2021 Q3).
- The CWS trend analysis reflects a 5-year period FY 2017–FY 2021. CWS violation data included violations from 2016 Q4 through 2021 Q3.

It is important to note how violation data is calculated in SDWIS and used in this report. For a given quarter, a CWS is considered in violation if it had at least one day during the most recent four quarters (Q4 2020 through Q3 of 2021 for most this report) with an active unresolved violation. Thus, by the end of the reporting period (Q3 FY21 for this report), some of these systems may no longer have the violation.

As shown previously in Figure 1, CWSs comprise 49,738 (34 percent) of the 146,585 PWSs in the United States. The sections below present the compliance data analysis. The first section, System Characteristic Trends, outlines characteristics of the overall CWS inventory and unique characteristics contributing to compliance. The Violation Trends section focuses on trends in violations, followed by an analysis of violated rules and an evaluation of timeframes for RTC following a violation.

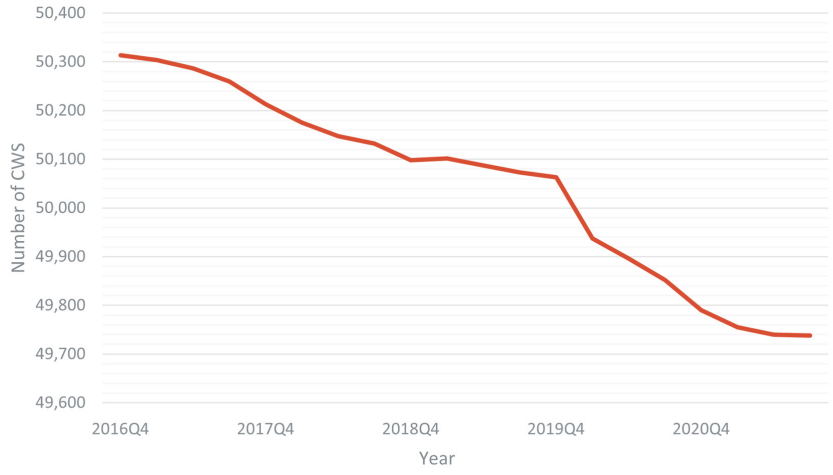
12 National Primary Drinking Water Regulations: Consumer Confidence Reports, 2024, Federal Register, 89, p. 45980.

System Characteristic Trends

System Inventory

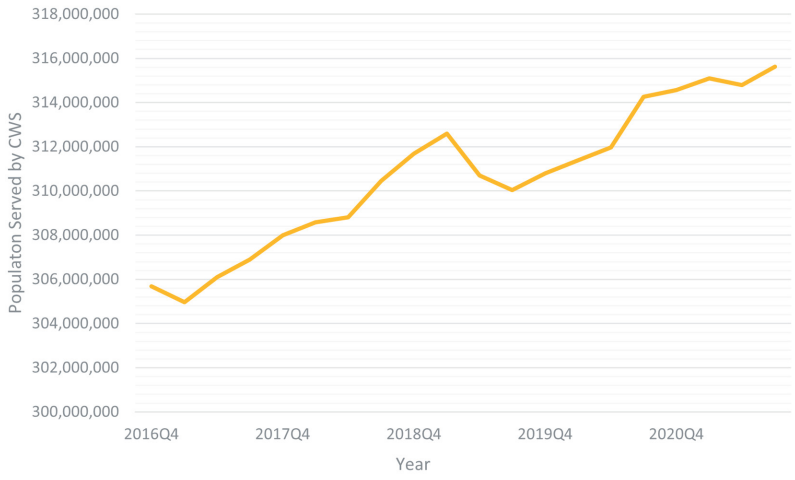
Figure 2 shows the 5-year trend in the number of CWSs nationwide. During the study period, the number of systems declined by roughly 1 percent, from more than 50,300 CWSs to 49,793 CWSs. At the same time, the population served by these systems increased by roughly 3 percent, from 306 million to 315.6 million served (Figure 3). The decline in the number of CWSs, even while there is an increase in population served, suggests a trend towards CWS consolidation to serve growing populations.

Figure 2. Number of CWSs, FY 2017–FY 2021. The number of CWSs declined by approximately 1 percent during this period.



Compliance Data Analysis

Figure 3. Population Served by CWSs, FY 2017–FY 2021. The population served by CWSs increased by roughly 3 percent over this period.



Primacy agencies oversee varying numbers of CWSs. The map and bar graph show the number of CWSs overseen by each primacy agency. Texas has the most CWSs with 4,632, followed by California (2,883), Washington (2,300), New York (2,299), and North Carolina (2,005). The heat map in Figure 5 shows that Texas, Washington, New York, Pennsylvania, and New Jersey have the highest geographic densities of CWSs.

Compliance Data Analysis

Figure 4. Number of CWSs by Primacy Agency, 2021 Q3. The map to the left illustrates the states, while the bar graph to the right shows territories and Tribal systems. Number of CWSs per primacy agency range from more than 2,000 in Texas, California, New York, Washington, and North Carolina, to five or fewer in Guam and District of Columbia.

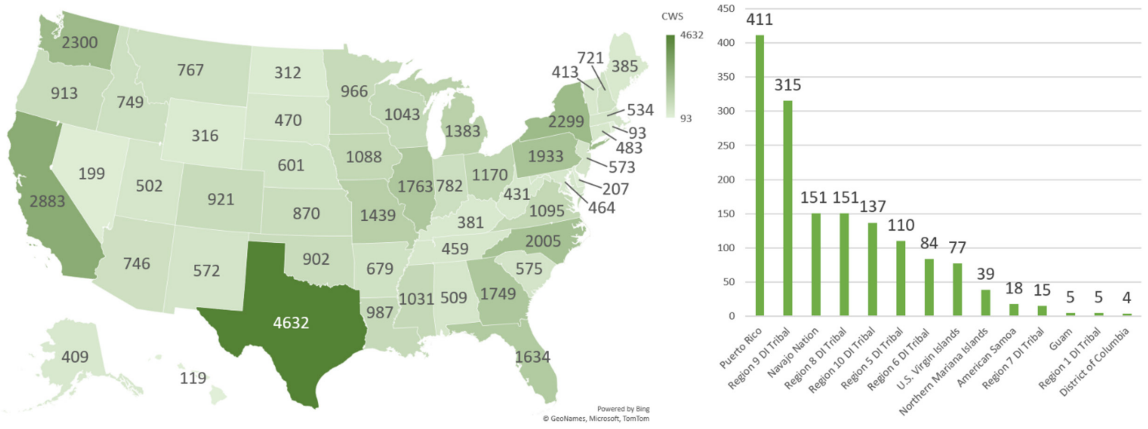
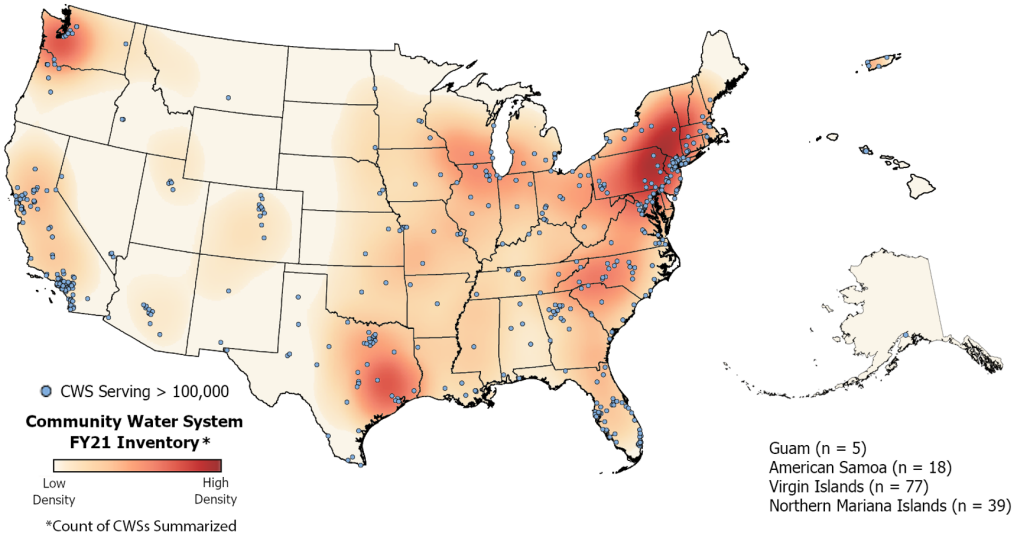


Figure 5. Heat Map of CWSs, FY 2021. The geographic density of CWSs is represented nationally. Points indicate CWSs serving populations greater than 100,000.



Compliance Data Analysis

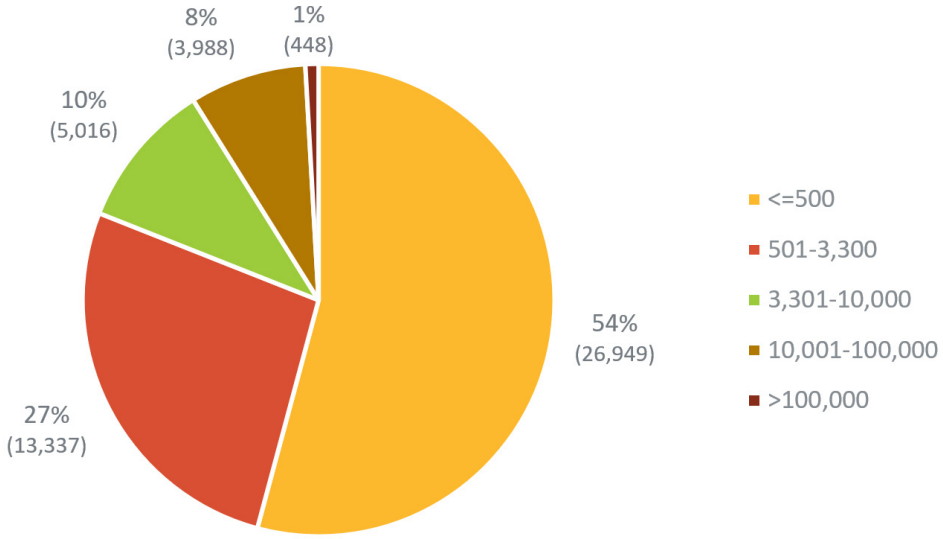
CWS System Characteristics

Certain system characteristics may contribute to unique compliance challenges. SDWIS Fed contains three of these system characteristics: system size, ownership type, and primary water source type. The sections below describe each characteristic in more detail. Later sections explore other possible correlations.

System Size

Of all CWSs operating nationwide, 91 percent are considered small systems, serving 10,000 or fewer persons, and 54 percent of all CWS serve 500 or fewer persons (Figure 6). Although only 9 percent of CWSs are considered large, most of the United States population (79 percent) is served by large CWSs serving populations greater than 10,000 (not shown in Figure 6).

Figure 6. Number of CWSs by Population Size Category, 2021 Q3. More than 54 percent of CWSs serve 500 or fewer persons and more than 90 percent serve 10,000 or fewer persons..



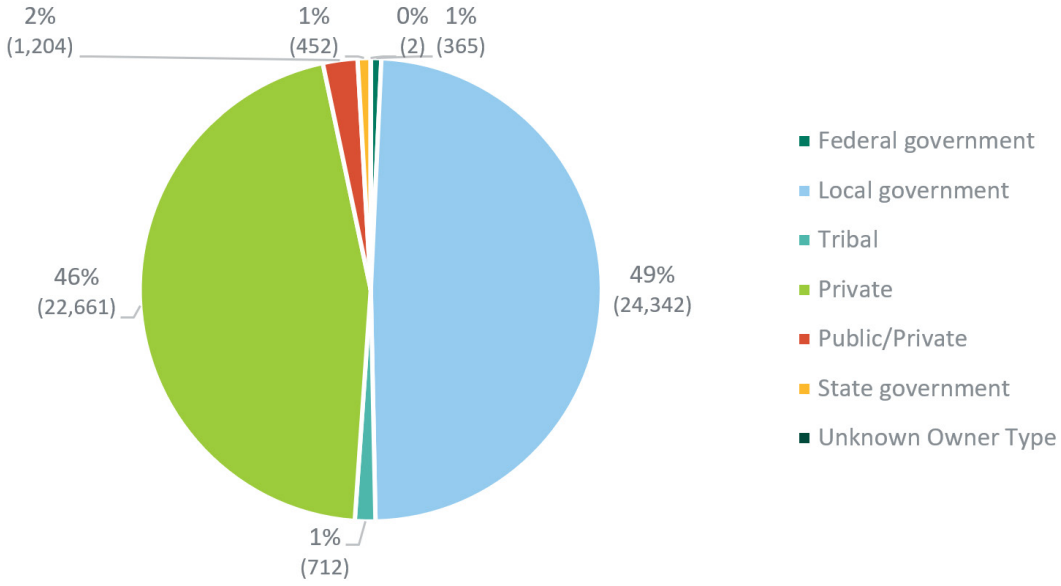
Ownership Type

A diverse set of water system owners make up the water industry in the U.S. Primacy agencies must submit water system ownership type to SDWIS Fed, and the resulting data reflects diversity in types of ownership across four major categories:

- Public ownership, including ownership and operation by federal government, state government, or local government (e.g., municipality, township, county, non-Tribal).
- Private ownership (e.g., homeowner association, investor-owned utilities).
- Public/private ownership and operation (i.e., publicly owned but privately operated).
- Tribal ownership (i.e., Tribal governments or utilities of federally recognized Tribes). Tribal systems are a subset of publicly owned and operated systems but are shown separately here due to the unique challenges they face compared to other public systems. [13]

Figure 7 shows the number of CWSs by ownership type. Nearly all systems fall into the ownership categories of local government or private ownership, with systems split nearly evenly between these two categories. Other ownership types are minor in comparison.

Figure 7. Number of CWSs by Ownership Type, 2021 Q3. Of all CWSs, 95 percent are owned



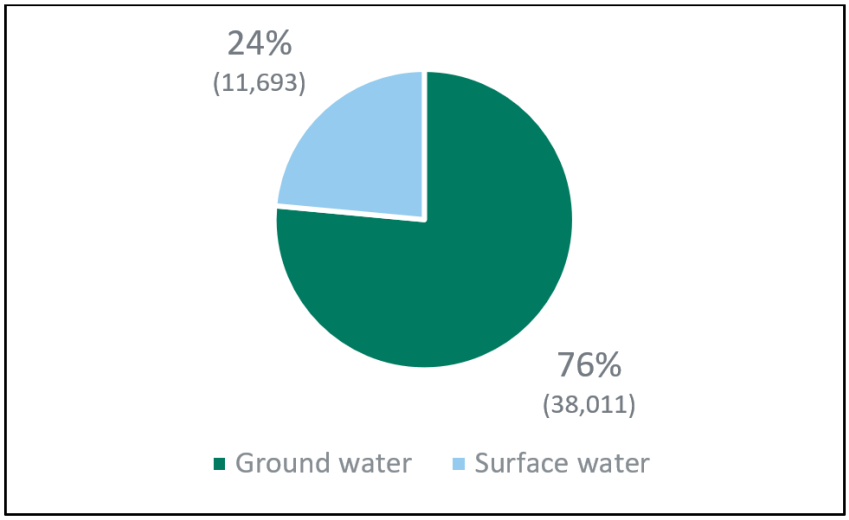
13 SDWIS Fed uses the term "Native American Ownership," but this report uses the term "Tribal."

Compliance Data Analysis

Water Source

Figure 8 illustrates the split between water systems using a GW source and those using a SW source. In SDWIS Fed, GW systems are those that rely exclusively on GW sources, including purchased GW systems. SW systems rely at least partly on a SW source, including purchased SW sources, and may also rely partly on ground water under the direct influence of surface water (GWUDI) sources. SDWIS Fed classifies any system with mixed source water – meaning it relies on both SW and GW in any amounts – as a SW system. SDWIS Fed classifies any system with mixed source water – meaning it relies on both SW and GW in any amounts – as a SW system. Note that 34 systems (out of nearly 50,000) did not have sufficient data in SDWIS Fed for the EPA to determine their water source, so these are omitted from Figure 8. Figure 9 further illustrates the breakdown of the number of GW and SW systems within each CWS population category.

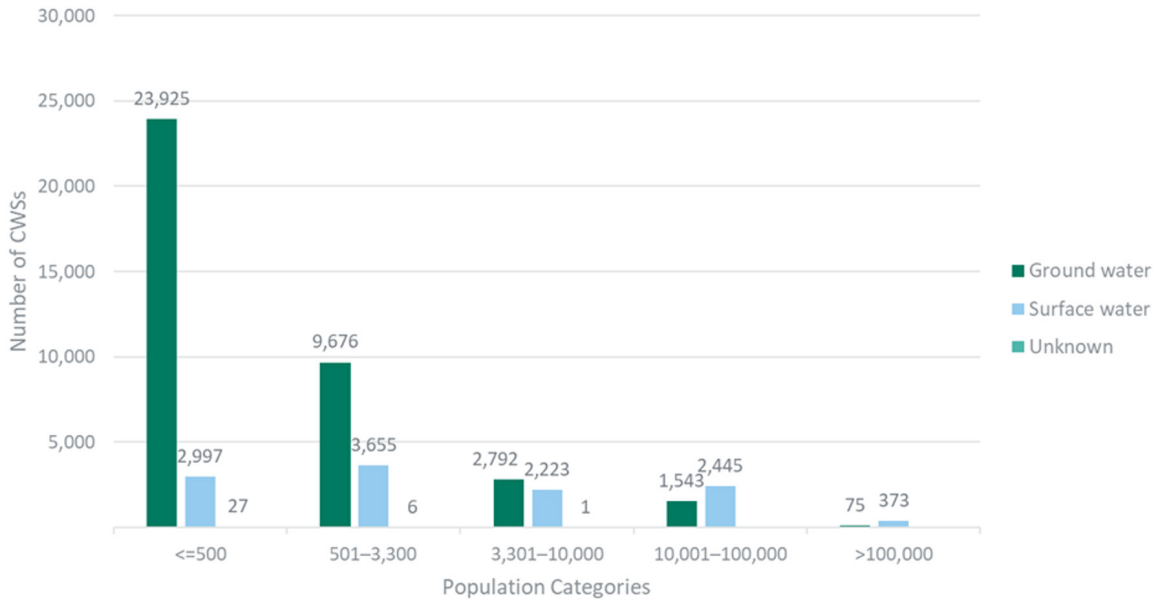
Figure 8. Number of CWSs by Source Water Type, 2021 Q3. More than 76 percent of CWSs are classified as GW, meaning all their water is GW. Source type is unknown for a tiny fraction of systems (34 systems, 0.0007 percent), so these are not reflected in the graphic.



***Ground water** = relies exclusively on ground water*

***Surface water** = relies at least partly on a surface water source*

Figure 9. Number of CWSs by Source Water Type and Population Category, 2021 Q3. GW systems dominate small systems, whereas SW systems are more common for larger systems.



Violation Trends

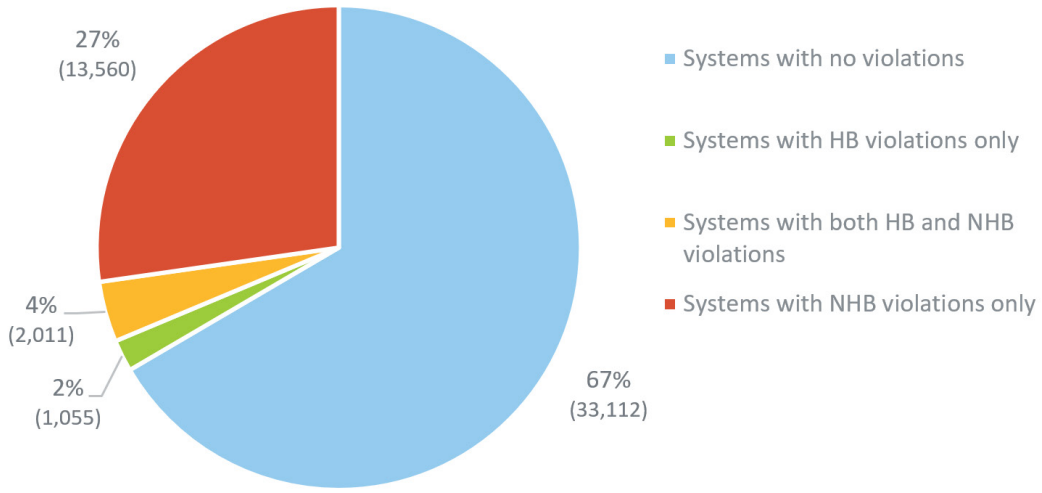
HB versus NHB Violations

HB violations are those that indicate the presence of unsafe levels of regulated contaminants in drinking water, or a failure to treat the water as required to remove such contaminants, leading to potential adverse health effects. By contrast, an NHB violation involves a failure to meet requirements for monitoring, reporting, or notifying consumers of possible contamination.

Compliance Data Analysis

Figure 10 shows the number of CWSs with HB and NHB violations reported for 2021 Q3. Of all CWSs, 67 percent reported no violations. Systems with NHB violations (15,571 CWSs, or 31 percent of systems in violation) largely outnumbered those with HB violations (3,066 CWSs, or 6 percent of systems in violation). The majority (90 percent) of all violations in FY 2021 were NHB violations. However, it should be noted that NHB violations, like a failure to monitor and report for a contaminant, can mask HB violations. Note that 4 percent of CWSs reported both HB and NHB violations.

Figure 10. Number of CWSs by Violation Type, 2021 Q3.



HB Violation Rates

In FY 2021, 6.2 percent of CWSs incurred one or more HB violations, impacting 23.9 million persons, while the rest of CWSs complied with all HB regulations. Figure 11 shows the 5-year trend in the number of CWSs with HB violations. The number of CWSs with HB violations remained steady in the first four years, with only a slight increase, and then a significant decline of 15 percent in the final year. This abrupt change may be the result of several factors, such as the EPA and primacy agencies focusing on reducing HB violations as well as improved implementation of more recent regulations such as RTCR and Stage 2 DBPR. System consolidation may have also reduced the total number of CWSs, in turn reducing the number of CWSs with violations (Figure 2). It is worth noting that Figure 11 data begins in 2017 Q2, immediately after the adoption of RTCR, which was the most recent major regulatory change that systems had to implement.

Figure 11. Number of CWSs with HB Violations, FY 2017–FY 2021. Note the y-axis does not start at zero to provide detail of the changes in the number of HB violations.

Compliance Data Analysis

The EPA's coordination with primacy agencies to improve CWS compliance has included technical assistance and oversight-related actions such as: delivery of rule and technical training for states and water systems; file reviews of primacy agency records, technical support through the EPA's national grant for small system training and technical assistance; and the In-Depth Analysis, as discussed previously (page 7). More recently, the EPA launched WaterTA[14], a national water technical assistance program to help communities identify water system challenges; develop plans for resolving them; build the necessary TMF capacity to execute those plans; and apply to receive water infrastructure funding, including resources provided under the BIL.

Additionally, the EPA's Office of Enforcement and Compliance Assurance (OECA) has adopted a multi-year National Enforcement and Compliance Initiative: Reducing Noncompliance at Community Water Systems (NECI)[15]. Under NECI, OECA and the EPA's regional Enforcement and Compliance Assurance Divisions (ECADs) are conducting more CWS inspections and taking federal actions to address noncompliance and public health risks. This federal enforcement oversight, in conjunction with the EPA's compliance assistance activities, is a key element in the EPA's overall effort to ensure public health protection using all tools possible, including federal SDWA enforcement. The EPA's objective to identify and address CWS noncompliance while promoting sustained compliance with SDWA regulations is a key element in the EPA's overall effort – in coordination with co-regulators in primacy agencies – to ensure public health protection using all tools possible, including federal SDWA enforcement. The EPA's OW and OECA have combined efforts to identify and address CWS noncompliance while promoting sustained compliance with SDWA regulations.

14 EPA's Office of Water WaterTA. https://www.epa.gov/water-infrastructure/water-technical-

15 EPA's National Enforcement and Compliance Initiative: Reducing Noncompliance at Community Water Systems (NECI). https://www.epa.gov/enforcement/national-enforcement-and-compliance-initiative-reducing-noncompliance-drinking-water

Compliance Data Analysis

Figure 12 presents the number of CWSs with HB violations organized by violation type (i.e., MCL, TT, and MRDL violations). Over the past five years, TT violations increased by 24 percent before declining noticeably in the final year. MCL violations declined steadily over all five years, by around 27 percent total. To show MCL and TT violations to scale, Figure 12 omits MRDL violations, which are consistently rare – amounting to only 3–12 per year.

Figure 12. Number of CWSs with HB Violations by Violation Type, FY 2017–FY 2021. MCL violations have declined by 27 percent, while TT violations increased during the first three years by 24 percent and then declined by 12 percent in the final FY. The number of MRDL violations were negligible compared to MCL and TT violations and are therefore omitted.

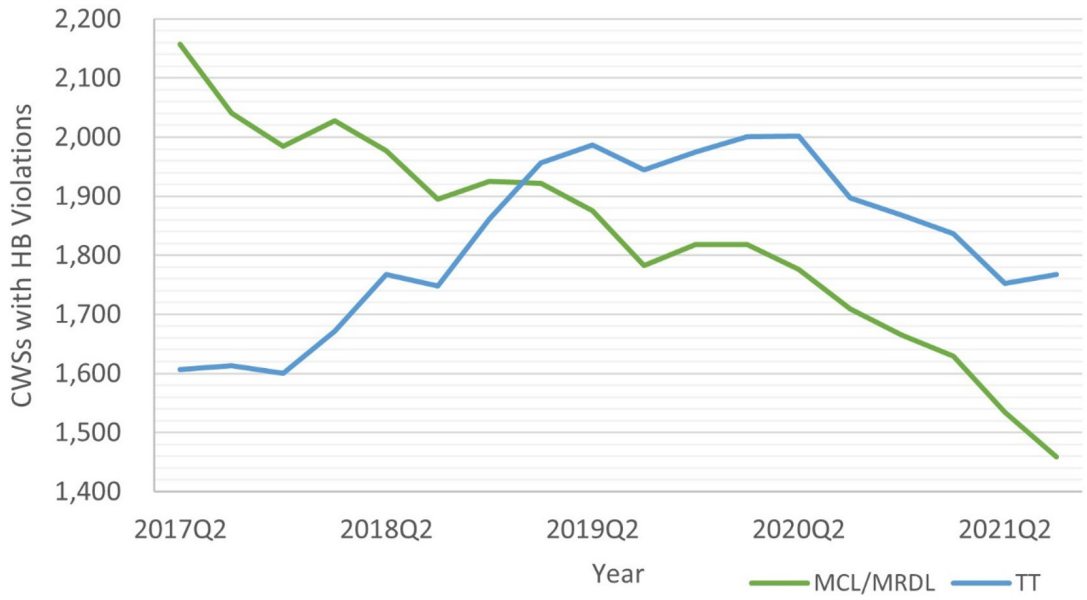


Figure 13 and Figure 14 present the number and percentage respectively of CWSs with HB violations per primacy agency in 2021 Q3. Texas had the highest number of CWSs with HB violations, followed by Louisiana, Pennsylvania, Oklahoma, and California. It is important to place these numbers into context. For example, while Texas had the highest number of CWSs with HB violations (323 CWSs), it also has the highest number of CWSs overall (Figure 4), and only 7.0 percent of its CWSs had HB violations.

Figure 14 illustrates that American Samoa had the highest percentage of CWSs with HB violations (55 percent), followed by the District of Columbia (50 percent). While these two primacy agencies had high percentages of systems in violation, the total numbers of systems in violation were low (Figure 13) due to a small number of systems serving these jurisdictions. Louisiana had the next highest percentage of violations (30.2 percent), the majority of which are GWR violations. More than 20 percent of the CWSs in Puerto Rico, West Virginia, Alaska, and New Mexico also had one or more HB violations.

Compliance Data Analysis

Figure 13. Number of CWSs with HB Violations by Primacy Agency, 2021 Q3. The map to the left illustrates the number of CWSs in the states, while the bar graph to the right shows territories and Tribal CWSs.

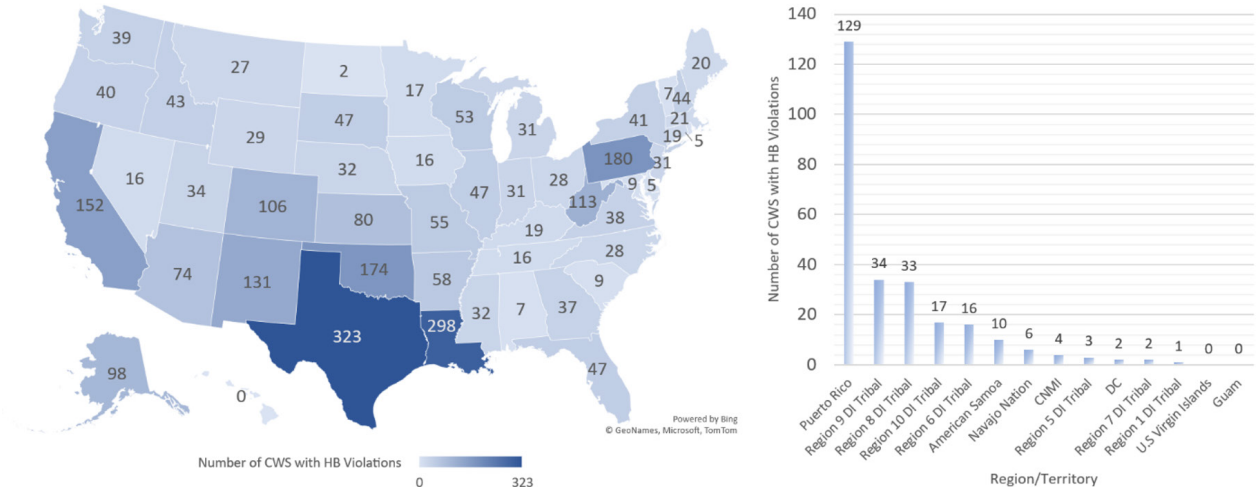
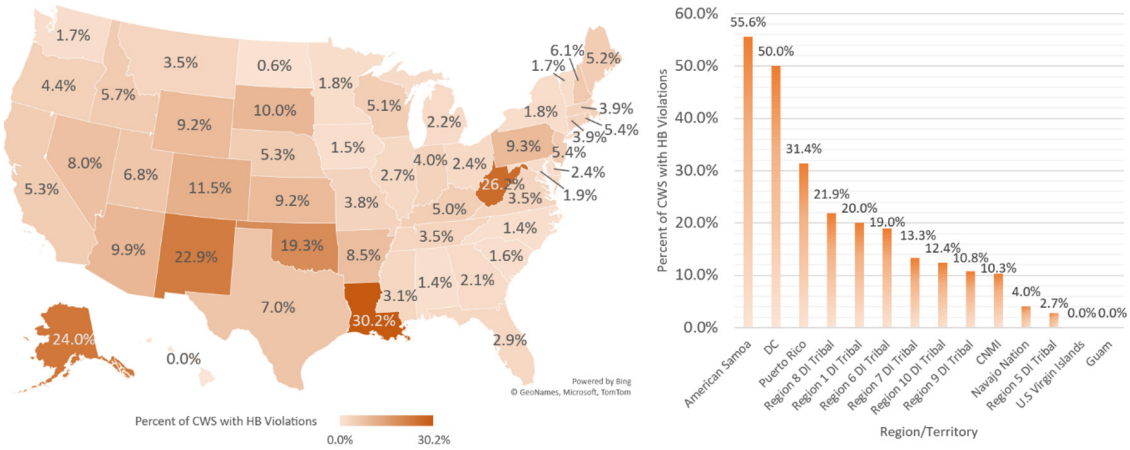


Figure 14. Percentage of CWSs with HB Violations by Primacy Agency, 2021 Q3. The map to the left illustrates the information for the states, while the bar graph to the right shows territories and Tribal CWSs.



Compliance Data Analysis

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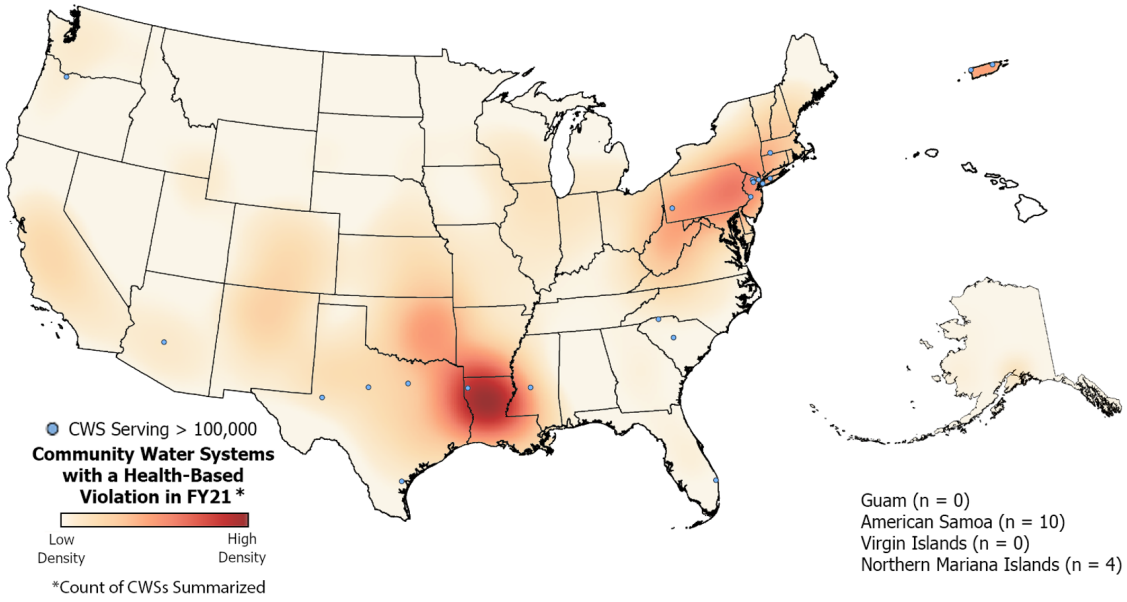
Figure 15 shows a heat map of CWSs with HB violations, with high numbers of CWSs with violations concentrated in Louisiana and the northeast metro corridor.

Figure 15. Heat Map of CWSs with HB violations, FY 2021. The density of CWSs with HB violations is represented nationally. The points indicate CWSs with HB violations serving populations greater than 100,000.

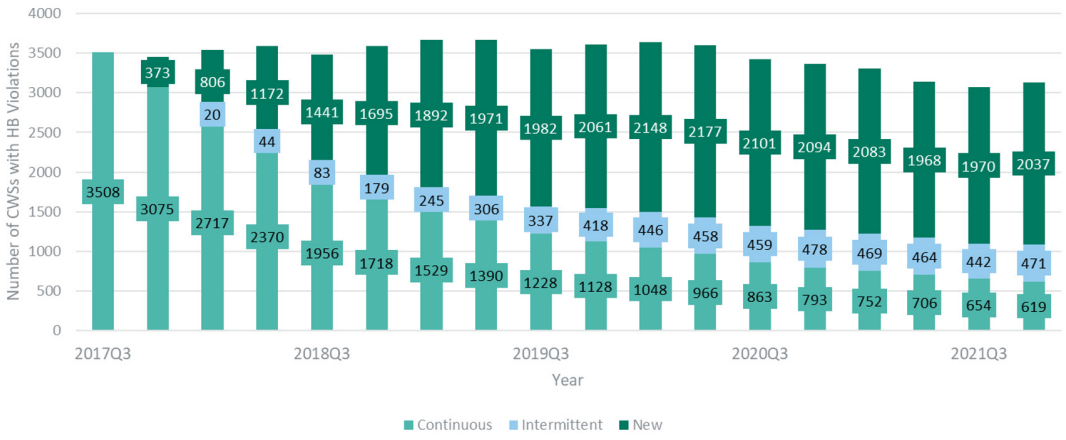


Compliance Data Analysis

Another way to analyze trends in CWS HB violations is to compare systems with recurring or continuing violations versus those with new violations. To conduct this analysis, the EPA used an initial dataset of systems with and without HB violations in 2017 Q3. The EPA then placed HB violations into one of three categories: **continuous**, indicating a CWS had continuous HB violations between 2017 Q3 and 2021 Q3; **intermittent**, indicating a CWS had an HB violation in 2017 Q3, which RTC, then committed a new HB violation in a later quarter; or **new**, indicating a CWS did not have an HB violation in 2017 Q3 but did have an HB violation in a later quarter.

Since 2017 Q3, the number of CWSs with continuous violations has steadily decreased. The number of CWSs with new or intermittent violations have increased (Figure 16). In subsequent analysis in this report, the EPA will evaluate whether any system characteristics or violation types (MCL, TT, MRDL) correlate with each of these three categories.

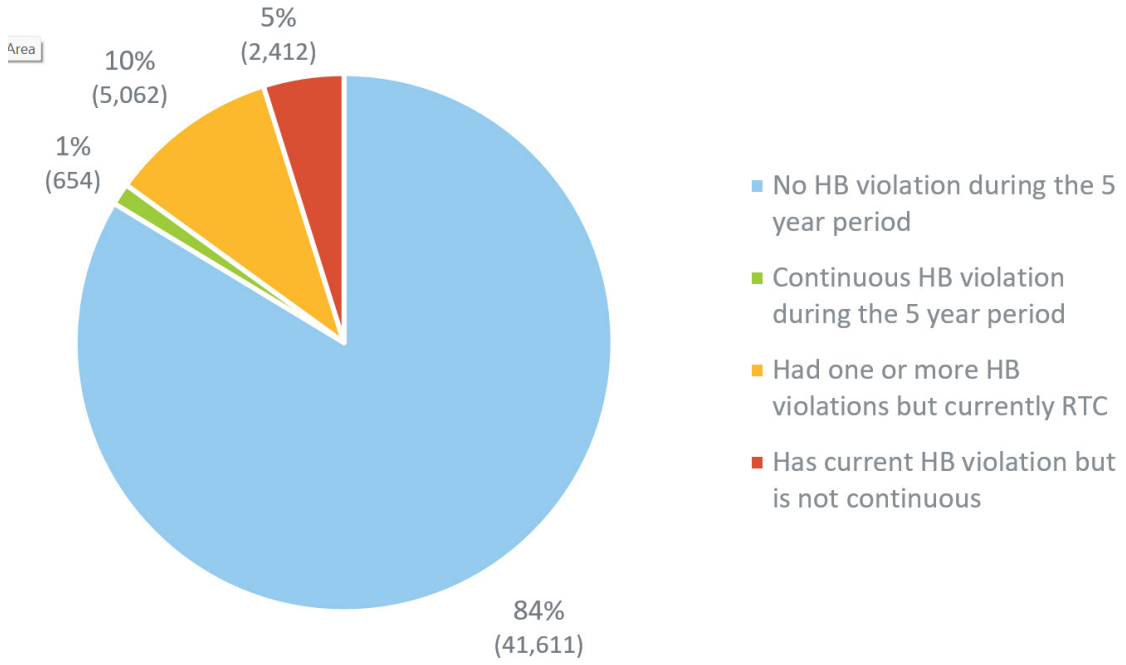
Figure 16. Number of CWSs with Continuous, Intermittent, or New HB Violations, 2017 Q3 to 2021 Q4. In this period, fewer than 20 percent of CWSs with HB violations had continuous HB violations since 2017 Q3. More than 10 percent had intermittent violations, meaning they RTC for a time before falling back into non-compliance.



Compliance Data Analysis

Figure 17 shows the HB violations over the last five years. All 49,738 CWSs are placed into one of four categories. Roughly 84 percent of CWSs did not report any violations over the last five years. The other 16 percent had violations: 10 percent of all CWSs had one or more violations but were currently in compliance; 5 percent had a current HB violation that was not continuous; and just over 1 percent had continuous violations over the last five years.

Figure 17. CWSs Based on Status of CWSs with HB Violations During Last Five Years, 2017 Q3 –2021 Q3.



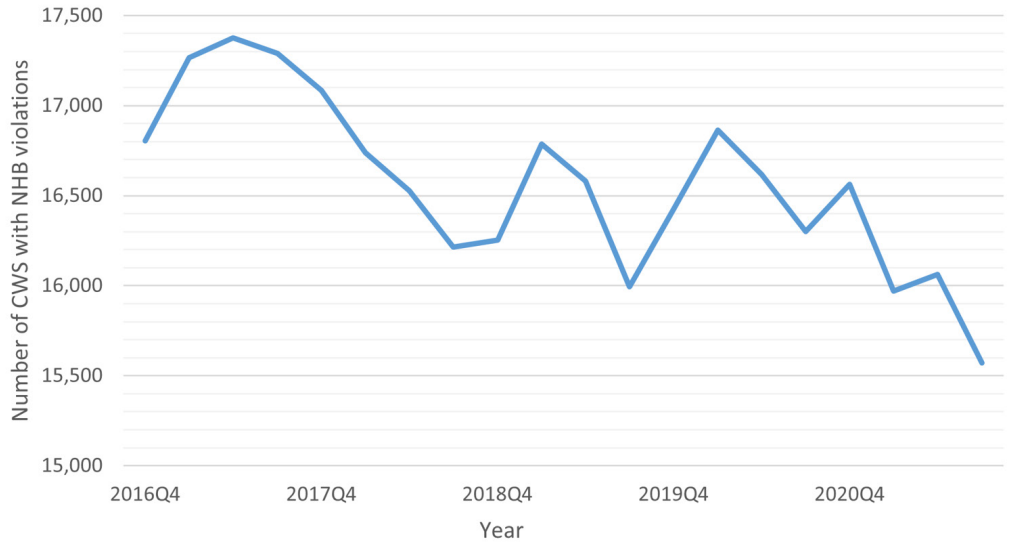
NHB Violation Rates

NHB violations – such as failure to monitor or report – may not directly threaten public health, but they can prevent the detection of HB violations. Therefore, multiple NHB violations at a system is cause for concern. A primacy agency reports an NHB violation when it determines a water system has failed to provide information by an applicable deadline, demonstrating that the water system failed to perform required monitoring or reporting, or failed to provide required information to the public and/or the primacy agency.

Compliance Data Analysis

Figure 18 shows the number of CWSs with NHB violations in each quarter during the past five years. The number of CWSs with NHB violations range between 15,500 and 17,500. These values represent a significant percentage of systems and comprise between 31 percent and 35 percent of the total CWSs nationally.

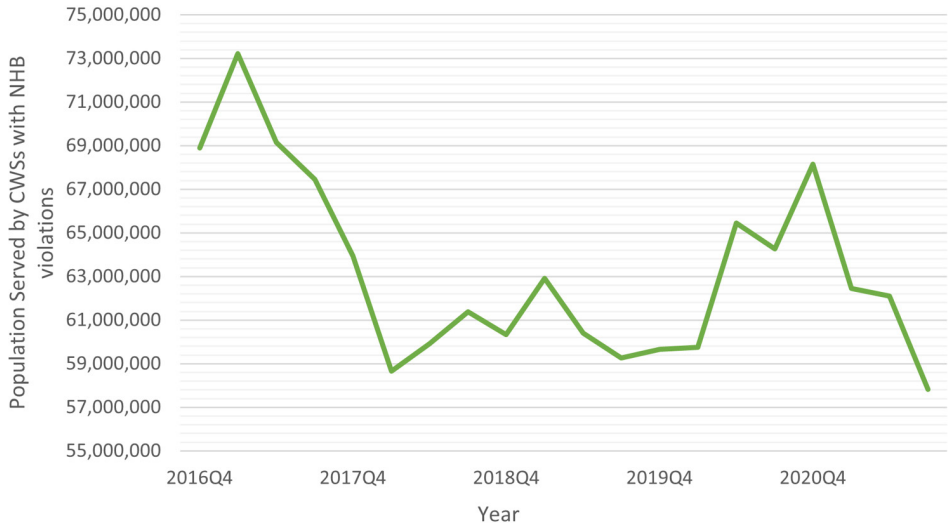
Figure 18. Number of CWSs with NHB Violations, FY 2017–FY 2021. Note the y-axis does not start at zero to provide detail of the changes in the number of NHB violations



Compliance Data Analysis

Figure 19 shows the population served by CWSs with NHB violations during FY 2017–FY 2021. Results varied within the general range of 60 to 70 million persons served.

Figure 19. Population Served by CWSs with NHB Violations, FY 2017– FY 2021.



The following maps show the number of CWSs with NHB violations per primacy agency (Figure 20), the density of CWSs with NHBs (Figure 21), and the percentage of CWSs with NHB violations relative to the total number of CWSs per primacy agency (Figure 22). In Figure 20, Texas had the most overall CWSs with NHB violations in 2021 Q3 with 1,966 CWSs with NHB violations, followed by Pennsylvania, Ohio, and Florida. The territory and Tribal programs often had the fewest CWSs with NHB violations, however, these programs also have the fewest number of CWSs. Figure 21 shows that density centers for CWSs with NHB violations correlate to the density trend of all CWSs, as shown in Figure 5.

Compliance Data Analysis

Figure 20. Number of CWSs with NHB Violations by States, Territories and Tribal CWSs (aggregated by the EPA Region), 2021 Q3. The map to the left illustrates the states, while the bar graph to the right shows territories and Tribal systems. Texas had the most CWSs with NHB violations at 1,966 CWSs, followed by Pennsylvania with 974 CWSs.

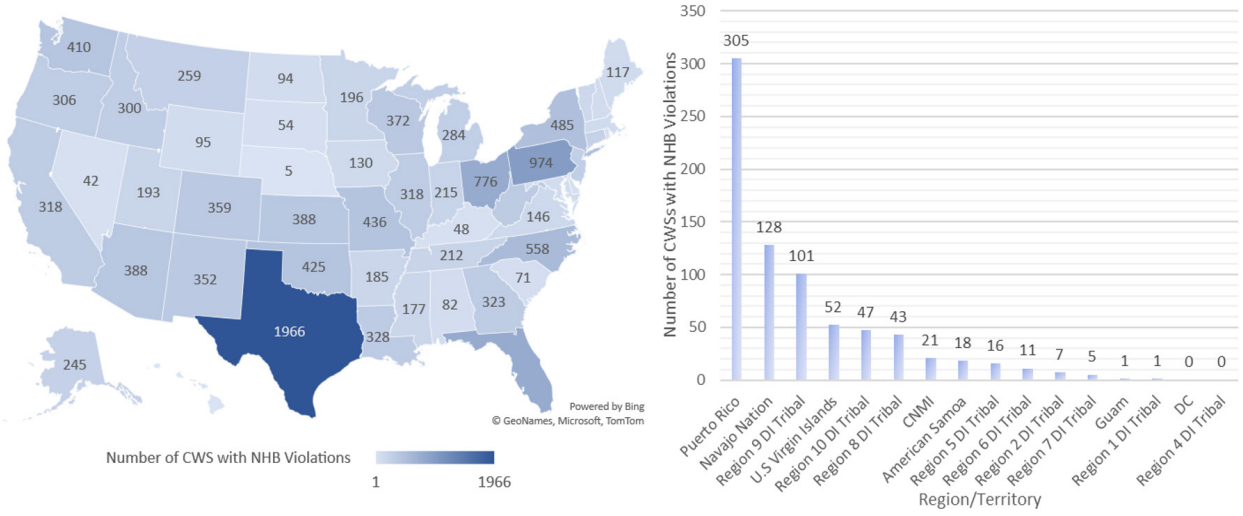
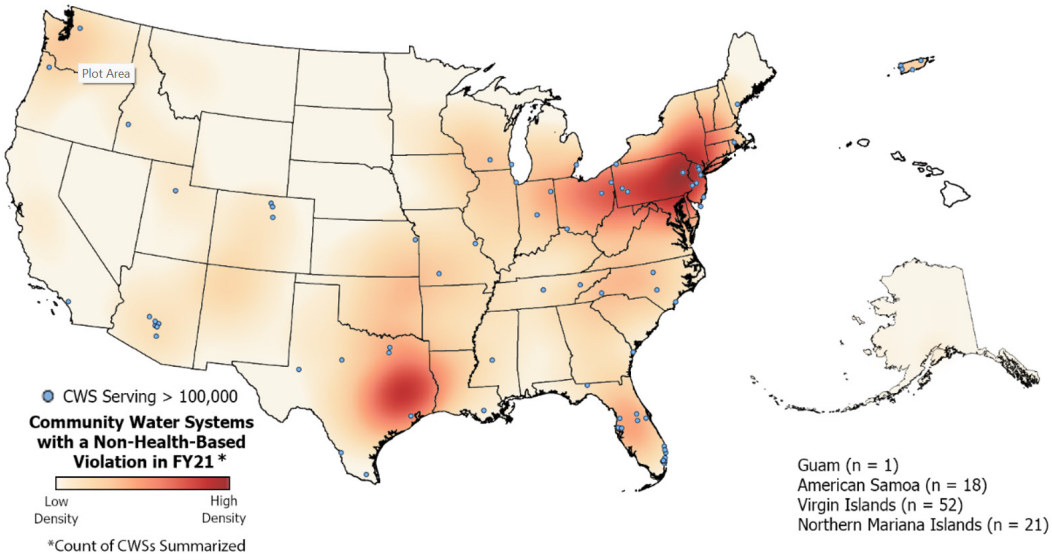


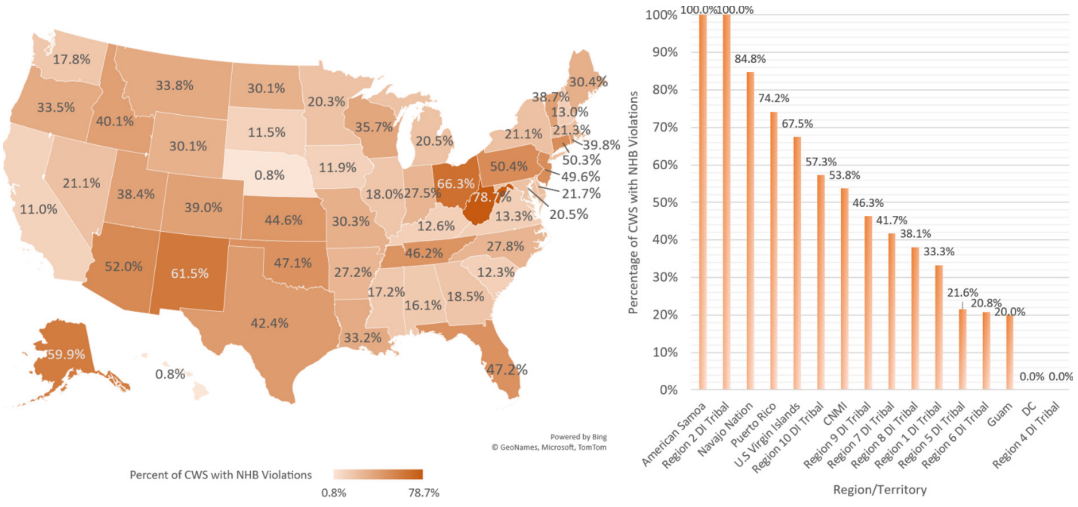
Figure 21. Heat Map of CWSs with NHB violations, FY 2021. The density of CWSs with NHB violations is represented nationally. Points indicate CWSs with NHB violations serving populations greater than 100,000.



Compliance Data Analysis

Figure 22 shows that the EPA regions and territories overseeing Tribal CWSs included noticeably high percentages of CWSs with NHB violations relative to total numbers of CWSs. One hundred percent of CWSs in American Samoa (18 CWSs serving 56,728 persons) and the EPA Region 2 Tribal systems (7 CWSs serving 12,190 persons) had NHB violations in 2021 Q3. Among the states, West Virginia had the highest percentage of CWSs with NHB violations (79 percent), followed by Ohio (66 percent). New Mexico, Alaska, Arizona, Pennsylvania, and Connecticut were all above 50 percent.

Figure 22. Percent of CWSs with NHB Violations by States, Territories, and Tribal CWSs (aggregated by the EPA Region), 2021 Q3. The map to the left illustrates the states, while the bar graph to the right shows territories and Tribal systems.



While the percentage of systems with NHB violations is substantial, it is important to place these numbers into context. Each year CWSs are required to collect many samples to comply with the NPDWRs, the number depends on systems size and source type, and can range from ~50 samples to over 1,000 samples annually. The systems must then report these results to the primacy agency within a specified period and must also provide them to the public through the CCR and PN. Missing any one of these requirements would lead to a NHB violation. In FY 2021 there were 74,282 violations at 15,511 CWSs, or 4.8 violations per systems with a NHB violation on average. Approximately 1/3 of these violations occurred in years prior to FY 2021 and have not been RTC, therefore they are still counted in the FY 2021 dataset, many of these are for failing to comply with CCR or PN requirements, violations that remain open until the system completes the missed requirement.

Environmental Justice Analysis of SDWA Violations

Introduction

Environmental justice means the just treatment and meaningful involvement of all people, regardless of income, race, color, national origin, Tribal affiliation, or disability, in agency decision-making and other Federal activities that affect human health and the environment. [16] The concept of just treatment includes not only the distribution of burdens across populations, but also the distribution of risk reduction resulting from the EPA actions. The EPA reviews EJ concerns regarding all populations, especially those who are most vulnerable to environmental and public health concerns including racial and ethnic minority populations, low-income populations, and/or Indigenous peoples for all environmental regulations. [17]

In Fall 2022, the EPA created the Office of Environmental Justice and External Civil Rights (OEJECR), which is responsible for incorporating EJ into all policies, programs, and activities. The mission of OEJECR is to facilitate efforts to protect the environment and public health in minority, low-income, Tribal, and other vulnerable communities who are most impacted by environmental and public health risks.

With the passage of the American Rescue Plan (ARP) and the BIL, Congress designated tens of millions of dollars in EJ funding to activities that address disproportionate environmental or public health challenges in disadvantaged communities. A large amount of EJ funding was allocated to water quality and infrastructure. The BIL provided the EPA with more than $35 billion toward the Drinking Water State Revolving Fund (DWSRF), including $15 billion for lead service line replacement (LSLR) and $4 billion to the DWSRF specifically for emerging contaminants. These funds will be made available over a period of five fiscal years. The BIL mandates that 49 percent of funds provided through the DWSRF General Supplemental Funding and DWSRF LSLR Funding must be provided as grants and forgivable loans to disadvantaged communities, including those with EJ concerns, which often include low-income people and communities of color. [18]

To evaluate EJ concerns associated with SDWA compliance, the EPA analyzed whether HB and NHB violations are related to sociodemographic factors associated with income, ethnicity or race, and geographic location. Because primacy agencies are not required to report this sociodemographic information to SDWIS Fed, this type of analysis is challenging. SDWIS Fed also does not include spatial information about each PWS's service area boundaries (SAB), which define the geographical area served by the water system. For a given CWS, if it is a large system, the SAB may contain many census tracts whereas for a very small system it may be much larger than the census tract in which it is contained. As census tracts can cover a significant geographic area,

16 Executive Order on Revitalizing Our Nation's Commitment to Environmental Justice for All, EO# 14096, 2023. https://www.whitehouse.gov/briefing-room/presidential-actions/2023/04/21/executive-order-on-revitalizing-our-nations-commitment-to-environmental-justice-for-all/

17 EPA. Technical Guidance for Assessing Environmental Justice in Regulatory Analysis, June 2016. https://www.epa.gov/sites/default/files/2016-06/documents/ejtg_5_6_16_v5.1.pdf

18 EPA Office of Water. Memorandum: Implementation of the Clean Water and Drinking Water State Revolving Fund Provisions of the Bipartisan Infrastructure Law, March 2022. https://www.epa.gov/system/files/documents/2022-03/combined_srf-implementation-memo_final_03.2022.pdf

this may not accurately or exclusively correspond to an individual drinking water system and the associated distribution system. Likewise, it is also possible that multiple CWSs may provide drinking water to customers in the same census tract.

To undertake this analysis, the EPA compiled information from SDWIS Fed, the Census Bureau, and the fourth Unregulated Contaminant Monitoring Rule (UCMR4), as well as SAB data as detailed below. The following sections of this report present the EPA's findings regarding how HB and NHB violations vary by income, ethnicity or race, and geographic location, beginning with a brief description of the EPA's methodology, followed by an analysis of the compiled data. A more detailed methodology is available in Appendix A – Service Area Demographic Calculation Methodology, including Table A 1 presenting items used for calculations, and Table A 2 presenting links for the data sources used.

EJ Data Resources

Service Area Boundaries

To determine service areas for CWSs, the EPA compiled information from several sources that provided various levels of spatial information for these systems (See Appendix A, Table A 3). Table 1 shows the information sources used for the SABs, listed in order of data availability.

Table 1. Data Sources for Service Area Boundaries.

Data Sources	Percent of CWS Population
SDWIS Fed ZIP codes	**60.0**
UCMR 4 ZIP codes	**30.9**
OECA SABs from primacy agencies	**9.0**
No data	**0.13**

Sociodemographic Data

EJScreen is an EPA EJ mapping and screening tool that provides the EPA with a national dataset and a consistent approach for combining environmental and demographic socioeconomic indicators. The EPA used the screening tool raw data files, which include the full EJScreen dataset as a geodatabase or comma separated values (CSV) text file. The EPA accessed low-income data through the EJScreen portal. [19] EJScreen considers people to be low-income if their income is less than twice the federal poverty level.

The Census Bureau collects information about the nation's people and economy through several surveys and programs. Specifically, the Bureau's American Community Survey (ACS) collects demographic information about individuals and households. The Census Bureau releases new ACS data annually and makes each annual dataset available for download online. [20]

The EPA used 2015–2019 ACS datasets that categorized each population served by a CWS into the following groups: American Indian or Alaska Native, Asian and Pacific Islander, Hispanic (of any race), White, and Black.[21] For the populations served by 44 CWS, there was no data in the overlaying census tracts for ethnicity. For more details on the 44 CWSs lacking available ethnicity data, see discussion in Appendix A – Service Area Demographic Calculation Methodology.

The EPA used the Census Bureau's urban-rural classification delineation to determine whether CWSs are in urban or rural areas. The EPA accessed the geographic data online. [22] The EPA used the definition of "urban areas" from the 2010 Census: territories that "encompass at least 2,500 people, at least 1,500 of which reside outside institutional group quarters." (This analysis does not reflect the Bureau's new definition in the 2020 Census, which defines urban areas as territories that "encompass at least 2,000 housing units or a population of at least 5,000.") Both the 2010 and 2020 Censuses define rural areas as "all population, housing, and territory not included within an urban area."

The EPA compared each CWS service area to the Census Bureau's urban-rural classification delineated data. A CWS was classified as urban when 20 percent or more of the water system service area was considered urban by the Census Bureau's criteria. As this analysis is based on area alone, it is likely that the total population served is much more than the 20 percent minimum threshold.

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19 EJ Screen Portal. https://gaftp.epa.gov/EJSCREEN/2022/

20 Census Bureau ACS data. https://data.census.gov/table?q=DP05&g=0100000US$1400000.

21 After this report was drafted OMB updated SPD15 to include Middle Eastern or North African, however this was not included within this analysis. To consolidate the analysis, EPA combined Asian and Native Hawaiian or Other Pacific Islander into one category. Throughout this report Asian and Native Hawaiian or Other Pacific Islander are designated as Asian or Pacific Islander, Black or African American as Black, and Hispanic or Latino American as Hispanic.

The EPA first designated all persons having a Hispanic designation as Hispanic, regardless of the race selected. As a result, the other fields are technically Non-Hispanic American Indian and Alaska Native, Non-Hispanic Asian and Pacific Islander, Non-Hispanic White, and Non-Hispanic Black populations. For the purposes of this report, the Non-Hispanic designation was removed and are referenced as American Indian or Alaska Native, Asian and Pacific Islander, White, and Black throughout the text.

22 Census Bureau urban/rural data. https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural.html

The EPA applied each sociodemographic dataset by assigning census blocks to the SAB. As needed, The EPA combined multiple census blocks as identified based on SAB or multiple Zone Improvement Plan (ZIP) codes. In some cases, more than one PWS Identification Number (PWSID) falls within the same census block or ZIP code. In those cases, the EPA assigned the same sociodemographic information to each system, unless the EPA had specific spatial data that made it possible to distinguish the two systems.

HB and NHB Violations

The EPA used the same HB and NHB violations data from SDWIS Fed used in the other sections of this report to compare compliance among different sociodemographic groups. The EPA combined the violation information with the sociodemographic data from EJScreen and the Census Bureau, as described in the following section.

EJ Areas with HB and NHB Violations

Income Level

The tables in this section (Table 2, Table 3, and Table 4) summarize populations and percent population – by income, race or ethnicity, and geographic location – for CWSs incurring HB and NHB violations. Table 2 shows that CWSs serving low-income populations incurred a higher rate of HB and NHB violations. Among CWSs with violations serving low-income populations, those with HB violations served approximately 8.1 million people, and those with NHB violations served approximately 20 million people.

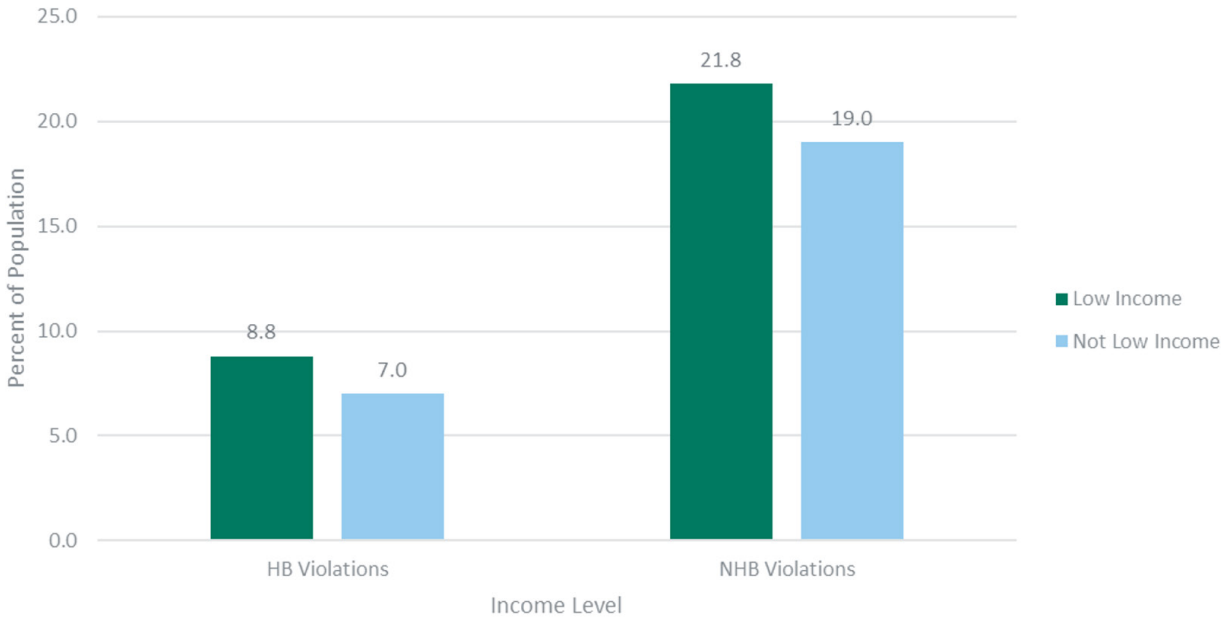
Table 2. Population and Percent of Population, by Income Level, Served by CWSs Incurring HB and NHB Violations.

	Low-income	Not Low-income
Population Served with HB Violations	**8,087,512**	**15,546,383**
Percent of Population with HB Violations	**8.8**	**7.0**
Population Served with NHB Violations	**19,999,431**	**42,127,614**
Percent of Population with NHB Violations	**21.8**	**19.0**

Compliance Data Analysis

Figure 23 shows the percentage of low-income and not low-income populations served by CWSs that incurred HB and NHB violations. As previously mentioned, for this report "low income" means the person or family's income is less than two times the federal poverty level.

Figure 23. Percent of Population, by Income Level, Incurring HB and NHB violations, Using 2022 Income Data.

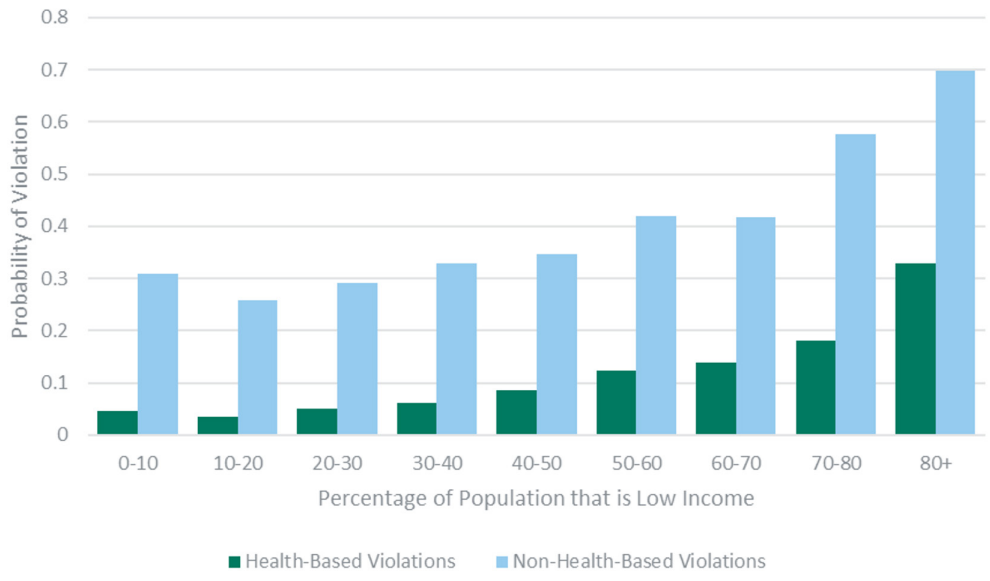


Compliance Data Analysis

The EPA performed a chi-square goodness of fit test on the income data to test for differences in the prevalence of HB and NHB violations between the low-income and not low-income populations. [23] The results of the test showed that the difference between the groups is statistically significant for both types of violation, [24] meaning the difference between the groups is not due to chance. Low-income populations are approximately 1.3 times more likely to be served by CWSs that have HB violations and approximately 1.1 times more likely to be served by CWSs that have NHB violations.

As shown in Figure 24, the EPA evaluated how the likelihood of a CWS violating HB or NHB requirement changes as the low-income proportion of the population served increases. To show this relationship, the EPA estimated the probability of violation occurring for communities with increasing percentages of low-income populations (in increments of 10 percent), where each group shown along the horizontal axis has a low-income population of less than 10 percent of the total population, 10–20 percent of the total, 20–30 percent of the total, etc. The vertical axis shows the predicted probability of a CWS incurring an HB or NHB violation.

Figure 24. Probability of a System Incurring an HB or NHB Violation Based on the Percentage of the System Served Population that is Low-Income, Using 2022 Income Data.



23 The chi-square test of goodness and fit is used to determine the likelihood that any difference between categories in the test is due to chance. See George W. Snedecor and William G. Cochran, Statistical Methods, 8th ed. (Ames, Iowa: Iowa State Press, 1989).

24 For the chi-square tests of goodness and fit completed for this EJ Analysis, a 99 percent confidence level was used. The results were statistically significant at this confidence level.

The predicted probability is between zero (there is no chance of a violation) and one (or 100 percent – meaning a violation will happen with certainty). Figure 24 illustrates that as the low-income proportion of a population increases, the probability of both HB and NHB violations also increases. Although this estimate does not account for other factors that affect compliance (e.g., system size), it demonstrates the direct correlation between the share of a service population that is low-income and the likelihood of an HB and NHB violation.

Race/Ethnicity Groups

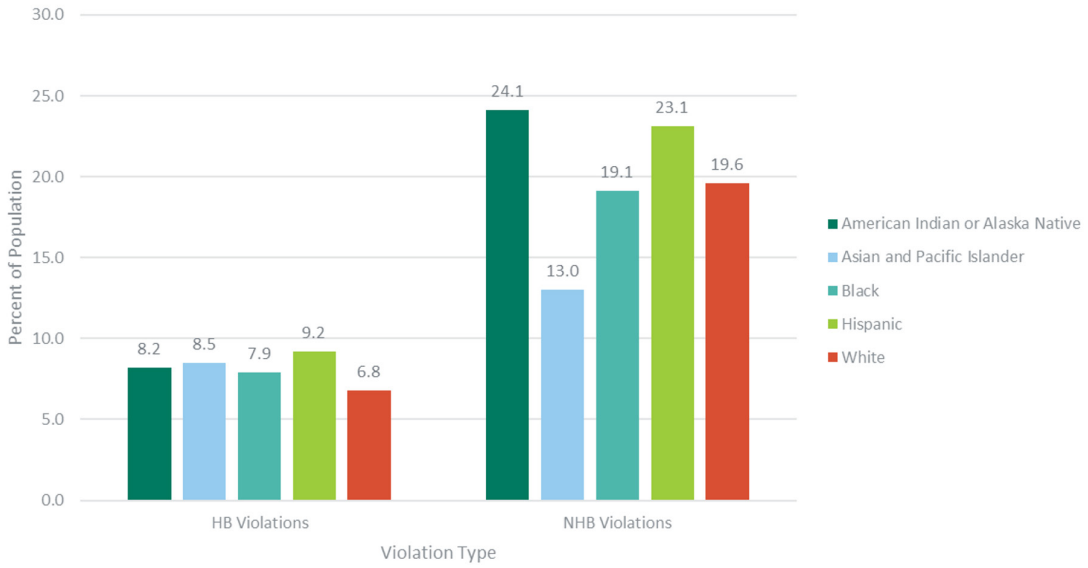
Table 3 shows CWS populations and CWS percent populations of the five race/ethnicity groups that incurred an HB and NHB violation. Of all the race/ethnicity groups, the most likely to see HB violations were Hispanic (9.2 percent), followed by Asian and Pacific Islander (8.5 percent), American Indian or Alaska Native (8.2 percent), and Black (7.9 percent) populations, in that order, with White (6.8 percent) least likely to see HB violations. Black, Hispanic, American Indian or Alaska Native, and Asian and Pacific Islander populations were 1.2–1.3 times more likely than the White population to be served by CWSs with HB violations.

Table 3. Population and Percent of Population, by Race/Ethnicity, served by CWS Incurring HB and NHB Violations.

	American Indian or Alaska Native	Asian and Pacific Islander	Hispanic	White	Black
Population Served with HB Violations	176,609	1,454,196	5,584,217	12,628,461	3,199,452
Percent of Population with HB Violations	8.2	8.5	9.2	6.8	7.9
Population Served with NHB Violations	521,753	2,218,837	13,995,835	36,184,814	7,762,392
Percent of Population with NHB Violations	24.1	13.0	23.1	19.6	19.1

Meanwhile, the most likely communities to see NHB violations were American Indian or Alaska Native (24.1 percent), followed by Hispanic (23.1 percent), White (19.6 percent), and Black (19.1 percent) populations, in that order, with Asian and Pacific Islander (13.0 percent) the least likely to see NHB violations. American Indian or Alaska Native, and Hispanic populations were 1.0–1.2 times more likely than White populations to be served by CWSs with NHB violations. Black and White populations were roughly equally likely to experience an NHB violation, while Asian and Pacific Islander populations were 0.7 times as likely as White populations to experience an NHB violation. Similar to what was done in the income analysis, the EPA performed a chi-square goodness of fit test on the ethnicity data to test for differences between the race/ethnicity groups for HB and NHB violations. The results of the test showed that the difference between the groups is statistically significant.

Figure 25. Percent of Population, by Race/Ethnicity (American Indian or Alaska Native, Asian and Pacific Islander, Black, Hispanic, White) Served by CWSs with HB and NHB violations, 2015–2019 ACS Data.



Geographic Location

Table 4 shows the number of CWSs with violations, percent of populations served by CWSs with violations, and populations served by CWSs with violations, categorized by urban and rural locations. For additional context, it is important to note that although Table 4 does not directly reference it, 67.5 percent of all CWSs serving 500 or fewer persons are rural, meaning no more than 20 percent of their covered area is urban.

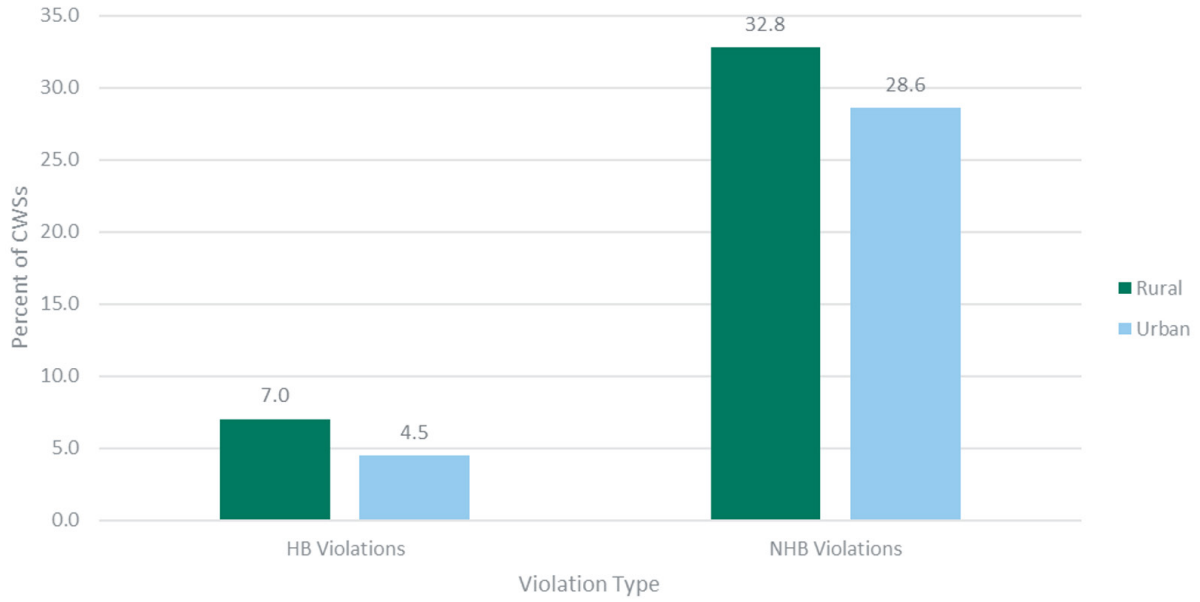
Table 4. Population and Percent of Population, by Location, Incurring HB and NHB Violations.

	Rural	Urban
CWS with HB Violation	2,209	729
% of CWS with HB Violation	7.0%	4.5%
Population Served with HB Violation	3,605,912	20,027,983
% of Population with HB Violations	5.1%	8.2%
CWS with NHB Violation	10,298	4,660
% of CWS with NHB Violation	32.8%	28.6%
Population Served with NHB Violation	17,905,625	44,221,420
% of Population with NHB Violations	25.4%	18.2%

While rural systems reported HB violations more frequently than urban systems, urban populations were more likely to be served by a CWSs with HB violations. This can be explained by the fact that urban water systems typically serve larger populations than rural ones. Consequently, when an HB violation occurs in an urban system, it affects a larger number of people. Conversely, rural systems may experience a higher frequency of violations, but because of their smaller population size, fewer people are affected by an individual HB violation. Similar to HB violations, rural systems were more likely to see NHB violations, and urban populations were more likely to see NHB violations.

Figure 26 shows the number of CWSs, both rural and urban, with HB and NHB violations. Note that the percentages shown in Table 4 and Figure 26 differ because they use two very different variables (population for Table 4, and system count for Figure 26). Rural CWSs were 1.6 times more likely to incur HB violations than those located in urban areas and 1.1 times more likely to incur NHB violations. Similar to what has been done in the income analysis, the EPA performed a chi-square goodness of fit test on the location data to test for differences between the urban and rural groups in levels of HB and NHB violations. The results of the test showed that the difference between the groups is statistically significant.

Figure 26. Percent of CWSs, by Geographic Location (Rural and Urban), with HB and NHB Violations, 2010 Urban and Rural Census Data.



EJ Trends

The trends recognized in the analysis indicate that CWSs that are within low-income, rural, and communities of color experience higher exposure to drinking water violations, both HB and NHB.

Low-income populations saw an 8.8 percent HB and 21.8 percent NHB violation rate, compared to the 7.0 percent HB and 19.0 percent NHB violation rates seen by not low-income populations. The populations most likely to be served by CWSs with HB violations were Hispanic (9.2 percent), American Indian or Alaska Native (8.2 percent), and Asian and Pacific Islander (8.5 percent) populations. Those most likely to see NHB violations were American Indian or Alaska Native (24.1 percent), Hispanic (23.1 percent), and White (19.6 percent) populations. Asian and Pacific Islander populations had the lowest NHB violation rates (13 percent).

As described above, rural CWSs were more likely to have HB (7.0 percent) or NHB (32.8 percent) violations, but urban populations were more likely to be served by CWSs with HB and NHB violations. This finding is consistent with many of the compliance issues faced by smaller systems, as discussed elsewhere within this report.

System Characteristics and HB Violations

System Size

Ninety-four percent of the CWSs with HB violations are small systems (i.e., serving fewer than 10,000 persons) (Figure 27). The EPA calculated the violation rates for the five populations categories (Figure 28). Approximately 6.5 percent of all small CWSs had HB violations, compared to about 4 percent of all large CWSs serving more than 10,000 persons, including 4.7 percent of all systems serving more than 100,000 persons. These results indicate a small system is 1.7 times more likely to incur an HB violation than a large CWS serving more than 10,000 persons.

Figure 27. Number of CWSs with HB Violations Within Each Population Served Category, 2021 Q3.

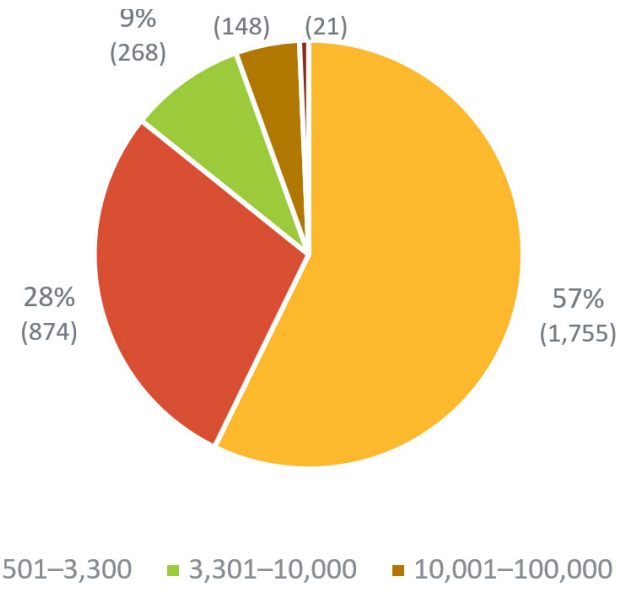
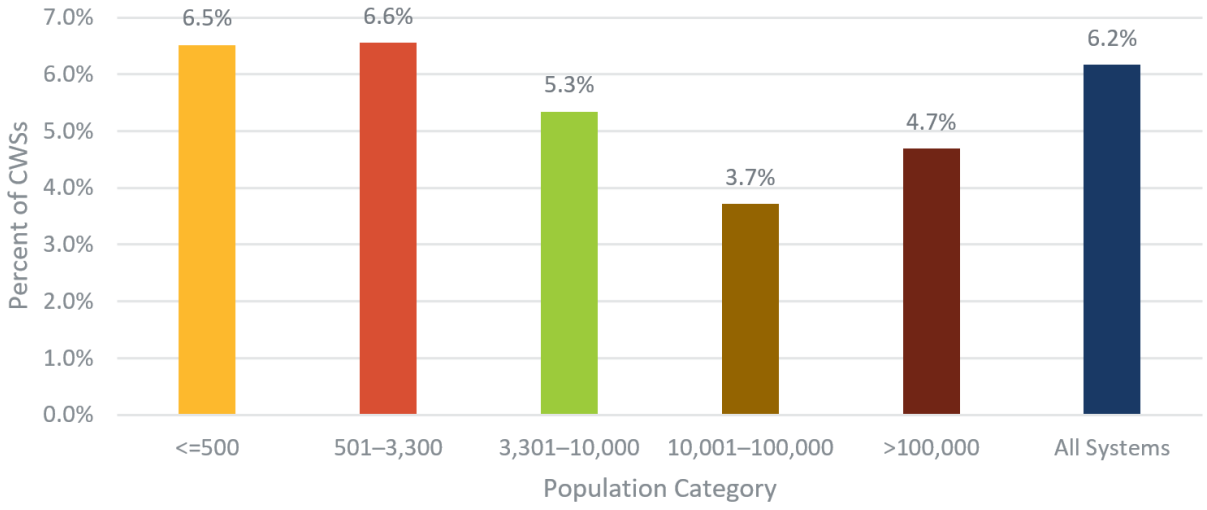


Figure 28. CWSs HB Violation Rate Within Each Population Served Category, 2021 Q3. HB violation rates decrease as population increases, especially those with a population more than 10,000–100,000 persons.



Ownership Type

Figure 29 shows a breakdown of the number of CWSs with HB violations by system ownership type. CWSs owned by local governments had the greatest number of violations, followed closely by privately-owned systems. Tribal CWSs account for only 1 percent of CWSs (Figure 7) yet make up 4 percent of all CWSs with HB violations (Figure 29) and had a 17 percent HB violation rate (Figure 30). Comparatively, all other system ownership types saw HB violation rates similar to the average for all systems combined (about 6 percent, with the exception of those listed as public/private, which had a violation rate of 3.5 percent).

Figure 29. Number of CWSs with HB Violation by Ownership Type, 2021 Q3.

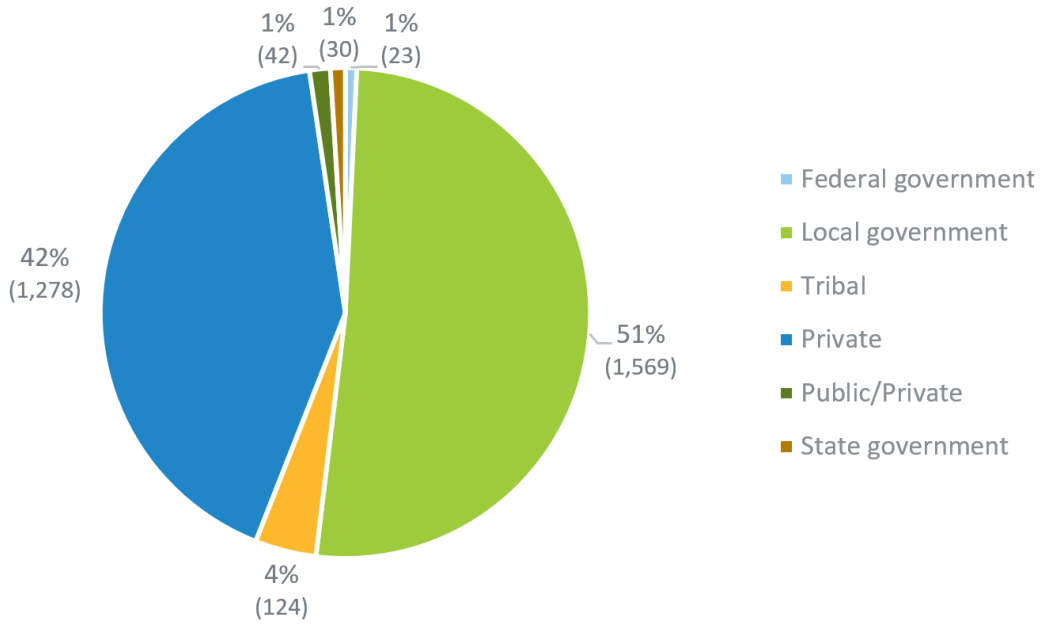
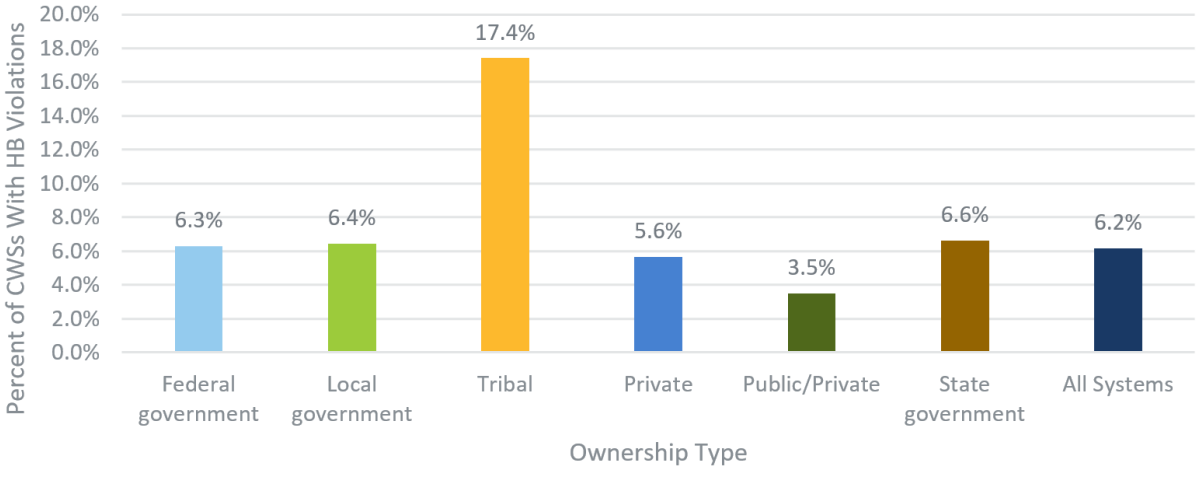


Figure 30. CWSs HB Violation Rate Within Each Ownership Type Category, 2021 Q3. Showing that Tribal-owned CWSs have the highest percentage of systems with HB violations (17 percent). Two systems were of unknown ownership and were excluded from All Systems.



Water Source

CWSs identified as GW systems accounted for 76 percent of all CWSs, while SW systems accounted for 24 percent of all CWSs. Figure 31 shows that 67 percent of systems with HB violations have GW as a primary source of water, whereas 33 percent of systems have SW as a primary source of water. While HB violations by GW systems outnumber those by SW systems, SW systems have a 1.6 times higher rate of violation than GW systems (Figure 32), indicating a higher rate of HB violations for SW systems. This is not surprising given that SW systems are more vulnerable to potential sources of contamination (e.g., bacterial pollution), and have more treatment requirements, both of which can lead to more HB violations.

Figure 31. Number of CWSs with HB Violations by Source Water Type, 2021 Q3. More GW systems had an HB violation than SW systems, as would be expected given that more than 75 percent of systems are GW.

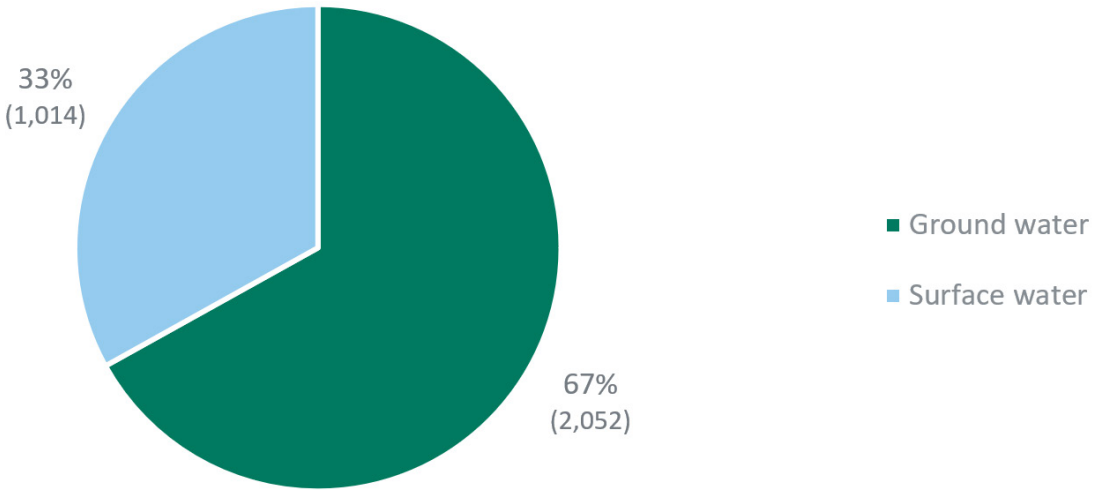


Figure 32. CWSs HB Violation Rate by Source Water Type, 2021 Q3. SW systems were 1.6 times more likely to have a HB violation than that of GW systems.

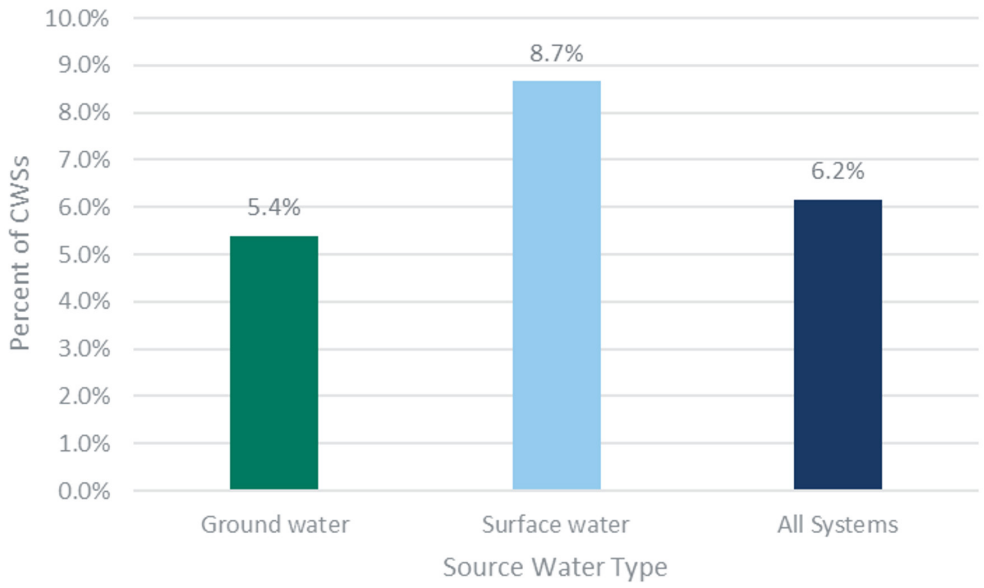


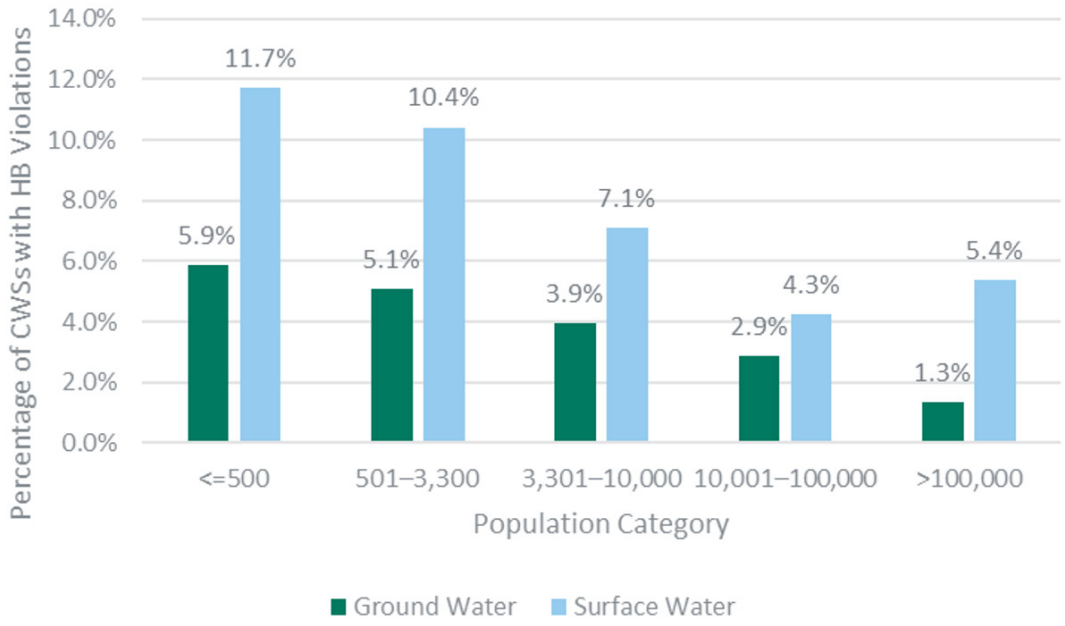
Figure 33 illustrates the percentage of systems with HB violations based on source water type, per population size category. The HB violation rate for GW systems decreases with increasing population size. These smaller systems often face TMF capacity challenges compared to larger systems. [25]

Similarly, HB violation rates among SW CWSs decrease with increasing population size, only increasing for the largest population size category (Figure 33). This general decline may be due to the larger systems' access to more resources, which can mitigate HB violations. The small spike in HB violations for the SW systems with populations greater than 100,000 persons could be related to the increased time that the water spends in the distribution system (water age), which may cause exceedances of DBPR MCLs. [26]

25 See Section 2.3 of: EPA Office of Water. America's Water Infrastructure Act (AWIA) – Section 2003 Report to Congress, EPA 815-R-19-005, July 2022.

26 EPA Office of Water. Stage 2 Disinfectants and Disinfection Byproducts Rule (DBPR) and Consecutive System In-Depth Analysis, EPA 815-R-19-001, July 2019. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100X0T6.txt

Figure 33. HB Violation Rate, 2021 Q3, Based on Source Water Type Across Population Groups. Violation rates for GW and SW systems generally decrease with increasing population.



System Characteristics and NHB Violations

System Size

Figure 34 shows the number of CWSs with NHB violations based on population size. Systems serving 500 or fewer persons accounted for the highest number (8,935 systems) and percentage (57 percent) of CWSs with NHB violations – which is not surprising, given that CWSs of this size also account for roughly 54 percent of all CWSs (Figure 6).

Figure 34. Number of CWSs with NHB Violations by Population Size, 2021 Q3.

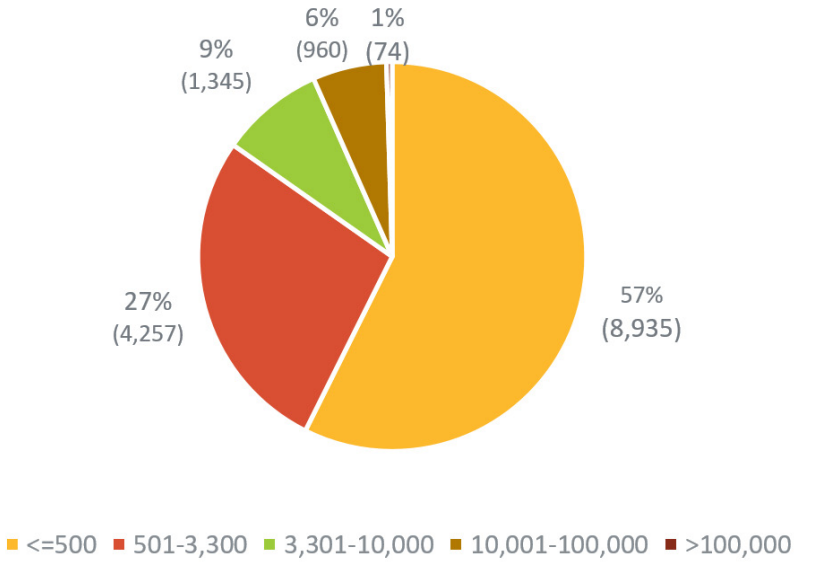
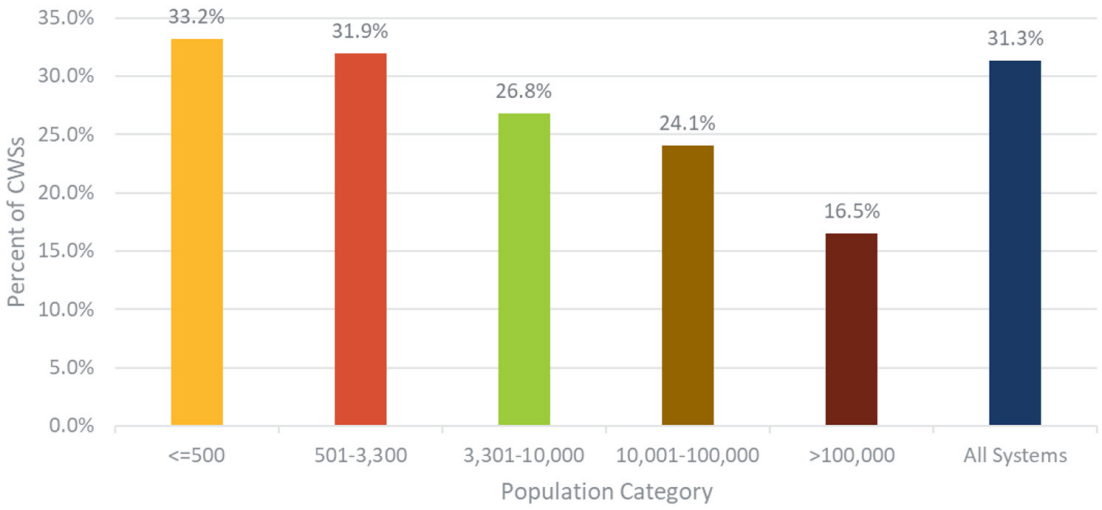


Figure 35 reflects that CWSs serving 500 or fewer persons are only slightly more likely (33.2 percent) than the average (31.3 percent) to incur an NHB violation. CWSs serving more than 100,000 persons have the lowest likelihood (16.5 percent) of NHB violations, with roughly half the likelihood of a violation compared to CWSs serving 500 or fewer persons.

Figure 35. CWSs NHB Violation Rate for Each CWS Population Category, 2021 Q3.



Ownership Type

Figure 36 shows a breakdown of CWSs with NHB violations by system ownership type. Similar to CWS HB violations, systems owned by local governments accounted for the highest number (7,350) and percentage (47 percent) of CWSs with violations, followed closely by privately-owned systems (7,237 or 47 percent). Figure 37 reflects the percentage of CWSs with NHB violations by ownership type. While Tribal-owned CWSs represent only 1 percent of all CWSs (Figure 7), they had the highest likelihood of an NHB violation (51.4 percent). Systems with other ownership types saw NHB violation rates roughly mirroring the average for all systems combined (31.3 percent). The total number of NHB violations was approximately five times the number of HB violations for all CWS systems.

Figure 36. Number of CWSs with NHB Violations by Ownership Type, 2021 Q3.

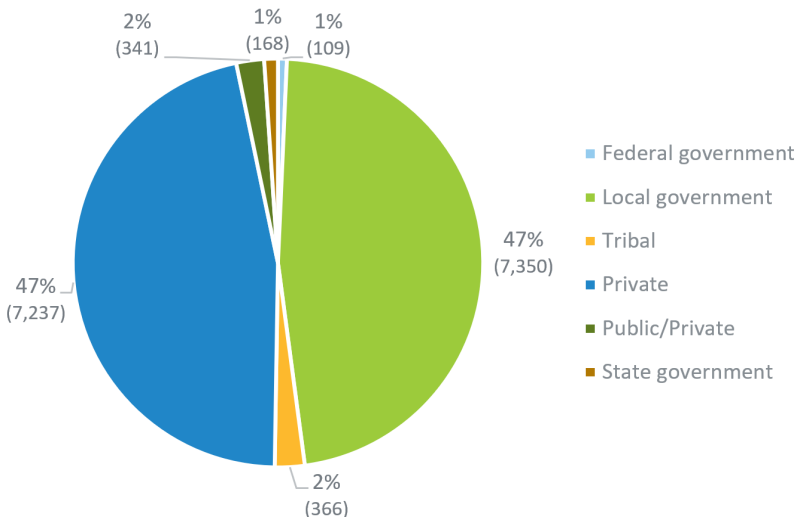
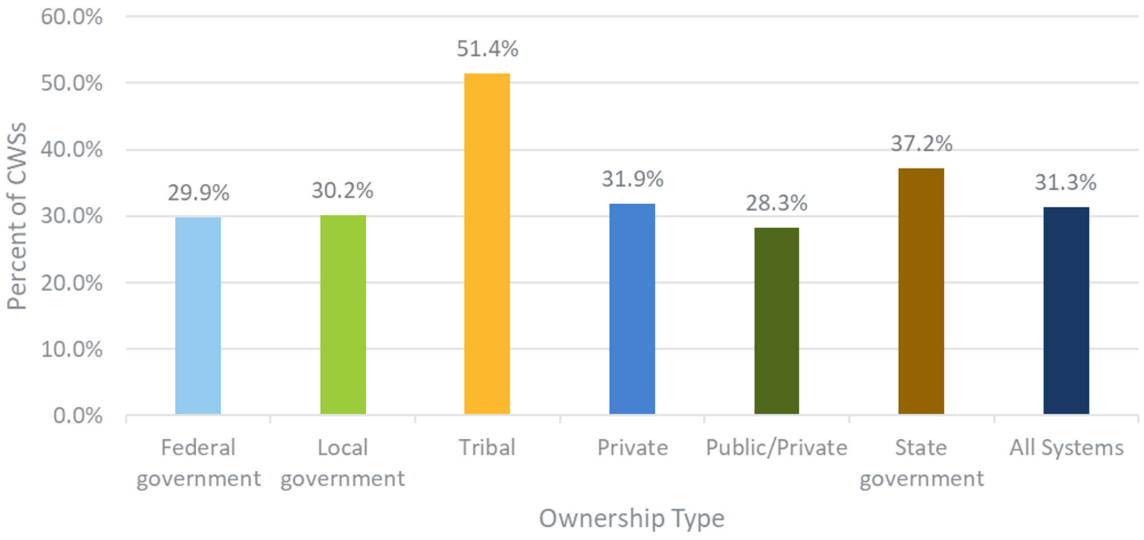


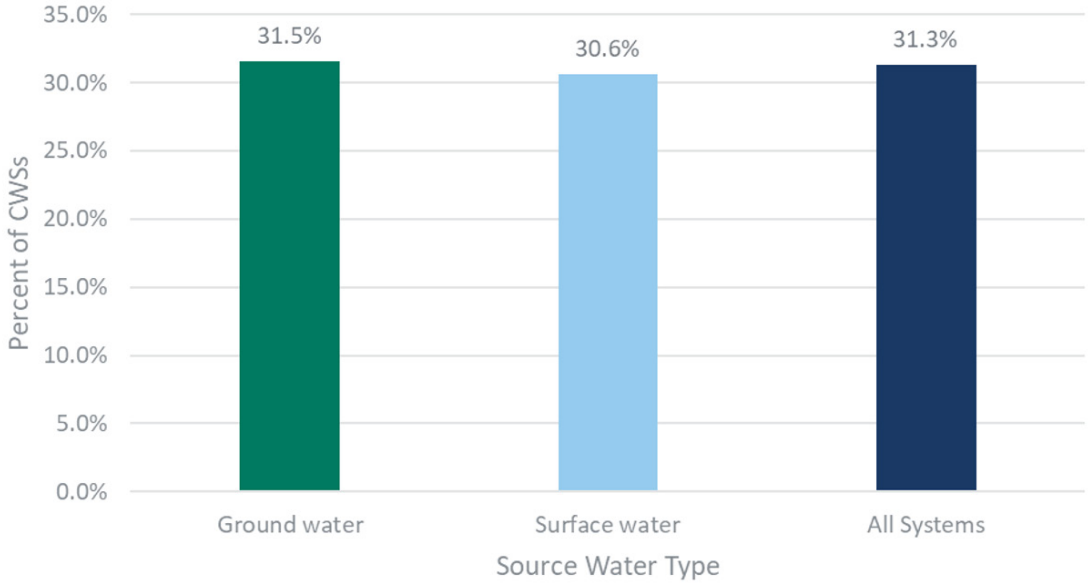
Figure 37. CWSs NHB Violation Rate by Ownership Type, 2021 Q3, showing that Tribal-owned CWSs have the highest percentage of systems with NHB violations (51.4 percent). Two systems were of unknown ownership and were excluded from the analysis.



Water Source

GW systems accounted for 76 percent of all CWSs, while SW systems accounted for 24 percent of all CWSs (Figure 8). The likelihood of an NHB violation was roughly similar among GW (31.5 percent) and SW (30.6 percent) systems (Figure 38). In contrast the likelihood of an HB violation was 1.6 times higher in SW systems (8.7 percent) than GW systems (5.4 percent) (Figure 27).

Figure 38. Percentage of CWSs with NHB Violations by Source Water Type, 2021 Q3. SW and GW systems have a similar rate of violation, with GW systems being slightly higher.



Regression Analysis on Violation Rates

Methodology

Logistic regression is a statistical method used to predict the probability of an event occurring. In this analysis, the EPA used logistic regression to calculate the likelihood of a CWS having a violation based on population served, ownership, and source type. The EPA used statistical software to model two logistic regressions: one for HB violations and one for NHB violations. This approach enabled the EPA to consider all three variables simultaneously to understand how each influences the probability of a violation. Table 5 presents the results of the logistic regression model.

The EPA calculated the likelihood based on each fitted regression model and expressed the likelihood as an odds ratio for each variable (population served, ownership, and source type). Odds ratios are a measure of the likelihood of a violation for a group of systems compared to the reference group to which all other categories are compared when determining the probability of a violation. An odds ratio equal to one means that the likelihood of a violation is the same for the group evaluated and the reference group. An odds ratio with a value less than one represents lower odds of a violation occurring compared to the reference group, while an odds ratio greater than one represents higher odds of a violation occurring compared to the reference group.

In the fitted models, the reference group comprises SW systems owned by local governments and serving 500 or fewer people. The EPA selected SW systems with populations of 500 or fewer people for the reference group because they are considered the most likely to have a violation. Local government was chosen as the most common ownership type. Table 5 does not include the odds ratios for SW, populations of 500 or fewer persons, and local government ownership because systems in these categories comprise the reference group variables; by definition the odds ratios for these variables are 1.00.

The EPA calculated the 95 percent confidence interval (CI) to estimate the precision of each odds ratio – meaning it is 95 percent confident that the true odds ratio is within the given range. Odds ratios with larger CI ranges are considered less precise, whereas odds ratios with smaller CI ranges are considered more precise. The EPA also calculated the pseudo R2 to determine the amount of variance explained by each model.

Logistic Regression Model Results

Table 5 shows the odds ratios for regression models on HB and NHB violation rates compared to source type, ownership, and population. It also displays the corresponding 95 percent CI for each odds ratio. The EPA based the calculations on 49,738 CWS observations. As an example of how to read Table 5, the first odds ratio shown in Table 5 shows the difference in the likelihood of a HB violation between a CWS identified as a system with a GW source compared to the reference group, SW CWS. The odds ratio is an estimated 0.504, which means that a CWS with a GW source is about half as likely (50.4 percent) to have a HB violation compared to a similar SW CWS (per the reference group described above). The 95 percent CI means that there is a 95 percent confidence that the range of 0.462–0.550 (or 46.2 percent–55.0 percent) includes the true odds ratio.

All odds ratios other than federal government ownership and state government ownership are statistically significant at 1 percent. The pseudo R2 is 0.0201 for the HB violations model, meaning that the predictor variables in the model explain 2.01 percent of the variance in the outcome. On the other hand, the pseudo R2 is 0.0064 for the NHB violations model, meaning the model explains 0.64 percent of the variance.

Table 5. Logistic Model of HB and NHB Violations (2021 Q1). The reference group is SW systems owned by local governments serving 500 or fewer people. By definition, the odds ratio and CI for the reference group are always 1.00.

Parameter	Health-Based Violations					Non-Health-Based Violations				
	Odds Ratio		95 percent Confidence Interval			Odds Ratio		95 percent Confidence Interval		
Source Water										
Ground Water	0.504	*	0.462	–	0.550	0.904	*	0.860	–	0.950
Population Served										
501–3,300	0.814	*	0.741	–	0.894	0.910	*	0.866	–	0.957
3,301–10,000	0.570	*	0.494	–	0.658	0.697	*	0.648	–	0.751
10,001–100,000	0.351	*	0.292	–	0.421	0.598	*	0.549	–	0.650
>100,000	0.398	*	0.255	–	0.623	0.367	*	0.285	–	0.473
Ownership										
Federal government	1.013		0.661	–	1.555	1.004		0.801	–	1.260
State government	1.082		0.743	–	1.576	1.347		1.110	–	1.635
Public/Private	0.585	*	0.427	–	0.801	0.872	*	0.766	–	0.993
Private	0.834	*	0.762	–	0.913	0.962	*	0.918	–	1.009
Tribal	2.939	*	2.397	–	3.604	2.245	*	1.931	–	2.609
Observations	49,738					49,738				
Pseudo R^2	0.0201					0.0064				

*Statistically significant at 1 percent.

Table 5 yields the following notable insights:

- If population and ownership are constant, GW systems are half as likely as SW systems to have an HB violation and about 10 percent less likely to have an NHB violation.
- As population size increases, the likelihood of an HB or NHB violation falls by as much as 65 percent compared to systems serving 500 or fewer people.
- Systems serving 501 to 3,300 persons are about 19 percent less likely to incur an HB violation and about 9 percent less likely to incur an NHB violation, compared to the reference group of systems serving 500 or fewer people.
- Systems serving greater than 100,000 persons are about 60 percent less likely to incur an HB violation and about 63 percent less likely to incur an NHB violation compared to the reference group of systems serving 500 or fewer people.

- Compared to the reference group of local government-owned systems, public/private owned systems are least likely to incur an HB or NHB violation, and Tribal-owned (American Indian or Alaska Native) systems are most likely to incur an HB or NHB violation.
- Public/private-owned systems are about 42 percent less likely to incur an HB violation and about 13 percent less likely to incur an NHB violation compared to the reference group of systems owned by local government.
- Tribal-owned systems are nearly 194 percent more likely to incur an HB violation and about 125 percent more likely to incur an NHB violation compared to the reference group of systems owned by local government.
- State government-owned systems are about 8 percent more likely to incur an HB violation and about 35 percent more likely to incur an NHB violation compared to the reference group of systems owned by local government.
- Privately-owned systems are about 17 percent less likely to incur an HB violation and about 4 percent less likely to incur an NHB violation compared to the reference group of systems owned by local governments.

Lead Action Level Exceedance Analysis

Under the LCR, systems are required to monitor the levels of lead in drinking water at customer taps. The lead action level (AL) is the concentration of lead in drinking water from customer taps. The AL is not a health-based standard nor is it used to establish a safe level of lead. The EPA developed a lead AL to measure the effectiveness of the corrosion control treatment in water systems.

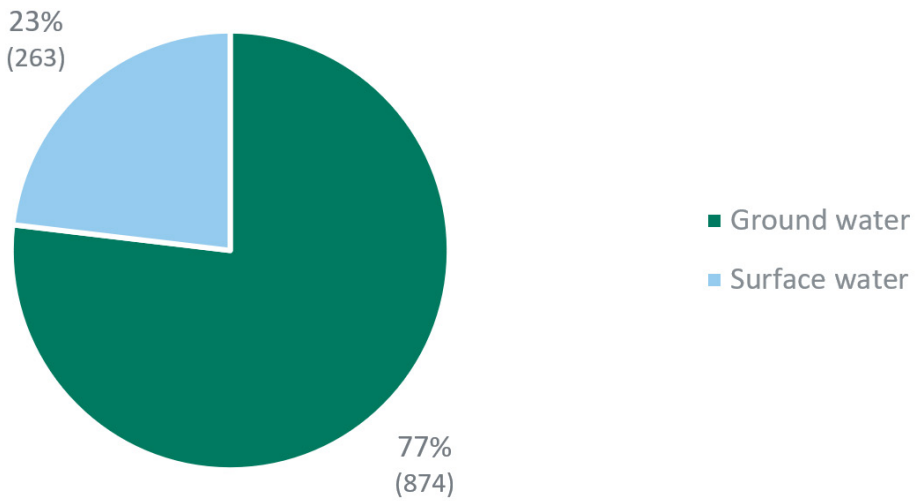
If lead concentrations exceed an AL of 15 parts per billion (ppb) in more than 10 percent of customer taps sampled, the system has a lead action level exceedance (ALE). An ALE does not constitute a NPDWR violation, but it does trigger additional requirements for the system to take including water quality monitoring, optimizing or installing corrosion control treatment, source water monitoring/treatment, public education and/or lead service line replacement. A violation occurs if a system does not take the actions required following an ALE.

This report evaluates lead ALE numbers by reviewing reported data from the previous three years, which is the length of one compliance period, and encompasses typical LCR monitoring frequencies, i.e., every six months, annually, or triennially. For this report the EPA used a three-year lead ALE dataset based on data reported from Q4 2018 through Q3 2021. This approach is reasonable because the frequency of required sampling and number of samples varies between systems, based on factors like population size and prior lead and copper results. Some systems with prior exceedances are required to sample more frequently, such as every six months and incur multiple lead ALEs, while others without any history of exceedances are on reduced monitoring schedules, such as every year or once every three years.

Lead ALEs by CWS Characteristics

Figure 39 shows that 1,137 systems – including 874 GW and 263 SW systems – had lead ALEs for a three-year dataset ending for 2021 Q3, serving a total population of 7.3 million people. [27] As shown in Figure 40, GW and SW systems were equally likely to have a lead ALE.

Figure 39. Number of CWSs with Lead ALEs by Water Source Type, three-year dataset ending 2021 Q3.



27 SDWIS Fed data, Q3 FY21.

Figure 40. Percentage of CWSs with Lead ALEs by Water Source Type, three-year dataset ending 2021 Q3. Both GW and SW CWSs have a percentage of CWSs with Lead ALEs equal to that of the inventory.

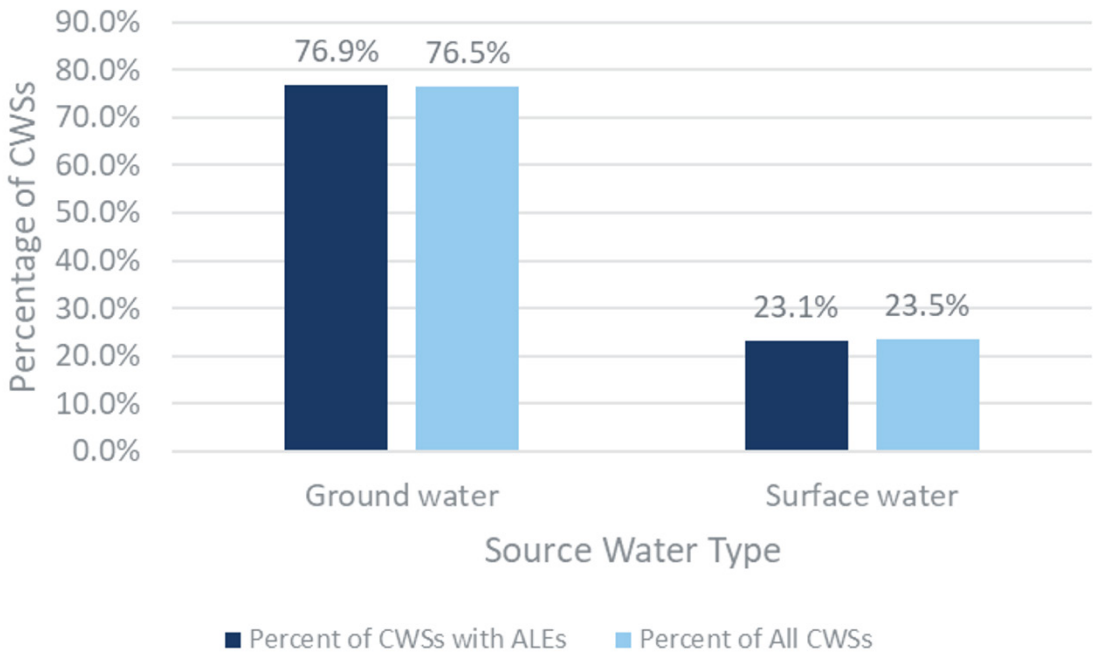


Figure 41 reflects that lead ALEs most commonly occurred in small systems, especially those serving 500 or fewer people. Systems in this population category had a lead ALE rate of 2.9 percent, about two times greater than that of large systems (Figure 42). Systems serving more than 100,000 persons represent a small portion of the total number of systems but have a greater percentage of lead ALEs (2.7 percent) than systems serving between 501 and 100,000 (roughly 1.5 percent).

Figure 41. Number of CWSs with Lead ALEs by System Size, three-year dataset ending 2021 Q3.

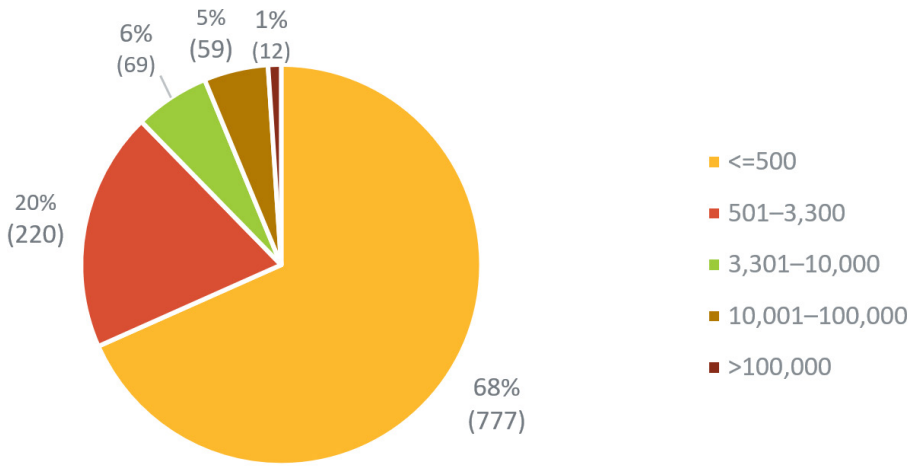


Figure 42. Percentage of CWSs with ALEs by System Size, three-year dataset ending 2021 Q3. Systems serving 500 or fewer persons had the highest proportion of ALEs among size categories, followed by those serving more than 100,000 persons.

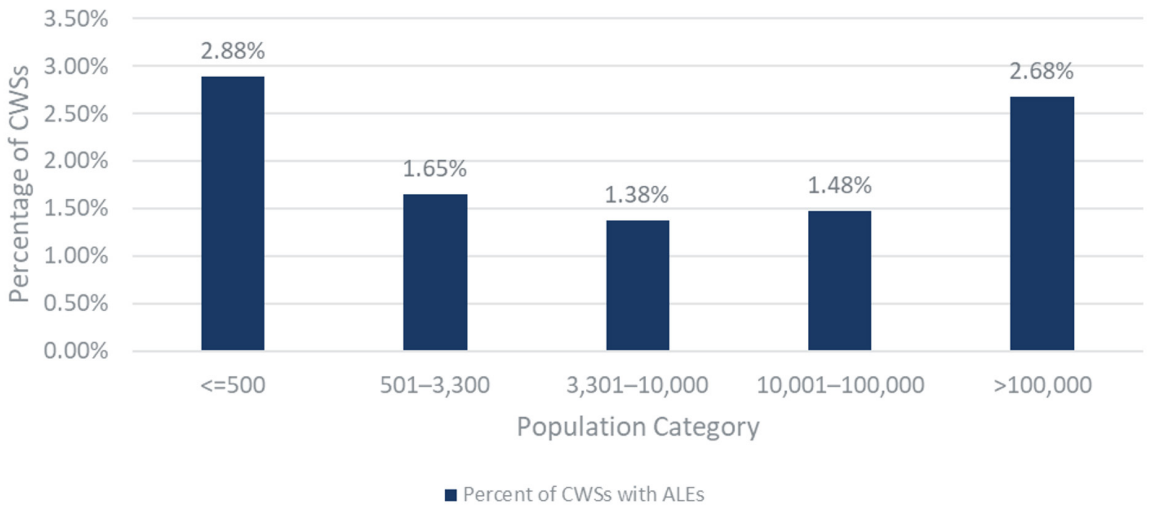


Figure 43 shows the number of CWSs with lead ALEs across system ownership types. The largest numbers of lead ALEs were found among privately-owned (52 percent) and local government-owned (39 percent) CWSs, which is to be expected given that most CWSs are privately- or local government-owned. A review of the data for these ownership types shows that most privately-owned CWSs serve populations of 500 or fewer persons, whereas local government owned CWSs are more diverse in population size. The CWSs most likely to have a lead ALE were systems owned by state government (nearly 6 percent) or Federal government (4.7 percent), each of which constitute a small portion of the total inventory of CWSs (Figure 44).

Figure 43. Number of CWSs with Lead ALEs by System Ownership Type, three-year dataset ending 2021 Q3.

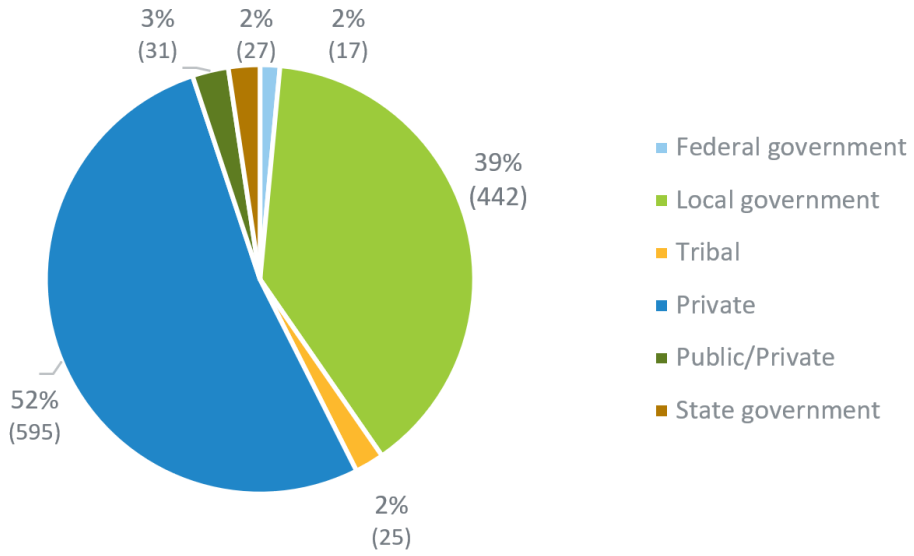
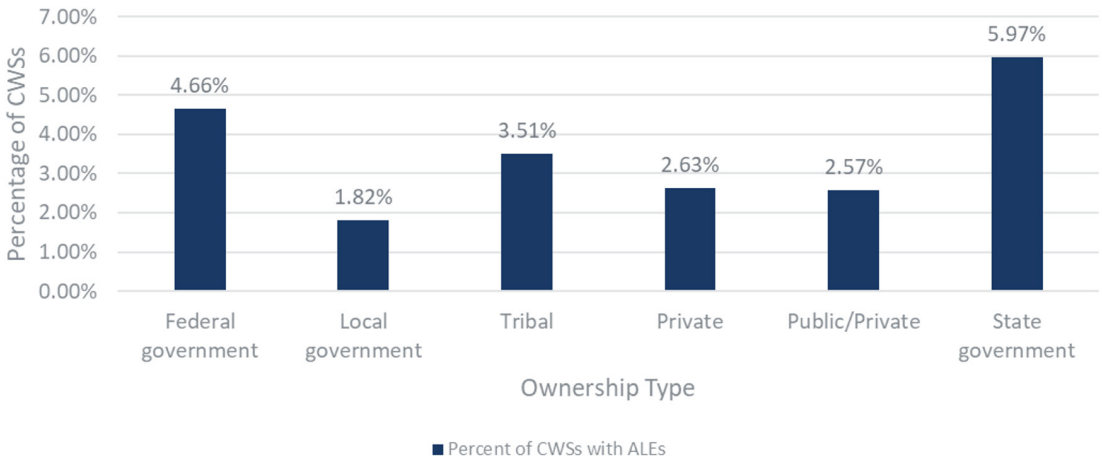


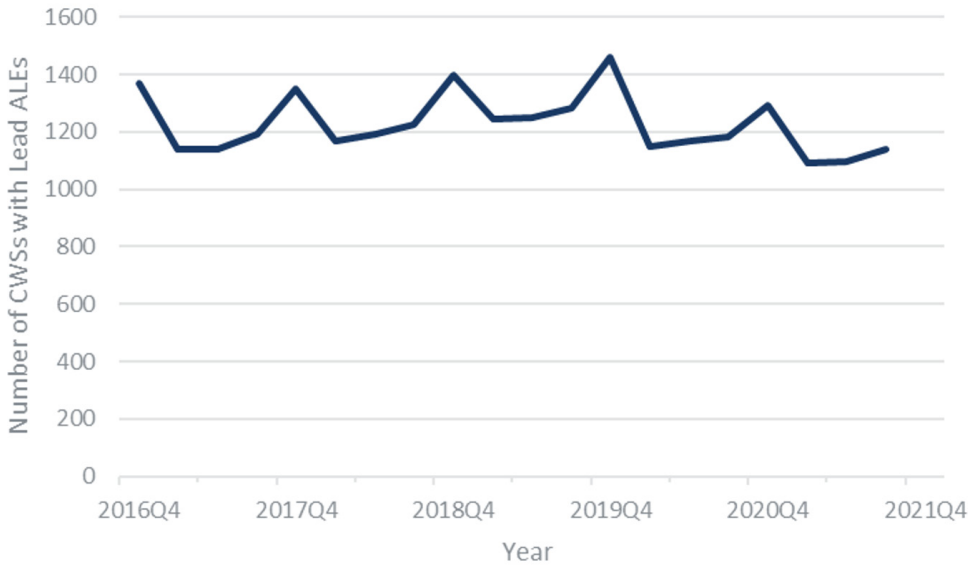
Figure 44. Percentage of CWSs with ALEs by Ownership Type, three-year dataset ending 2021 Q3.



Lead ALE Trend

The number of lead ALEs has remained relatively consistent over the period of 2016 Q4–2021 Q3 (Figure 45). The highest numbers of ALEs often occur in Q4 of each year, a pattern that likely mirrors common sampling schedules. Systems that monitor annually or less frequently are required to sample between June 1 and September 30, which is mostly Q4 of the government fiscal year. As this is a common season for monitoring, it naturally follows that more lead ALEs are identified and reported in this period each year.

Figure 45. Number of CWSs with ALEs, 2016 Q4–2021 Q3. Each data point is based on ALEs reported during the three previous years to ensure that all systems have conducted monitoring.



CWSs with Multiple ALEs

The EPA also evaluated systems with multiple ALEs in recent years. Specifically, The EPA identified CWSs that: 1) had three or more ALEs within the past five years (through 2021 Q3); and 2) reported an ALE in its most recent sample. Based on these criteria, only 62 systems (0.1 percent) have had multiple lead ALEs, including 45 GW and 17 SW systems (Figure 46). Most multiple ALE systems served 3,300 or fewer people, with only one serving more than 10,000 people (Figure 47). The distribution of ownership types was generally consistent with that of the total CWS inventory – 50 percent of multiple ALE systems are privately owned, and 34 percent are local government owned (Figure 48).

In this report the EPA has provided compliance data through FY21, consistent with the date BIL was implemented. In 2022, the EPA released the *EPA Strategy to Reduce Lead Exposures and Disparities in U.S. Communities*, which included specific goals for reducing lead exposure in drinking water. As a result, the number of systems with multiple ALEs has declined by approximately one-third since the end of FY21, to 42 CWSs at the end of FY23. During this time the EPA's goal has been to target oversight and technical assistance provided to states and water systems to reduce lead in drinking water.

Figure 46. Number of CWSs with Multiple ALEs. Specifically with three or more ALEs within the past five years including the most recent sample also an ALE, by Water Source Type, 2021 Q3.

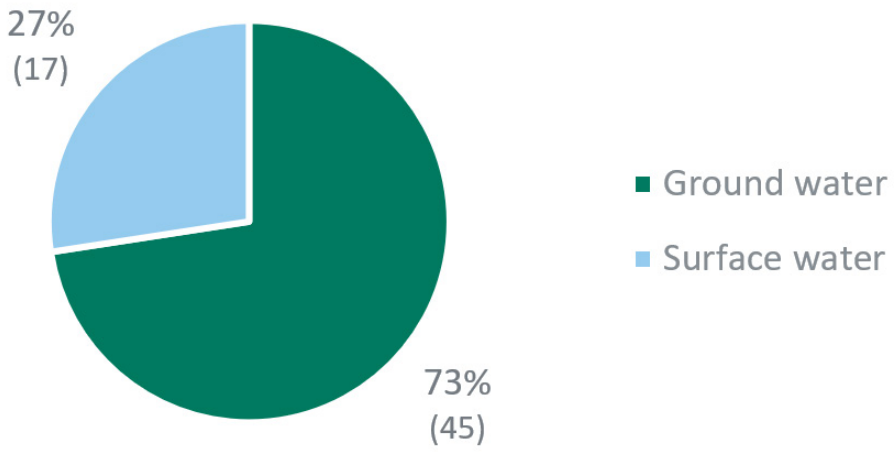


Figure 47. Number of CWSs with Multiple ALEs by System Size, 2021 Q3.

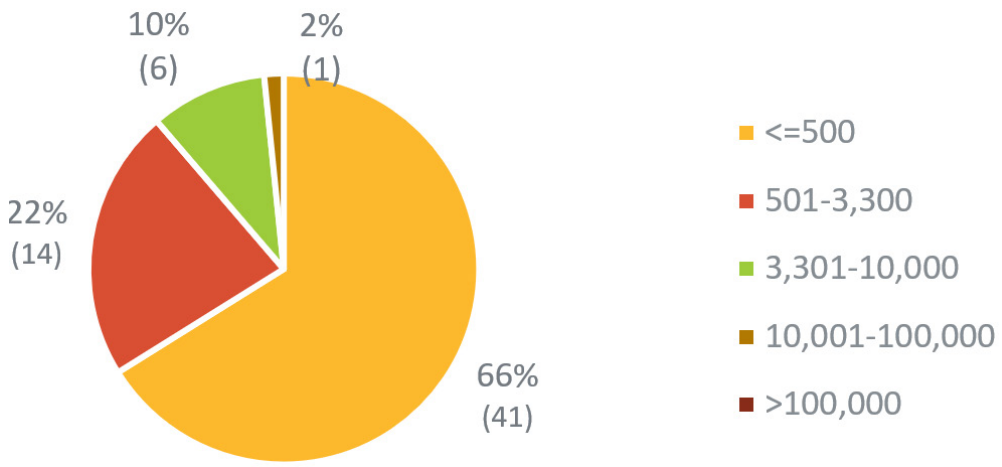
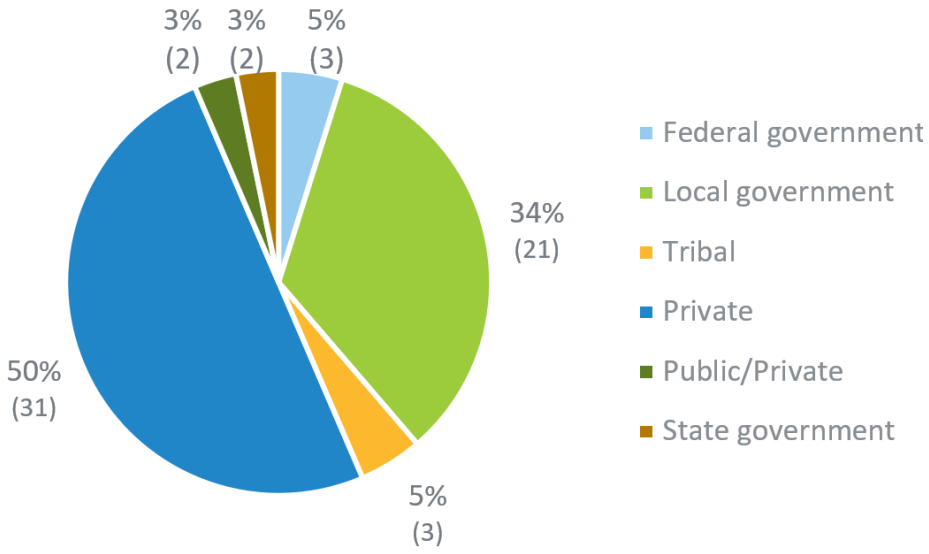


Figure 48. Number of "Multiple ALE" CWSs by Ownership Type, 2021 Q3.



Rule Violation Analysis

Figure 49 shows the distribution of CWSs with HB violations among the specific NPDWRs. To facilitate discussion and analysis, the EPA has grouped rules into the following six categories: LCR; GWR; RTCR; Stage 1 and Stage 2 DBPRs ("DBPRs"); SWTR, LT1ESWTR, and LT2ESWTR ("Suite of SWTRs"); and IOC, VOC, SOC, Nitrates, Arsenic, and Radionuclides ("Chem/Rad Rules"). The highest percentage of HB violations fall into the DBPRs category (28 percent), followed by the GWR (23 percent) and Chem/Rad Rules (19 percent).

Figure 49. Number of CWSs with HB NPDWR Violations, by Rule Category, 2021 Q3.

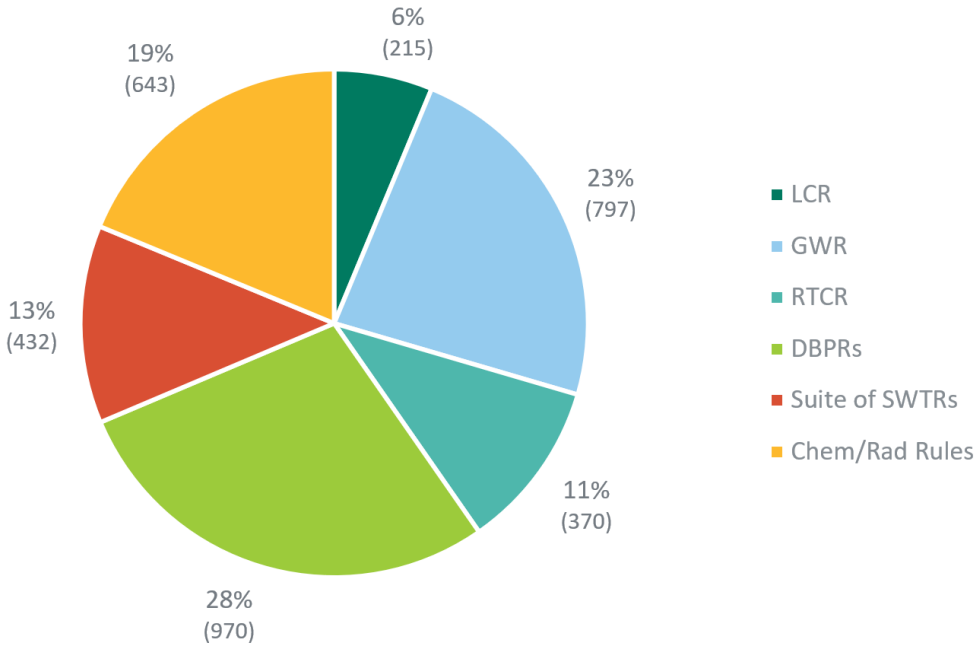
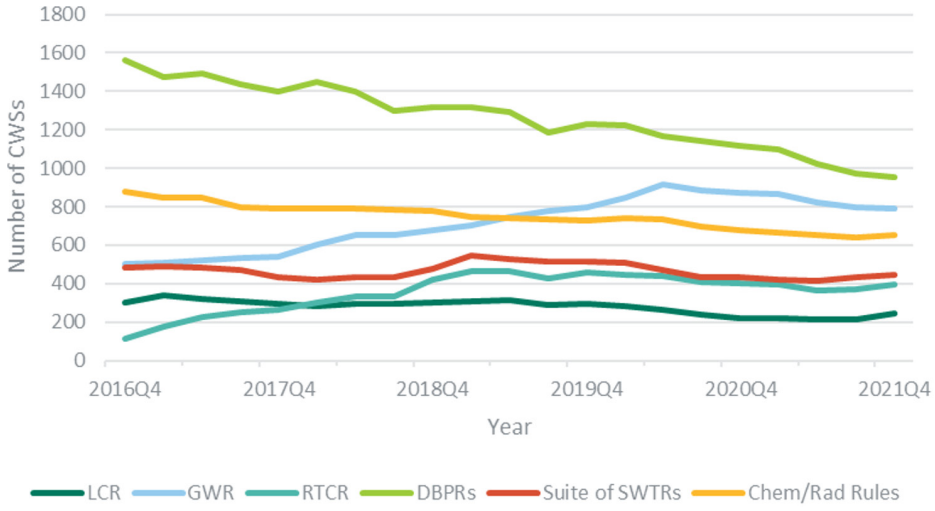


Figure 50 shows the 5-year trend for the number of CWSs with HB violations of each category. Throughout this interval, the number of CWSs in violation of DBPRs was highest, but it declined by 39 percent over the 5-year period. CWSs in violation of Chem/Rad Rules were second-most common during the first half of the 5-year period, but that number declined by 26 percent, such that by the end of the 5-year period, CWSs in violation of the GWR become the second most common rule violated. Systems with LCR violations were relatively rare and decreased by 19 percent. In contrast, this timeframe saw increases in the number of systems in violation of the GWR (58 percent) and/or RTCR (259 percent). Systems in violation of the Suite of SWTRs remained fairly constant throughout the 5-year period.

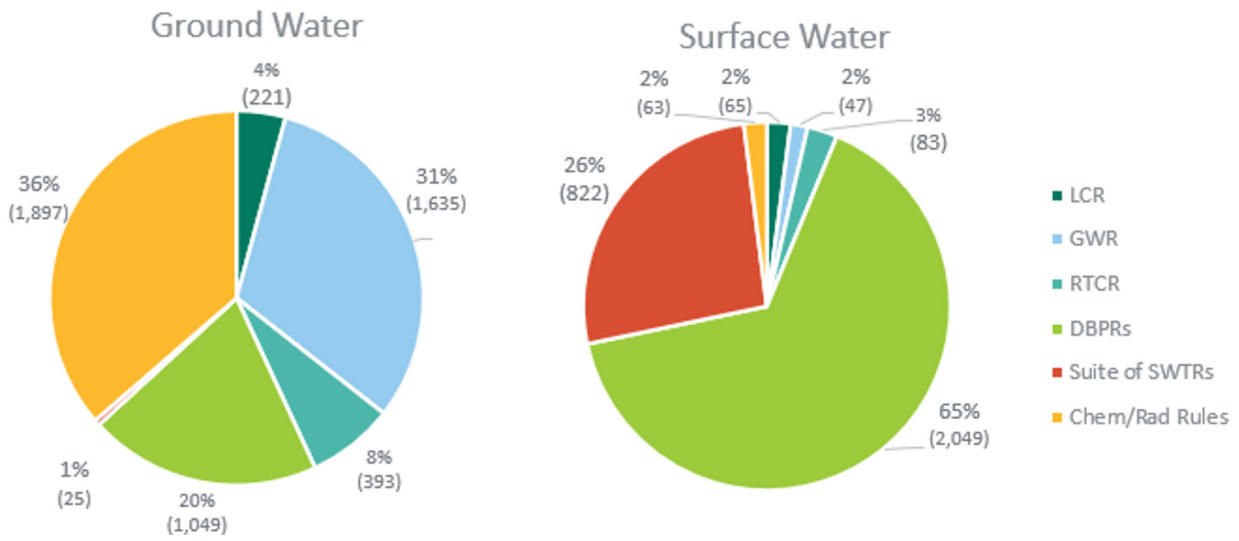
Figure 50. Five-Year Trend of CWSs with HB Violations by Rule Category, FY 2017–FY 2021. Key trends are the decreases in the number of systems in violation of DBPRs (39 percent decrease), Chem/Rad Rules (26 percent decrease), and LCR (19 percent decrease). The number of systems in violation of the GWR and RTCR rules increased. Note: a system may be in violation of more than one rule category..



Rule Violations by Water Source

The distribution of HB violations among rules differs significantly based on the type of source water (Figure 51). Among GW systems with HB violations, roughly 88 percent of these systems are in violation of the Chem/Rad Rules (36.3 percent), GWR (31.3 percent), and the DBPRs (20.1 percent). Only 1 percent are in violation of the Suite of SWTRs. Note, the EPA found 1 percent of GW systems (25 systems) are in violation of the Suite of SWTRs, even though GW systems do not have any requirements under the Suite of SWTRs. As such, these systems may represent systems that have recently changed primary sources or some other misclassification of water source within SDWIS. These CWSs are illustrated in Figure 51 and subsequent figures.

Figure 51. Number of GW Systems and SW Systems with HB Violations by Rule Category, 2021 Q3.



Among SW systems with HB violations, roughly 91 percent of these systems are in violation of DBPRs (65 percent) and/or the Suite of SWTRs (26 percent). Only 9 percent are in violation of the Chem/Rad Rules, LCR, GWR, or RTCR collectively.

Figure 52 shows the 5-year trend of CWSs with a GW source and HB violations, grouped by rule category. At first, the number of GW CWSs in violation of the Chem/Rad Rules was highest, but it declined by 26 percent over the 5-year period, and violation of the GWR rose by 60 percent to become the most common. In comparison, the LCR, DBPRs, and Suite of SWTRs saw a relatively low, steady, slightly declining number of GW CWSs in violation. The RTCR, a new rule introduced prior to this period, saw an increase in violations during the first three years and then a levelling off – a trend historically consistent with other new regulations. The EPA notes that 25 CWSs using GW also violated the SWTRs. There are no requirements for GW systems to comply with under the SWTRs and these systems may represent some misclassification of the water source or systems that have recently switched sources within SDWIS. These CWSs are illustrated in this and subsequent figures.

Figure 52. Number of GW CWSs with HB Violations, FY 2017– FY 2021. Trends during this period show a 26 percent decline in GW CWSs in violation of the Chem/Rad Rules and a 60 percent increase in GW CWSs in violation of GWR.

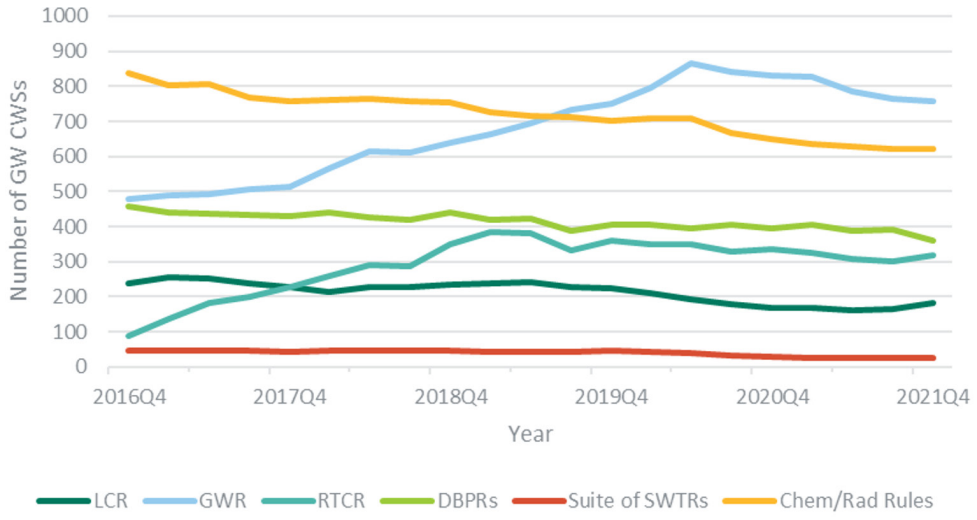
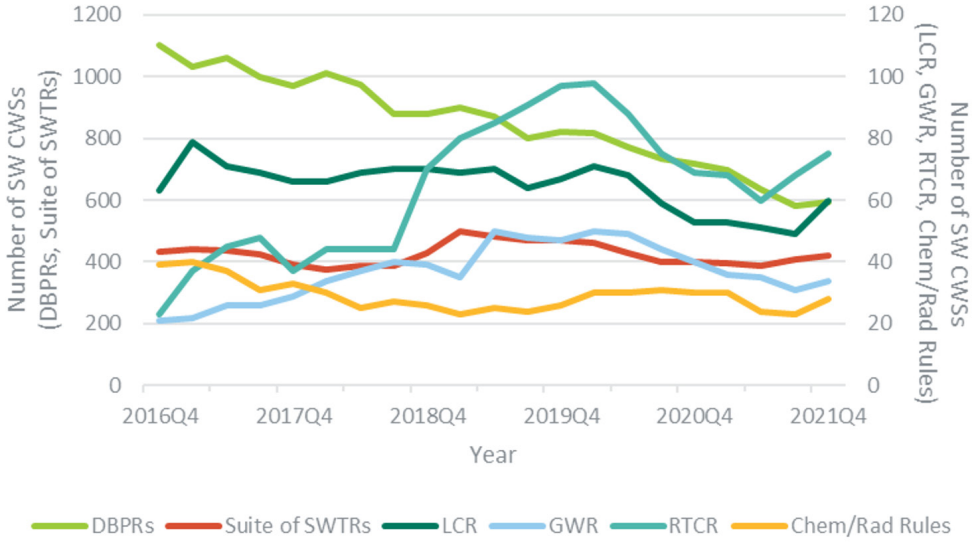


Figure 53 shows the 5-year trend of SW CWSs with HB violations, grouped by rule category. Note that two separate scales are used for the various categories, providing greater visibility of changes for all six categories:

- The primary vertical axis (left) is used for DBPRs and the Suite of SWTRs, which had high numbers of CWSs in violation, on a scale of 0 to 1200.
- The secondary vertical axis (right) is used for all other rule categories, which had significantly fewer CWSs in violation, on a scale of 0 to 120.

SW CWSs in violation of the DBPRs were by far the most common throughout the reporting period, but they declined by 46 percent over the 5-year period. SW CWSs in violation of the RTCR more than doubled in 2018–2019 then leveled off significantly after 2020 Q4. The GWR showed a noticeable increase in number of HB violations to about 2019, and then becomes more variable. Other rules, such as LCR and Chem/Rad Rules have more variable trends during this period. Violations of the GWR showed a similar but less extreme evolution. General declines are visible in the number of SW CWSs in violation of LCR (38 percent) and Chem/Rad Rules (45 percent). The Suite of SWTRs stayed relatively constant.

Figure 53. Number of SW CWSs with HB Violations, FY 2017–2021. A secondary axis is used for all rule categories other than DBPRs and Suite of SWTRs. Trends to note during this period include a roughly 50 percent decline in systems with DBPRs violations.

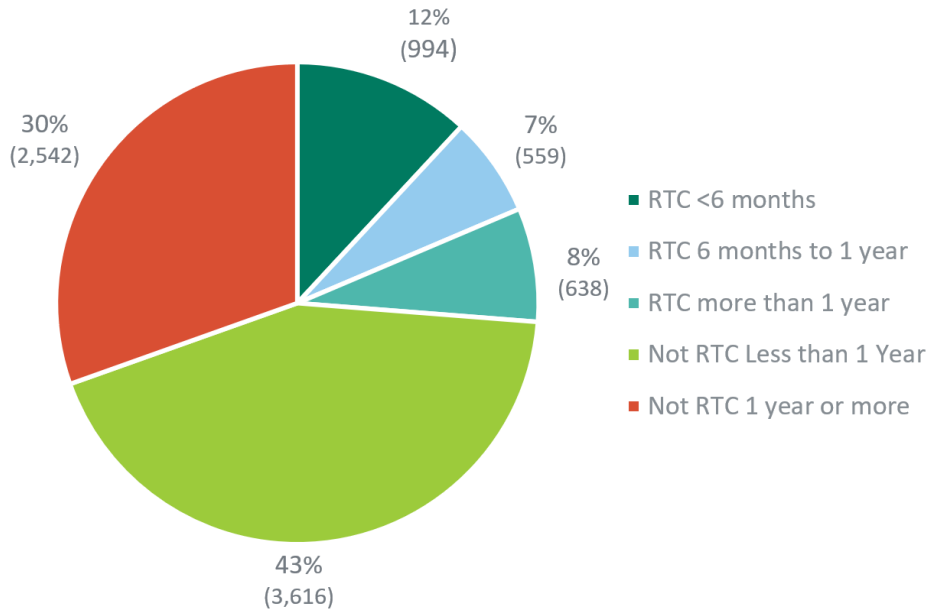


CWS Return to Compliance Evaluation

Typically, Return to Compliance (RTC) means that a CWS has addressed and resolved a violation by completing monitoring, reporting, implementation of treatment, and/or other required activities. A CWS can achieve RTC by compliance assistance, informal enforcement, formal enforcement, or some combination of the three. Formal enforcement includes administrative orders with and without penalty and civil or criminal judicial actions. Informal enforcement includes notices of noncompliance a primacy agency may issue, such as an informal notice of a violation or warning letters. SDWIS Fed includes compliance codes for tracking the dates of violation and RTC, enabling the EPA to calculate the duration of time individual systems were in violation.

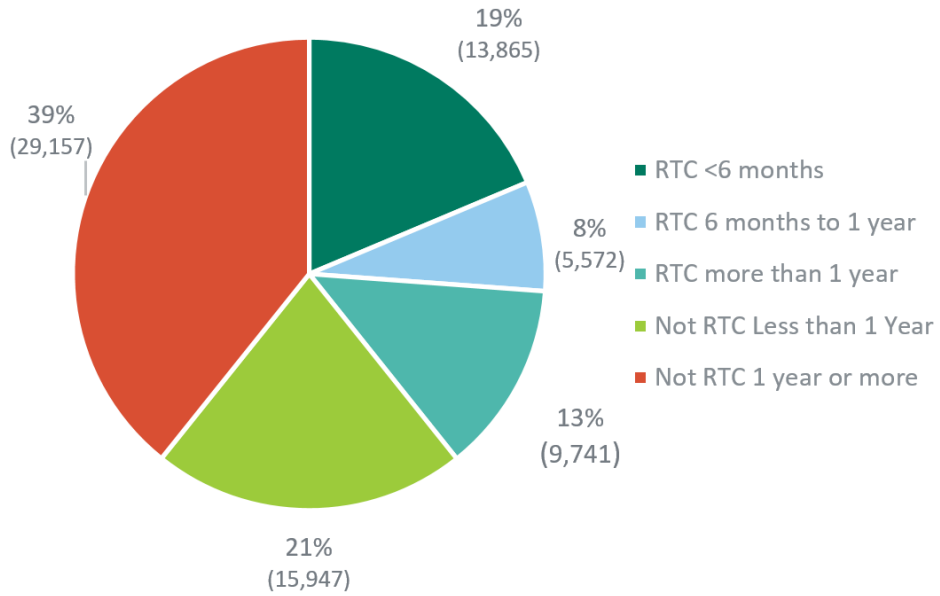
Figure 54 and Figure 55 use the FY 2021 dataset to illustrate the duration of HB and NHB violations remaining open without RTC, and how long RTC tends to take. In this period, only 27 percent of systems with HB violations were RTC: either within one year (19 percent) or within more than a year (8 percent). A majority (73 percent) of HB violations were not RTC at the end of the measurement period: 43 percent of systems were not RTC for less than a year and 30 percent were not RTC for more than a year.

Figure 54. HB Violation RTC Data, 2021 Q3.



Meanwhile, systems with NHB violations were more likely to RTC (Figure 55), but CWSs not RTC tended to remain so for longer periods. Roughly 40 percent of CWSs with NHB violations have RTC: either within one year (27 percent) or within more than a year (13 percent). The other 60 percent of CWSs with NHB violations are not RTC: 39 percent for more than a year, and 21 percent for less than a year.

Figure 55. NHB Violation RTC Data, 2021 Q3.



In late 2009, the EPA introduced a new, more holistic approach for targeting non-compliant water systems for enforcement: the SDWA Enforcement Response Policy (ERP). [28] ERP assists primacy agencies by clarifying when a noncomplying system will be designated a priority for enforcement, and whether resolution is expected by RTC – either via an agreed upon compliance schedule or a formal enforcement action – within two quarters. To aid in identifying CWSs with significant noncompliance, ERP launched the ETT that assigns a point value each quarter to every violation in SDWIS Fed that has not been reported RTC or addressed by formal enforcement. Violations receive one, five, or 10 points depending on the relative seriousness of the violation. This scale mirrors the PN Rule tiers identifying which violations trigger provision of notice required within 12 months (least urgent), 30 days, or 24 hours (most urgent). ETT tabulates an aggregate quarterly score for each noncomplying system, with one additional point assessed for each year the oldest violation at the system has remained uncorrected and unaddressed. Noncomplying CWSs with an ETT violation score

28 EPA Office of Enforcement and Compliance Assurance –Enforcement Response Policy for the Public Water System Supervision (PWSS) Program under the Safe Drinking Water Act and Implementation of (SWA) the Enforcement Targeting Tool, December 8, 2009. https://www.epa.gov/enforcement/enforcement-response-policy-public-water-system-supervision-pwss-program-under-safe

of 11 or higher are serious violators and are designated priorities for enforcement. Once a system reaches priority status, the primacy agency is expected to act within two quarters to return the system's violations to compliance or initiate a formal enforcement action that compels the system's timely RTC. However, regardless of a CWS's status on the ETT, the EPA expects primacy agencies to act immediately on acute HB violations and subsequently confirm that systems with such violations RTC. As the federal oversight agency, the EPA expects primacy agencies to escalate their actions accordingly if a water system continues to be a priority on the ETT or otherwise raises concerns. Further, the EPA understands the formal enforcement action requires the system to RTC, but RTC may not be immediate.

Asset Management Plans

AMPs use detailed asset inventories, life-cycle cost analyses, risk assessments, and financial planning to set priorities and maintain the desired level of customer service in a cost-effective manner. When implemented effectively, AMPs can help PWSs operate more efficiently, make more informed investment decisions, optimize the use of limited financial resources, enhance communication with customers and stakeholders, and meet regulatory requirements.

Federal regulations do not require PWSs to develop or implement AMPs, and primacy agencies are not required to track and report to the EPA whether PWSs are maintaining their AMPs. However, recognizing the benefits of developing and implementing AMPs, Congress amended Section 1420 [29] of the SDWA in 2018 to require state [30] drinking water programs to consider and include, as appropriate, asset management into their Capacity Development Strategies. Specifically, each Capacity Development Strategy should include a description of how the state will:

1. Encourage PWSs to develop AMPs that include best practices for asset management; and
2. Assist, including through the provisions of technical assistance, PWSs in training operators or other relevant and appropriate persons in implementing such AMPs.

In response to this Congressional mandate, the EPA has been working with state drinking water programs to evaluate and update, if needed, their Capacity Development Strategies to address asset management and ensure that methods to identify and prioritize PWSs in need of TMF capacity improvement align with compliance initiatives and current drinking water challenges. The EPA also supports primacy agencies in seeking stakeholder input on updates to Capacity Development Strategies.

Most Capacity Development Strategies include incentives for PWSs to develop and implement AMPs and/or best practices. [31,32] A few primacy agencies have laws or regulations in place requiring PWSs to do so. The following provides examples of incentives that states have introduced to encourage PWSs to develop and implement AMPs and associated best practices:

- Offering PWSs asset management training and technical assistance, including in-person and online trainings, manuals and web-based tools, and on-site technical assistance.
- Incorporating asset management measures to ensure new systems have capacity prior to commencement of operation.

29 The 2018 amendments to Section 1420 of the SDWA are included in America's Water Infrastructure Act (Public Law 115-270, Section 2012, October 23, 2018).

30 Section 1420(c) is part of the DWSRF Capitalization Grant which are available to all PWS in the fifty states and PR. As such, for this section the terms PWS and state are used.

31 EPA, State Asset Management Initiatives, 2019. https://www.epa.gov/sites/default/files/2019-03/documents/asset_management_initiatives_document_508.pdf

32 Primacy agencies often use Drinking Water State Revolving Fund (DWSRF) set-asides to fund asset management strategies (e.g., grants for PWSs to develop AMPs).

- Providing additional priority points [33] when a PWS is seeking DWSRF financing for projects that are identified in an AMP.
- Requiring PWSs to develop AMPs or complete asset management training to receive subsidy funds as a condition of their DWSRF loan or providing additional subsidy to certain PWSs (e.g., disadvantaged communities) that have an AMP.
- Offering grants to develop AMPs or conduct other asset management activities (e.g., develop asset inventories, assess asset condition, and conduct leak detection surveys).
- Requiring PWSs to develop AMPs for assets in projects financed by DWSRFs.

The following provides examples of laws and regulations that primacy agencies have enacted to require PWSs to develop and implement AMPs:

- State of Connecticut's General Statutes §19a-37
  - Connecticut law requires CWSs serving fewer than 1,000 people to complete, and update annually, a fiscal and AMP for all capital assets. The plan must include the following information about each asset: useful life (based on the current condition); maintenance and service history; manufacturer's recommendations; and plan for reconditioning, refurbishment, or replacement. The plan also must provide information regarding the CWS's water losses and efforts to reduce such losses.
- State of Ohio's Revised Code Section 6109.24 and Ohio Administrative Code Chapter 3745-87
  - Ohio laws and regulations required PWSs to implement an asset management program by October 1, 2018, to demonstrate the TMF capability of the system. The program must include: an inventory and evaluation of all PWS assets; operations and maintenance and emergency preparedness and contingency planning programs; criteria and timelines for infrastructure rehabilitation and replacement; approved capacity projects and capital improvement planning; and a long-term funding strategy to implement the asset management program. As part of the asset management program, the regulations also require CWSs and NTNCWSs to report metrics [34] to the Ohio EPA annually to gauge the status of the system. The Ohio EPA encourages PWSs to set goals for these metrics to improve operations and reduce costs over time.
- State of Michigan's Asset Management Requirement (Rule 1606, Administrative Rules for Act 399; 1976 PA 399 as Amended)
  - Michigan's regulation requires all water systems serving more than 1,000 people to complete an AMP to guide spending decisions for repair and replacement of drinking water infrastructure. Each AMP must consider many factors including asset inventory, criticality assessment, service goals, capital improvement plan, and funding structure.

33 State DWSRF Programs use priority points to rank project financing requests according to the program's priorities. Top priorities include projects 1) to address the most serious risks to human health, and 2) that are necessary to ensure compliance. Projects with the highest number of priority points are more likely to receive financing.

34 CWSs and NTNCWSs in Ohio must document and report the metrics: operating ratio, operating cost to produce water per service connection, breaks per ten miles of distribution pipe, non-revenue water, maintenance tasks per year on vertical assets, and one additional customer service metric determined by the PWS.

- State of New Jersey's Water Quality Accountability Act (Public Laws 2017, c. 133 and 2021, c. 262)
  - The goal of New Jersey's Water Quality Accountability Act is to improve the safety, reliability, and administrative oversight of water infrastructure in the state. The Act sets requirements for CWSs with more than 500 service connections in New Jersey to implement an AMP designed to inspect, maintain, repair, and renew its infrastructure consistent with standards established by AWWA. The plans must include water main renewal and water supply and treatment programs, and other provisions (e.g., hydrant testing and valve inspection and exercising). CWSs must also dedicate funds to address priority projects identified in the plan, and update and certify plans and report on progress on a routine basis.

According to research conducted by AWWA's Asset Management Committee, [35] it is challenging to determine the direct impacts of state asset management policies, including those that encourage or require water systems to develop and implement AMPs. Determining these impacts is difficult in part because:

- Affecting change through asset management takes time, and most policies have not been in place long enough to have directly measurable impacts;
- Programs may not be requiring the data collection necessary to assess the impacts of their asset management-related policies; and
- Programs often lack the resources to collect and review information needed to analyze the effectiveness of the policies.

Despite these challenges, asset management policies continue to evolve, and according to AWWA's research, the "breadth of anecdotal evidence supporting the encouragement and requirement to implement some level of asset management is significant."

As asset management policies continue to evolve, the EPA continues to review and update, when appropriate, the materials it makes available to states, PWSs, and other stakeholders concerning best practices for asset management strategies. For example, the EPA recently developed a set of worksheets[36] to guide programs in identifying strengths and weaknesses in their Capacity Development Strategies and ensuring compliance with the SDWA and AWIA requirements, including those related to asset management. Other examples include the EPA's asset management factsheets and workbook materials [37] and an "asset management switchboard," [38] a repository of documentation and tools related to asset management, which the EPA created in partnership with a technical assistance provider.

35 AWWA, Key Data to Inform Government Asset Management Policies, 2019. https://www.awwa.org/Portals/0/AWWA/ETS/Research/KeyDataReport2019.pdf?ver=2019-09-13-133310-377

36 EPA. Capacity Development Worksheets. https://www.epa.gov/sites/default/files/2021-03/documents/final_cap_dev_attachments_1-3_508.pdf

37 EPA. Interactive Tools for Owners and Operators. https://www.epa.gov/dwcapacity/interactive-tools-owners-and-operators

38 Southwest Environmental Finance Center. Asset Management Switchboard. https://swefcamswitchboard.unm.edu/am/

Conclusions

CWSs are vital to the health, safety, and economies of communities throughout the U.S. With the passage of the BIL, Congress asked the EPA to document compliance with SDWA's NPDWRs and to identify characteristics of CWSs that correlate to trends in compliance based on data reported to SDWIS. CWS non-compliance situations vary in terms of scope, scale, severity, and cause. The EPA evaluated both HB and NHB compliance and found the following characteristics:

- Based on data from FY 2021, the majority of CWSs (94 percent) provide drinking water that meets all health-based standards and most systems (69 percent) conduct all of the required monitoring and reporting for the NPDWRs;
- During the five-year period evaluated (FY 2017-FY 2021), there was a general decline in the number of CWSs with HB (15 percent) and NHB (10 percent) violations;
- Communities of color and low-income populations were statistically more likely to receive water from a CWS with a HB violations, approximately 1.3 times; Congress through the BIL has provided increased funding for the DWSRF program with 49 percent of this funding specifically targeted for disadvantaged communities to help reduce this disparity;
- Small systems (1.7 times) and systems located in rural areas (1.6 times) were statistically more likely to have a HB violation. The EPA, through implementing the requirements Congress passed in AWIA, has worked with states to update their capacity development programs to address this challenge and in particular, include as appropriate asset management;
- A small number of CWSs had continuous (1.2 percent of all CWS) or intermittent health-based violations (0.9 percent) over the five-year period evaluated; these systems are a focus for the EPA and are often an enforcement priority;
- The EPA identified that SW systems are most likely to violate SWTRs and DBPRs (91.6 percent of HB violations for SW systems) and GW systems are more likely to violate Chem/Rad and GWR (67.6 percent of GW systems); the EPA has focused on these rules through In-Depth Analyses and targeted trainings on common issues contributing to noncompliance to help states and systems improve compliance.

Importantly, this report includes an Environmental Justice analysis of drinking water system compliance. To help understand if there is a correlation between disadvantaged communities and compliance, the EPA analyzed whether HB/NHB violations are correlated to sociodemographic factors like income, ethnicity, race, and/or location. Except for Asian and Pacific Islanders, which had the lowest NHB violation rates, low-income, racial and ethnic minorities, and rural populations were statistically more likely to receive water from a CWS with a HB or NHB violation, compared to systems that are not low-income, non-Hispanic White, or located in urban areas.

This report focuses on specific compliance and inventory data available in SDWIS Fed (e.g., violation data, system size, water source, and ownership). There are other CWS characteristics that include:

- Age and condition of system,
- Treatment steps/types,
- Managerial and financial status of system,
- Service area boundaries,
- Asset management plan for the system,
- Lead service line presence, and
- Source water characteristics.

These characteristics could contribute to SDWA compliance challenges however, these are not typically available in SDWIS Fed and were not evaluated in this report.

Acronym List

ACS	American Community Survey
AL	Action Level
ALE	Action Level Exceedance
AMP	Asset Management Plan
ARP	American Rescue Plan
AWIA	America's Water Infrastructure Act of 2018
AWWA	American Water Works Association
BG	Block Groups
BIL	Bipartisan Infrastructure Law
CCR	Consumer Confidence Report
CCR Rule	Consumer Confidence Reports Rule
CFR	Code Of Federal Regulations
CI	Confidence Interval
Chem/Rad Rules	Chemical Contaminant Rules/Radionuclides Rule
CMD	Compliance Monitoring Data
CSV	Comma Separated Values
CWS	Community Water System
DBPs	Disinfection Byproducts
DBPRs	Disinfectants And Disinfection Byproducts Rules (Stage 1 and Stage 2)
DWSRF	Drinking Water State Revolving Fund
ECAD	Enforcement And Compliance Assurance Division
ECHO	Enforcement And Compliance History Online Website
EJ	Environmental Justice
EPA	United States Environmental Protection Agency
ERP	Enforcement Response Policy
ETT	Enforcement Targeting Tool
FBRR	Filter Backwash Recycling Rule
FY	Fiscal Year
GW	Ground Water
GWR	Ground Water Rule
GWUDI	Ground Water Under the Direct Influence
HB	Health-Based

Acronym List

HSNC	Historically Significant Non-Complier
IESWTR	Interim Enhanced Surface Water Treatment Rules
IOC	Inorganic Contaminant
LCR	Lead And Copper Rule
LSLR	Lead Service Line Replacement
LT1ESWTR	Long-Term 1 Enhanced Surface Water Treatment Rule
LT2ESWTR	Long-Term 2 Enhanced Surface Water Treatment Rule
M	Monitoring
MCL	Maximum Contaminant Level
MRDL	Maximum Residual Disinfectant Level
NAS	National Academy of Sciences
NECI	National Enforcement And Compliance Initiative
NHB	Non-Health-Based
NPDWR	National Primary Drinking Water Regulation
NTNCWS	Non-Transient Non-Community Water System
O	Other
OECA	Office of Enforcement And Compliance Assurance
OEJECR	Office of Environmental Justice And External Civil Rights
OW	Offices of Water
PN	Public Notice
PN Rule	Public Notification Rule
PWS	Public Water System
PWSID	Public Water System Identification Number
PWSS Program	Public Water System Supervision Program
Q1	First Quarter
Q2	Second Quarter
Q3	Third Quarter
Q4	Fourth Quarter
R	Reporting
RTC	Return To Compliance
RTCR	Revised Total Coliform Rule
SAB	Service Area Boundaries

Acronym List

SDWA	Safe Drinking Water Act
SDWIS Fed	Safe Drinking Water Information System Federal Reporting Service
SDWIS State	Safe Drinking Water Information System State System
SOC	Synthetic Organic Contaminant
SW	Surface Water
SWTR	Surface Water treatment Rule
SWTRs	Suite of Surface Water Treatment Rules
TMF	Technical, Managerial, and Financial
TNCWS	Transient Non-Community Water System
TT	Treatment Technique
TTHM	Total Trihalomethanes
UCMR	Unregulated Contaminant Monitoring Rule
VOC	Volatile Organic Contaminant
ZIP	Zone Improvement Plan

Appendix A – Service Area Demographic Calculation Methodology

Table A 1. Final Table Columns

Column Name	Description	Source
PWSID	Public Water System ID	SDWIS
ZIP Code	5 Digit ZIP Code	SDWIS
GW_or_SW_Code	Ground Water / Surface Water Flag	SDWIS
Primacy_Agency_Code	Two-character postal code	SDWIS
Pop_Cat_5	Population category	SDWIS
PWS_Type	Public Water System Type	SDWIS
EPA_Region	EPA State-Based Regions 1-10	SDWIS
PWS_Name	Public Water System Name	SDWIS
Primacy_Agency	Region/State/Territory Name	SDWIS
Primacy_Type	Primacy Agency Type (Tribal/State/Territory)	SDWIS
Owner_Type	More specific Primacy Owner description	SDWIS
FINAL_PWSID_FLAG	Flag if PWS should be used in analysis	SDWIS calculated
PWS_Source	PWS Source if data is from 'SAs_All_Source_with_ overlap' shapefile	SDWIS
IN_UCMR	IN UCMR flag if data is from 'SAs_All_Source_ with_overlap' shapefile	SAs_All_Source_with_overlap shapefile
IN_STATE	IN STATE flag if data is from 'SAs_All_Source_ with_overlap' shapefile	SAs_All_Source_with_overlap shapefile
SUM_ACSTOTPOP	Sum of intersected block group population by PWS	EJSCREEN block groups
SUM_MINORPOP	Sum of intersected block group minority population by PWS	EJSCREEN block groups
MINORITYPOP_PCT	Percent of intersected block group minority population by PWS	EJSCREEN block groups

Appendix A – Service Area Demographic Calculation Methodology

Table A 1. Final Table Columns

Column Name	Description	Source
SUM_LOWINCOME	Sum of intersected block group low-income population by PWS	EJSCREEN block groups
LOWINCOMEPOP_PCT	Percent of intersected block group low-income population by PWS	EJSCREEN block groups
TOTPOP_ACS	Sum of intersected census tract population by PWS	ACS Census Tracts (Table DP05)
NONHISPWHITEPOP_ACS	Sum of intersected census tract Non-Hispanic White population by PWS	ACS Census Tracts (Table DP05)
NONHISPWHITEPOP_PCT	Percent of intersected census tract Non-Hispanic White population by PWS	ACS Census Tracts
BLACKPOP_ACS	Sum of intersected census tract Non-Hispanic Black population by PWS	ACS Census Tracts
BLACKPOP_PCT	Percent of intersected census tract Non-Hispanic Black population by PWS	ACS Census Tracts
AMINDPOP_ACS	Sum of intersected census tract Non-Hispanic American Indian population by PWS	ACS Census Tracts
AMINDPOP_PCT	Percent of intersected census tract Non-Hispanic American Indian population by PWS	ACS Census Tracts
ASIANPACISLPOP_ACS	Sum of intersected census tract Non-Hispanic Asian Pacific Islander population by PWS	ACS Census Tracts
ASIANPACISLPOP_PCT	Percent of intersected census tract Non-Hispanic Asian Pacific Islander population by PWS	ACS Census Tracts
HISPOP_ACS	Sum of intersected census tract Hispanic population by PWS	ACS Census Tracts
HISPOP_PCT	Percent of intersected census tract Hispanic population by PWS	ACS Census Tracts
SA_TOT_AREA	PWS/ZIP Code Total Area	SAs_All_Source_with_overlap shapefile, ECHO_DFR_SDWA_LARGE_ACTIVE.. shapefile, ZIP Code shapefile
EPA_DATA_FLAG	Flag if service area data comes from 'SAs_All_Source_with_overlap' shapefile	SAs_All_Source_with_overlap shapefile
URBAN_AREA	Total urban area within PWS/ZIP Code Total Area	Census Urban Areas
HB_FLAG	Flag if HB violation found in PWSID	'HB_Violations_Data_Table.xlsx'
NHB_FLAG	Flag if NHB violation found in PWSID	'NHB_Violations_Data_Table.xlsx'

Appendix A – Service Area Demographic Calculation Methodology

Table A 1. Final Table Columns

Column Name	Description	Source
URBAN_AREA_PCT	Percent of service area defined as urban	Census Urban Areas
Population_Served_Count	SDWIS population served count	SDWIS

Table A 2. Data Sources

Data Source	Source Link
EJSCREEN	Source Link
Census Tracts	Source Link filter: geography, All Census Tracts
Urban vs. Rural Classification	Source Link
Service Areas	Client shapefiles: 'SAs_All_Source_with_overlap.shp' and 'ECHO_DFR_SDWA_LARGE_ACTIVE_CWS_EJSCREEN_OVER80_2.shp'
ZIP Codes	Source Link
HB and NHB Violations	'HB_Violations_Data_Table.xlsx', 'NHB_Violations_Data_Table.xlsx'
Census Bureau	Source Link
ACS Ethnicity Data	Source Link Table DP05: ACS DEMOGRAPHIC AND HOUSING ESTIMATES 2015-2019

Table A 3. SABs

Data Source	Small CWSs (<10,000)	Large CWSs (>10,000)	Total Service Areas
OECA Shapefile	23	4,263	4,286
UCMR Shapefile	14,698	42	14,740
SDWIS ZIP Codes	28,510	126	28,636
No Location	44	0	44

Methodology

Preliminary R Script:

R script was created to pull ZIP code and population served count from SDWIS Fed data, and match OECA SABs compilation data for large CWS and UCMR PWSIDs to determine which spatial data would be used in analysis, and which ZIP codes needed to be analyzed via intersected ZIP code.

To recognize matches in the PWSIDs from the shapefile data, the OECA SABs compilation and the UCMR EPA datasets were written into the R script to prioritize the OECA SABs compilation areas when there was a match, and then use the UCMR EPA data for the rest of the service areas. For PWSIDs without spatial data, the PWSID was intersected with the ZIP code(s) to use for spatial analysis. In some cases, more than one PWSID falls within the same ZIP code. In those cases, the EPA assigned the same sociodemographic information to each system for that ZIP code, unless the EPA had spatial data from the OECA SABs compilation or UCMR files and the output demographic data will be the same for all PWSIDs within the same ZIP code. This explains cases where PWSIDs had the same data for intersecting block group (BG) and census tract demographic values. As mentioned in this analysis, while spatial SABs were used when available, the remaining active PWSIDs were calculated using intersecting ZIP code(s).

Python Script:

- 1st threshold method:
  - All BGs with EJ data (total population, minority population, and low-income population) are intersected with Service Areas.
  - Intersecting BGs to each Service Area are **removed** if less than 5 percent of the BG area is intersected, and/or if intersecting area is < 10 sq m.
    - Analysis removes issues with barely or wrongly intersected BGs.
- Since the service areas vary greatly in size, about 10,000 of the 22,000 total service areas get no results through the first threshold of processing.
  - This is to be expected since the small service areas are often in very large rural BGs and are fully intersected by the BG but still make up less than 5 percent of the large BG area.
- 2nd threshold method:
  - The remaining service areas are calculated by finding the BG that has the largest area of overlap with the service area.
- The results from both methods are then combined so that all service areas have the expected total population, minority population, and low-income population values.
- The script then intersects the urban and rural dataset to provide the amount of area that falls within each SAB.

- The script also intersects the service areas with their census tract so specific ethnic group census tract information can be added.

The same methods were run for the census tract data, while swapping the 1st threshold method to 1 percent in order to capture more census tracts that might not have unknown or "null" data.

Final R Script:

The outputs of the python methodology were aggregated within an R script to create the final output table. In this script, HB and NHB data is joined, and urban area is calculated, while ZIP code-based PWSID demographic values are created for PWSIDs within the same ZIP code(s). All these components are reviewed for consistency, aggregated, and exported for the final output table. General Notes:

There was no population ethnicity data available for 44 CWSs due to non-matchable ZIP code data. The original PWSID/ZIP Code from the UCMR service area dataset did not match the 2021 Q3 SDWIS Fed file and thus the ethnicity data could not be calculated properly.

The Census Bureau urban and rural source data only provided the urban and rural area for the tracts. They do not include an urban/rural category. This report defined rural systems (Figure 14) as systems where the urban percentage was less than 100 percent of the service population. Future analysis may use another threshold.

To confirm accurate matching between demographic data and service areas, the EPA evaluated the sociodemographic variables for all systems in the CWS inventory – serving a large majority of the U.S population – and compared these variables to the United States population from ACS (Tables A 4 through A 6). The percentage makeup of the CWS inventory and United States demographic data by income level (Table A 4) is similar to that of the overall CWS population, with differences of 0.38 percent for both low-income and not low-income populations. The CWS inventory and United States demographic percentages for the five race/ethnicity categories (Table A 5) are similar, as the percent differences among the five race/ethnicity groups range from 0.03 percent to 1.20 percent. The CWS inventory and United States demographic percentages by location (Table A 6) are also similar, with differences of 2.32 percent for rural populations and 3.36 percent for urban populations. Due to the nature of the dataset used for this report, it is likely that the rural and urban percentages are not fully representative.

Table A 4. CWS Inventory and United States Demographic Data by Income Level.

	Low-income	Not Low-income	All Income Levels
CWS Population Served	91,752,381	221,772,411	313,524,792 [39]
Percent Population Served	29.26	70.74	100.00
United States Population	97,225,877	230,790,365	328,016,242
Percent United States Demographic Data	29.64	70.36	100.00
Percent Difference	0.38	0.38	0.00

Table A 5. CWS Inventory and United States Demographic Data for Race/Ethnicity Categories. [40]

	American Indian or Alaska Native	Asian and Pacific Islander	Black	Hispanic	White	All Ethnicities
CWS Population Served	2,165,398	17,086,586	40,628,851	60,592,464	184,655,446	313,524,792
Percent Population Served	0.69	5.45	12.96	19.33	58.90	100.00
United States Population	2,160,496	18,251,837	39,980,733	61,755,289	197,132,096	328,016,242
Percent United States Demographic Data	0.66	5.56	12.19	18.83	60.10	100.00
Percent Difference	0.03	-0.11	0.77	0.50	-1.20	0.00

39 This population differs from the total CWS population described in the Executive Summary due to limitations of the CWSs that were accessible to analyze in the EJ analysis.

40 Race/Ethnicity individual category populations served does not equal the total CWS population served as all PWSID SDWIS Fed population counts were able to be summed, but not all PWSIDs had quantifiable race/ethnicity populations.

Table A 6. CWS Inventory and United States Demographic Data for Rural/Urban Location.[41]

	Rural	Urban	All Locations
CWS Population Served	70,633,524	242,891,268	313,524,792
Percent Population Served	22.53	77.47	100.00
United States Population	66,300,254	265,149,027	328,016,242[42]
Percent United States Demographic Data	20.21	80.83	100.00
Percent Difference	2.32	3.36	0.00

Sociodemographic CWS Inventory Compared to the United States Population Methodology:

Table A 4 (Low-Income)

Low-income populations were calculated using the EJScreen low-income indicator defined as "the percent population in households where the household income is less than or equal to twice the federal poverty level" and grouped at the BG level. The percentage of low-income CWS population served relates closely to the United States population breakdown; however, the overall lower population reflects the portion of United States population not served by CWSs.

Table A 5 (Race/Ethnicity)

Race and ethnicity data are from the ACS, which provides the data by census tract. The EPA assigned tracts to each service area. Due to the nature of race/ethnicity groupings provided by ACS, the analysis divides the population into the following groups:

- Hispanic or Latino of any race
- Non-Hispanic White
- Non-Hispanic Black

41 Note: Table A 6 is a representation of service areas where rural definition is defined as spatially covered by 20 percent or less urban area, and the remaining service areas are defined as urban. The 20 percent threshold was used to provide a more accurate estimation of the urban and rural population split compared to the raw data analysis.

42 Note: Table A 6' Total United States Population value is from the Census ACS 2015-2019 data while the individual Rural and Urban United States Populations were derived from the 2010 Census data.

- Non-Hispanic American Indian and Alaska Native
- Non-Hispanic Asian and Native Hawaiian and Other Pacific Islander

Asian populations and Pacific Islander populations were separate within the ACS data but combined within this report as one category (Asian and Pacific Islanders).

There are further groupings provided by ACS for “some other race alone” and “two or more races” that do not fit into the aforementioned categories. The population for these groupings is 8,735,791people (approximately 3 percent of total). Utilizing the groupings in this fashion allows for no double counting of any of the population groupings but does not account for this population. The population in each of the five categories is divided by the total population, excluding this group. This assures that the total population in each service area is assigned to one of these five race/ethnicity categories. This implicitly distributes the “some other race alone” and “two or more races” proportionally among the other categories. Additional data about the race and ethnicity of these people would be needed to assign them to the existing race/ethnic groups. Another alternative is to add a sixth race/ethnic group to include these people.

Table A 6 (Urban/Rural)

The source dataset for urban and rural areas included polygons for urban areas, all other areas are considered rural. These data were intersected with the service areas to determine the area percentage of each service area that is urban and rural. The EPA found that a threshold of 20 percent of the service area being classified as urban provided an accurate estimation of the urban and rural population nationally. These results are presented above. The EPA also considered classifying CWSs as entirely urban, a mix of urban/rural or rural as shown in Figure A 1.

Figure A 1. Percent of CWSs, by Location (urban, rural, urban/rural), with HB and NHB violations, 2010 Urban and Rural Census Data.