REPORT OF THE OFFICE OF DRINKING WATER OF THE VIRGINIA DEPARTMENT OF HEALTH

A Study on Virginia's Drinking Water Infrastructure and Oversight of the Drinking Water Program (HJR 92, 2020)

TO THE GOVERNOR AND THE GENERAL ASSEMBLY OF VIRGINIA

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A Study on Virginia's Drinking Water Infrastructure and Oversight of the Drinking Water Program

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VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment
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Office of Drinking Water
Safe Drinking Water for a Healthy Virginia

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Executive Summary

The Virginia Department of Health (VDH), Office of Drinking Water (ODW) protects public health through its oversight of Virginia's drinking water program. ODW regulates 2,811 waterworks in the Commonwealth of Virginia, collectively serving approximately 7.5 million consumers--about 89% of the Commonwealth's total population. The drinking water program is vital. Safe and adequate drinking water directly influences community health and economic prosperity. Businesses use drinking water every day for processing, cooling, and product manufacturing. New businesses need drinking water to serve communities. Although Virginia's drinking water is among the safest and most reliable in the world, several case studies offered in this report serve as reminders of the importance of capital improvements and asset management to address aging infrastructure.

ODW collaborates with owners, operators, and stakeholders to protect public health and the environment. ODW ensures compliance with applicable laws and regulations by conducting sanitary surveys and inspections; providing training and technical assistance; issuing permits and plan approvals; tracking compliance monitoring; managing data and information; training licensed operators; and where appropriate, taking enforcement actions and offering low interest loans. Virginia's drinking water program protects public health from "source to tap" by assessing the vulnerability of water sources and preparing communities for resilient response to natural and manmade hazards. ODW's program has high compliance rates with water quality standards. Core metrics for the program include the percent of waterworks with an unresolved health-based violation (less than 2%), the percent of waterworks that sample on time (better than 98%), and the percent of waterworks inspected on time (over 99%).

Climate change can impact availability of water and water quality in Virginia. More intense weather can cause more severe droughts or worsening run-off, both adversely affecting water quality and quantity. Good water infrastructure and planning creates resilience to combat the effects of climate change and ensure public health and safety. Old and unmaintained water infrastructure leaks can allow contaminants to enter the drinking water supply with weak pressure. Significant leaks also reduce revenues and unnecessarily deplete aquifers and surface water sources affected by climate change.

During the SARS-CoV-2 pandemic, ODW actively monitored and helped waterworks, focusing on community waterworks. ODW encouraged and promoted water shut-off moratoriums to ensure citizens had access to drinking water, essential in the pandemic fight to keep surfaces clean and for personal hygiene. ODW also established guidance to ensure essential staff, such as licensed operators and maintenance workers, were available and had sufficient policies in place to protect drinking water. ODW worked with stakeholders to ensure minimal impacts to waterworks during the pandemic. The pandemic highlighted the critical importance of the drinking water program's sustainability and resiliency.

In 2015, EPA estimated Virginia had an $8.135 billion need over the next 20 years at its 1,100 community waterworks, which represented an 8% increase from EPA's last assessment in 2011. EPA's assessment suggests Virginia has a $407 million annual average of water infrastructure need. EPA is currently updating its 2015 needs assessment. One tool Virginia has to address infrastructure need is the Drinking Water State Revolving Fund (DWSRF), a federal grant program that funds construction projects at waterworks. Virginia must provide a 20% match, and combined with interest and principal repayments, ODW can offer about $22.5 million per year to support waterworks infrastructure funding in small and disadvantaged communities. ODW offers construction loans below private market rates and can oftentimes provide funding when a small or disadvantaged community cannot get funding in the

private marketplace. In addition, research shows that each $1 of DWSRF investment in water infrastructure provides almost $3 in economic benefit. Adding one job in the water sector creates an estimated 3.68 jobs in the local economy to support that job.[1] Non-economic benefits include public confidence in the drinking water supply and safety, which promotes health and financial stability as citizens look for options other than sugary beverages and more expensive bottled water.

Lead in drinking water is a risk to public health. There is no safe level of lead consumption. Several communities in Virginia receive DWSRF benefits through the lead service line replacement (LSLR) program. ODW has awarded $3.69 million for eight projects in four localities over the past several years using DWSRF funding. Alexandria, Henry County, Richmond, and Chesapeake all received help to replace lead service lines. Other communities are also seeking help with LSLR, but there is limited federal funding and no dedicated state funding to more proactively remove lead service lines.

The Public Water System Supervision (PWSS) program, funded by another federal grant, provides about $2.1 million in funding each year, with a 25% state match. The PWSS grant primarily funds staffing needs to oversee waterworks. Operation fees that community and nontransient noncommunity waterworks pay annually provide approximately $4.8 million per year in additional support to program. Over the past three years, the drinking water program's operating budget has remained flat while expenses have increased, creating a funding need for the program.

More funding would ensure a robust program in Virginia. As of October 2020, ODW had two vacancies. ODW currently has 119 full time employees (including two vacancies) budgeted for FY 2021. ODW estimates it needs more funding for operations to implement core federal grant programs to maintain primacy. However, because of funding concerns, ODW has instituted a hiring freeze on critical positions. The DWSRF grant allows up to 32% of funding to go towards "set-aside" programs. These set-asides provide significant funding for ODW programs. With the PWSS and operation fee funding flat over several years,[2] ODW has increasingly relied on the set-aside funds under the DWSRF to support staff positions and operations.

Lead sampling and legionella in schools, harmful algal blooms, injection of highly treated wastewater into drinking water aquifers, per- and polyfluoroalkyl substances (PFAS), and various responses for coal ash disposal and planned natural gas pipelines stress limited resources required to operate the drinking water program. Emerging contaminants and unregulated contaminants also remain a public health concern and increasing resource needs. The 2020 Virginia General Assembly session resulted in more work directed to ODW to address lead in drinking water at schools and child day programs (SB392, SB393, HB797, and HB799), PFAS (HB586 and HB1257), and legionella at schools (SB410). ODW anticipates more non-regulatory and regulated activities requiring more resources. For example, the U.S. Environmental Protection Agency expects to issue lead and copper rule revisions (LCRR) soon. Due to the complexity of the proposed LCRR, ODW estimates it will likely require 12 more full-time employees (FTEs) to properly implement, but no additional funding is provided for this need.

[1] The U.S. Conference of Mayors. Local Government Investment in Municipal Water and Sewer Infrastructure: Adding Value to the National Economy. Richard A. Krop, Ph.D., Charles Hernick, and Christopher Frantz. The Cadmus Group, Inc. August 14, 2008. See also the 2017 Drinking Water State Revolving Fund Eligibility Handbook. EPA, June 2017.

[2] Operation fees are capped at $3.00 per service connection, not to exceed $160,000 per year, by Code of Virginia § 32.1-171.1 and the Budget Bill.

Eight waterworks had lead action level exceedances during 2019. As of the first quarter of 2020, 33 active waterworks had LCR monitoring/reporting violations and four had LCR treatment technique violations. With lower action levels in the LCRR, ODW expects the number of waterworks with lead violations to increase.

ODW has undertaken several initiatives since 2017 to improve business process and efficiency. ODW requires laboratories to submit sampling results electronically through the EPA's Compliance Monitoring Data Portal (CMDP). Requiring data submission through CMDP reduces errors, improves data quality, and allows ODW to focus on higher priority needs. Next, ODW is on-boarding new software to remove old, unsecure databases and allow staff to perform inspections with tablets that automatically upload and share results in real time.

Finally, ODW reworked some staff duties to create a compliance specialist position in each field office and a compliance coordinator in the central office. With one position in each field office focused on compliance issues, central office staff worked with field directors and compliance specialists to implement several new policies and procedures to reduce the number of waterworks that EPA classified as "serious violators" because of ongoing non-compliance (generally related for a failure to monitor). ODW revised its Enforcement Manual to reflect the new roles and approach. During 2019, VDH issued 1,250 NOAVs, 80 warning letters, and one Special Order. In the past five years (2015-2019), the number of community waterworks with health-based violations has continued to decline. As of August 2020, only 1.8%, or 20 community waterworks had health-based violations. Serious violators decreased from 30 in 2019 to 11 in 2020.

The Office of the State Inspector General (OSIG) is performing a programmatic review of Virginia's drinking water program to determine whether ODW effectively monitors waterworks in Virginia. OSIG's interim report and recommendations are found in Section VI. Agency recommendations are found in Section V.

Definitions

"Action level" means the concentration of lead or copper in water specified in 12VAC5-590-385, which determines, in some cases, the treatment requirements contained in 12VAC5-590-405 that an owner is required to complete.

"Community waterworks" means a waterworks that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

"Consumer" means any person who drinks or uses water from a waterworks for human consumption.

"Level 1 assessment" means an evaluation to identify the possible presence of sanitary defects, defects in distribution system coliform monitoring practices, and, when possible, the likely reason that the waterworks triggered the assessment.

"Level 2 assessment" means an evaluation to identify the possible presence of sanitary defects, defects in distribution system coliform monitoring practices, and, when possible, the likely reason that the waterworks triggered the assessment in a more comprehensive investigation than a Level 1 assessment.

"Maximum contaminant level" or "MCL" means the maximum permissible level of a contaminant in pure water that is delivered to any user of a waterworks. MCLs are set as close to EPA's maximum contaminant level goals as feasible using the best available treatment technology. MCLs may be either

"primary" (PMCL), meaning based on health considerations, or "secondary" (SMCL) meaning based on aesthetic considerations.

"Nontransient noncommunity waterworks" or "NTNC" means a waterworks that is not a community waterworks and that regularly serves at least 25 of the same persons over six months out of the year. Schools, factories, and long-term health care facilities that operate their own waterworks are examples of NTNC waterworks.

"Service connection" means the point of delivery of water to a customer's building service line as follows:

1. If a meter is installed, the service connection is the downstream side of the meter;

2. If a meter is not installed, the service connection is the point of connection to the waterworks;

3. When the waterworks owner is also the building owner, the service connection is the entry point to the building.

"Small waterworks" means a waterworks that serves 3,300 persons or fewer.

"Transient noncommunity waterworks" or "TNC" means a noncommunity waterworks that is not a nontransient noncommunity waterworks. A TNC serves at least 25 persons daily for at least 60 days out of the year. Restaurants, campgrounds, and marinas that operate their own waterworks are examples of TNC waterworks.

"Very small waterworks" means a waterworks that serves 1,000 persons or fewer.

"Waterworks" means a system that serves piped water for human consumption to at least 15 service connections or 25 or more individuals for at least 60 days out of the year and includes all structures, equipment, and appurtenances used in the storage, collection, purification, treatment, and distribution of pure water except the piping and fixtures inside the building where such water is delivered.

Acronyms

AL	Action level
AMP	Asset Management Plan
AWIA	America's Water Infrastructure Act
BSSP	Bacteriological Sample Siting Plans
CFR	Code of Federal Regulations
CIP	Capital Improvement Plan
CDBG	Community Development Block Grant
CMDP	Compliance Monitoring Data Portal
CWDF	Coalfield Water Development Fund
DWINSA	Drinking Water Infrastructure Needs Survey and Assessment
DWSRF	Drinking Water State Revolving Fund
EMMA	Electronic Municipal Marketing Access
EPA	U.S. Environmental Protection Agency
ETT	Enforcement Targeting Tool
FCAP	Financial & Construction Assistance Program
FOIA	Freedom of Information Act
FY	Fiscal year
GIS	Geographic Information Systems

HUD	Housing and Urban Development
IUP	Intended Use Plan
LCR/LCRR	Lead and Copper Rule / Lead and Copper Rule Revisions
LSL	Lead service lines
LSLR	Lead Service Line Replacement (Program)
MCL	Maximum contaminant level
mg/l	Milligrams per liter (which are equivalent to parts per billion)
NOAV	Notice of Alleged Violation
NPDWR	National Primary Drinking Water Regulations, 40 CFR Part 141
NTNC	Nontransient Noncommunity Waterworks
ODW	Office of Drinking Water
OSIG	Office of the State Inspector General
PMCL	Primary maximum contaminant level
PFAS	Per and Polyfluoroalkyl substances
ppb	Parts per billion (which are equivalent to milligrams per liter)
PWSS	Public Water System Supervision
PWSL	Public Water Supply Law, Code of Virginia §§ 32.1-167 through 32.1-176
RTCR	Revised Total Coliform Rule
SDWA	Safe Drinking Water Act, 42 U.S.C. § 300f et seq.
SDWIS	Safe Drinking Water Information System
SERCAP	Southeast Rural Community Assistance Project
SWAP	Source Water Assessment Program
SWPP	Source Water Protection Program
TMF	Technical, managerial and financial
TNC	Transient Noncommunity Waterworks
VAC	Virginia Administrative Code
VDH	Virginia Department of Health
VPFP	Virginia Pooled Financing Program
VRWA	Virginia Rural Water Association
VRA	Virginia Resources Authority
WEP	Rural Utilities Service Water and Environmental Programs
WIFIA	Water Infrastructure Finance and Innovation Act

I. Purpose of Study

ODW prepared this report in response to House Joint Resolution No. 92 (HJ92), which Delegate Lopez sponsored during the 2020 General Assembly session. The bill text is as follows:

HOUSE JOINT RESOLUTION NO. 92
Agreed to by the House of Delegates, February 10, 2020
Agreed to by the Senate, February 25, 2020

Requesting the Office of Drinking Water of the Department of Health to study the Commonwealth's drinking water infrastructure and oversight of the drinking water program. Report.

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Patron—Lopez

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WHEREAS, the Office of Drinking Water of the Department of Health is responsible for protecting the public health by ensuring that all people in the Commonwealth have access to an adequate supply of clean, safe drinking water that meets federal and state drinking water standards; and

WHEREAS, the National Primary Drinking Water Regulations and state Public Water Supplies Law 14 (§ 32.1-167 et seq. of the Code of Virginia) and state regulations governing waterworks and waterworks operators set out standards for drinking water quality, drinking water infrastructure, and oversight of the drinking water program; and

WHEREAS, problems or issues with the existing drinking water infrastructure or oversight of the drinking water program may result in an increased risk of contamination of drinking water with lead, copper, and other substances or organisms; and

WHEREAS, contamination of drinking water may have serious negative effects on the health and well-being of residents of the Commonwealth; now, therefore, be it

RESOLVED by the House of Delegates, the Senate concurring, That the Office of Drinking Water of the Department of Health be requested to study the Commonwealth's drinking water infrastructure and oversight of the drinking water program.

In conducting its study, the Office of Drinking Water of the Department of Health shall (i) evaluate the existing drinking water program infrastructure and oversight of the drinking water program to identify problems or issues that may result in contamination of drinking water with lead or copper or other substances or organisms or increase the likelihood of contamination of drinking water with lead or copper or other substances or organisms and (ii) develop recommendations for addressing such problems or issues.

All agencies of the Commonwealth shall provide assistance to the Office of Drinking Water of the Department of Health for this study, upon request.

The Office of Drinking Water of the Department of Health shall complete its meetings by November 30, 2020, and shall submit to the Governor and the General Assembly an executive summary and a report of its findings and recommendations for publication as a House or Senate document. The executive summary and report shall be submitted as provided in the procedures of the Division of Legislative Automated Systems for the processing of legislative documents and reports no later than the first day of the 2021 Regular Session of the General Assembly and shall be posted on the General Assembly's website.

ODW compiled data on Virginia waterworks and reports from professional organizations, the federal government, and academia to develop this report. Staff presented a working draft to the Waterworks Advisory Committee, a stakeholder group established through Virginia's Waterworks Regulations,[3] to

[3] See 12VAC5-590-40 (5).

receive their input and recommendations on the draft report. ODW also worked with OSIG regarding its review of program activities.

II. Oversight of Drinking Water Program

The Public Water Supplies law (PWSL) authorizes the Board of Health to supervise and control all water supplies and waterworks in the Commonwealth insofar as the bacteriological, chemical, radiological, and physical quality of waters furnished for human consumption may affect public health and welfare.[4] Enacted in 1950, the PWSL is broader than the Safe Drinking Water Act (SDWA) in that it authorizes the Virginia Department of Health (VDH) to regulate not just drinking water standards and treatment practices, but also waterworks construction, operation, and maintenance, permitting, enforcement, and receivership.

Congress passed the SDWA in 1974, which authorized EPA to promulgate the National Primary Drinking Water Regulations (NPDWR). The NPDWR set forth uniform, nationwide standards for drinking water to protect the public against adverse health effects from exposure to naturally occurring and man-made contaminants. Congress amended and reauthorized the SDWA in 1986, 1996, 2005, 2015, 2016, and 2018. The 1986 amendments directed EPA to establish standards for 83 additional contaminants and to incorporate filtration at surface water treatment plants. The 1996 amendments focused on risk-based decision-making, sound science, transparency, consumer education and awareness.

In addition to setting drinking water standards and treatment techniques, the SDWA also allows EPA to award states with primacy (i.e., primary responsibility for implementing the federal program). To maintain primacy, Virginia promulgated the Waterworks Regulations, which may be no less stringent than the federal requirements in the SDWA and NPDWR. Through primacy, VDH oversees monitoring and reporting requirements, routine operations, plans for construction and modification, sanitary surveys, training and technical assistance, and enforcement of drinking water standards. VDH has been the primacy agency for the federal law and regulations since 1977.

If a waterworks violates a water quality standard or other requirement, then VDH's priority is to work with the waterworks to address the issue and return to compliance. VDH issues notices of alleged violation to inform the waterworks of the regulatory requirement not met and what the waterworks must do to return to compliance. If the waterworks is either unwilling or unable to address the violation in a timely and appropriate manner, then enforcement may be necessary. Enforcement can include informal letters and meetings, or formal administrative orders requiring compliance actions. Enforcement also works with the Financial and Construction Assistance Program (FCAP) and Capacity Development to identify resources and provide technical, managerial and financial (TMF) capacity assistance to waterworks. Waterworks with health-based violations are reported to the EPA, the Enforcement Targeting Tool, which weighs violations based on the history of noncompliance and the potential for harm to human health.

The PWSL also authorizes the State Health Commissioner to issue an emergency order to protect public health from imminent dangers. In most cases, emergency responses are left up the waterworks owners and operators that are most familiar with the waterworks' design and operation, condition of infrastructure, system capabilities, and governing resources. ODW typically provides a supporting role by providing technical assistance, information to various entities and waterworks, and other compliance

[4] See Code of Virginia § 32.1-167, et seq.

assistance as needed. Most incidents involve water main breaks, equipment failures, pressure loss, or boil water notices.

a. ODW Management and Organizational Structure

VDH is the primacy agency for implementing the SDWA in the Commonwealth of Virginia. Within VDH, the Office of Drinking Water (ODW) is responsible for implementing the drinking water program. ODW has six regional field offices and a central office to support field office activities. The Office Director oversees the Divisions of Compliance and Enforcement; Policy and Program Guidance; Capacity Development, Training and Outreach; Financial and Construction Assistance Program; Emergency Preparedness and Security; and business management working through VDH's Shared Business Services.

Reporting to the Office Director, the Deputy Office Director supervises six field offices and the Division of Technical Services, which includes oversight of the sanitary survey and permit programs, data management, source water protection, and laboratory coordination. In 2019, following the suggestion of an organizational study by Virginia Commonwealth University's Performance Management Group, ODW converted a support office into a sixth field office, the Richmond Field Office. ODW redrew boundaries and rebalanced workload among the six field offices in 2020. Field offices work directly with waterworks owners, operators, and consultants to review construction plans, draft and issue permits, inspect waterworks for compliance, and provide technical and operational assistance. They also evaluate monthly and quarterly operation reports to ensure waterworks are providing adequate water quality and quantity, flag potential compliance issues, and help waterworks return to compliance when there are monitoring, reporting, or other alleged violations of the Waterworks Regulations. ODW's central office in Richmond supports the field offices through following core programs:

Technical Services

The Division of Technical Services oversees the sanitary survey program, including monitoring sanitary survey metrics, schedule attainment, completion of the eight elements of a sanitary survey[5], development of program documents, revisions to the program, record keeping, and reporting to EPA. VDH considers sanitary surveys as a cornerstone of the drinking water program to ensure safe, adequate, and reliable supply of drinking water that meets both state and federal drinking water standards.

A sanitary survey is a review of a public water system to assess its capability to supply safe drinking water. Sanitary surveys provide an opportunity for ODW to visit the waterworks and educate the operator about proper monitoring and sampling procedures and provide other technical assistance. Sanitary surveys are a proactive public health measure and an important component of the SDWA and PWSS grant. Over the years, VDH has maintained a strong sanitary survey program with surveys conducted more frequently than the federal requirement.

The PWSL and Waterworks Regulations require a permit from the State Health Commissioner to construct or operate any waterworks. The Commissioner has delegated this authority to ODW to issue permits. The Division of Technical Services oversees the statewide project review program and operation

[5] 12VAC5-590-350. A sanitary survey includes an evaluation of all of the following eight components: source; treatment; distribution system; finished water storage; pumps, pumping facilities, and controls; monitoring, reporting, data verification, and a special monitoring evaluation during each sanitary survey to determine whether the waterworks monitoring is appropriate or needs modification; waterworks management and operation; and number and classification of licensed operator(s).

permit program, including developing program documents, guidance documents, recordkeeping, related training, and ongoing quality control.

Field staff review project documentation, including plans, specifications, engineer reports, and other construction data to confirm that the proposed construction will comply with the design requirements established in the Waterworks Regulations. Following a satisfactory review, ODW issues waterworks construction permits to waterworks to complete upgrades and modifications. When construction is complete, ODW inspects the work, evaluates water quality, and, following approval, issues operation permits. ODW may issue a temporary permit if the waterworks does not fully comply with the Waterworks Regulations, but the conditions do not jeopardize public health.[6] A temporary permit will contain conditions required to achieve compliance and a specific time to achieve compliance.

Field staff provide technical assistance to waterworks owners, operators, consultants and the public on a variety of drinking water topics during sanitary surveys, preliminary engineering conferences, training events, and calls or meetings. Technical assistance is a critical part of ODW's efforts to help waterworks achieve and maintain compliance with the regulations. The Division of Technical Services develops guidelines, policies, and standards for field staff to provide technical assistance.

Source water programs include the Source Water Assessment Program (SWAP), the Source Water Protection Program (SWPP), and the Interagency Project and Permit Review (IPPR) program. The SWAP facilitates and promotes source water protection measures among the waterworks community. ODW delineates an assessment area for each drinking water source and creates an inventory of potential sources of contamination using Geographic Information Systems (GIS). ODW uses this information to make a susceptibility determination of the drinking water source in relation to the potential source of contaminants found in the assessment area. The 1996 Amendments to the SDWA require ODW to develop a SWAP that will delineate the boundaries of assessment areas, identify contaminants, determine source susceptibility, and make these results available to the public.

The SWPP protects the quality of drinking water sources by preventing and reducing contamination. This is one of the best approaches to ensuring the sustainability of Virginia's drinking water supply. ODW provides resources to help fund local protection activities, such as wellhead protection programs for ground water and watershed management programs for surface waters. ODW encourages waterworks to add source water protection as part of a multi-barrier approach to providing safe drinking water.

The IPPR helps sister agencies and federal environmental reviews of large projects, including road projects and other development. Staff works with local health districts and other offices within the agency to collate comments and offer advice on possible concerns related to environmental health, epidemiology risks, and drinking water concerns.

VDH keeps an inventory of waterworks and reporting requirements. The Data Management team maintains the data systems and reporting requirements. The SDWA requires Virginia to maintain records of tests, measurements, analyses, decisions, and determinations performed on each waterworks. Virginia reports quarterly information about waterworks and violations to EPA. ODW has collaborated with

[6] See Code of Virginia § 32.1-172 E. Whenever application shall be made to the Commissioner for a permit, he shall examine the application and, as soon as practicable thereafter, shall issue the permit if, in his judgment, the proposed waterworks will furnish pure water. If the proposed waterworks is not in compliance with all regulations of the Board but, in the opinion of the Commissioner, the public health will not be jeopardized, the Commissioner may issue a temporary permit for such period of time and subject to such conditions as the Commissioner may deem appropriate for the owner to achieve compliance with such regulations.

certified laboratories, serving as waterworks owners' authorized agents, to receive analysis results in electronic format through CMDP for direct upload into the required databases. Data requires quality checks and corrections. In addition to maintaining the integrity of the data, data management is instrumental in response and recovery for all hazardous emergencies by providing information about waterworks status and laboratory analysis results. Through quality assurance, user training, tool development, laboratory results processing, and strong relationships and involvement in EPA data governance, the Data Management team ensures that the other divisions have the data necessary to perform their program functions effectively.

Training, Capacity Development and Outreach

ODW facilitates the development of TMF competencies for waterworks staff by offering and sponsoring on-going training. The curricula for these programs include technical topics such as: equipment operation and maintenance, drinking water chemistry and microbiology, water treatment technologies, and operator math. Managerial aspects of waterworks operation are addressed through course offerings on: the Virginia Waterworks Regulations, capacity development, financial planning, asset management, waterworks administration, and waterworks security.

The Waterworks Operator Short School is the preeminent water and wastewater operator training in Virginia. ODW actively participates in the Short School by providing many of the course instructors. This annual training is a week-long course held at Virginia Tech since the 1940's. There have always been three levels to the course: introductory, intermediate, and advanced. Each level provides approximately 15 classes and focuses on a variety of waterworks operations topics. The curricula for the intermediate and advanced courses build on the preceding year's course. A supervisory level course was added in 2018 to address skills that supervisors and lead operators need to be successful. Virginia Tech held the course July 27 through August 1, 2020 and 96 people attended this training.

Several additional training courses are offered through ODW. These courses are held in association with Virginia Tech, Mountain Empire Community College and other service providers. Course offerings can vary yearly; however, ODW maintains a core of training courses which assist waterworks develop employees and TMF capacity.

Capacity Development ensures that owners have the TMF capability to successfully operate, maintain, and sustain its waterworks over the long term. TMF capacity demonstrates the waterworks' ability to reliably produce and deliver drinking water that meets state and federal drinking water standards. A waterworks demonstrates technical capacity through its physical infrastructure, including its water source, and in its knowledge and skill in operating the facility. Managerial capacity is evidenced by a waterworks' planning, customer service, organization, and ability to operate the waterworks. Financial capacity is documented by the waterworks' ability to balance revenues and expenditures, maintain acceptable reserves, and achieve overall financial strength and stability.

These components directly correlate with a waterworks' ability to achieve and maintain compliance with the regulatory requirements, as well as plan and prepare for future maintenance and upgrades. The TMF components that constitute capacity are interdependent; all three are essential for ensuring the sustainability of a waterworks. Weakness in one area of capacity can in turn impair the other components. For example, waterworks that demonstrate a lack of managerial capacity by establishing inadequate service rates cannot set aside resources for future maintenance, limiting their financial capacity.

During the previous five years, the Capacity Development program has undergone tremendous growth. ODW reclassified four positions between 2014 and 2019 to provide direct technical assistance to waterworks. These positions quickly developed full workloads by assisting waterworks personnel with business operations plans, asset management plans, small engineering projects, planning and design funds, deployment of third party assistance, training, and numerous other outreach activities. ODW authorized the last position to provide services to transient and nontransient non-community waterworks.

Financial and Construction Assistance Program

The 1996 amendments to the SDWA established the DWSRF Program. Funds for the DWSRF are awarded to eligible states through an EPA capitalization grant. ODW administers the capitalization grant for the DWSRF and associated state funds. Funds awarded to a state through a capitalization grant are categorized into two uses: (i) non-project funds or set-asides and (ii) funds that are used for construction projects at waterworks. Construction funds address public health problems and ensure compliance with the applicable laws and regulations.

Virginia provides a 20% state match, which must be deposited into a dedicated state loan fund on or before the date the state receives the federal grant payments. The Virginia Water Supply Revolving Fund (Fund) is Virginia's dedicated state loan fund.[7] Under this state law and in conjunction with ODW, the Virginia Resources Authority (VRA) has been tasked by the General Assembly with the financial management of the Fund, and activities include: the disbursement and collection of DWSRF Program funds, verifying the credit worthiness of potential borrowers, and managing program assets through investments in securities or obligations. ODW must provide EPA with an annual Intended Use Plan (IUP) for the capitalization grant, which describes how the capitalization grant will be expended, including all set-aside and construction funds.

Congress has set the following goals for the DWSRF funds:

- Assistance to Small Waterworks: A minimum of 15% be awarded as loan assistance to waterworks that regularly serve fewer than 10,000 persons.
- Green Project Reserve: A minimum of 20% to address green infrastructure, water or energy efficiency improvements, or other environmentally innovative activities.
- Additional Subsidization: A minimum of 20% of the grant can be awarded to any project and up to an additional 35% in additional subsidies can be provided to communities that could not otherwise afford such projects. Additional subsidies should be directed to: 1) repair, replacement, and upgrade of infrastructure in existing communities; 2) investigations, studies, or plans that improve the technical, financial and managerial capacity of the assistance recipient to operate, maintain, and replace financed infrastructure; and/or 3) preliminary planning, alternatives assessment and eligible capital projects that reflect the full life cycle costs of infrastructure assets, conservation of natural resources, and alternative approaches to integrate natural or "green" systems into the built environment.

EPA conducts annual reviews of ODW's DWSRF program as part of their required responsibility to oversee and ensure ODW complies with their grant conditions. FCAP continues to initiate new metrics and programs, and customer service surveys indicate the program is effective and well received.

[7] See Code of Virginia § 62.1-233 et seq.

In FY 2020, EPA awarded Virginia $17.965 million for the DWSRF program, an amount that is consistent with previous years. Virginia's 20% match was almost $3.593 million. The state budget included this amount as passed in March 2020. However, during the budget session in April 2020, the Governor proposed and the legislature adopted amendments that included, among other things, unallotting $482,400 in FY2021 and the same amount in FY2022 as an increase related to the DWSRF capitalization grant. In order for VDH to provide the full 20% match for the grant, ODW will need to use DWSRF program assets, maintained outside of the Fund, and established to reimburse VRA's costs and expenses incurred in the administration of the Fund. ODW sold bonds this year to increase funds available for the construction project authorized in FY 2018 and FY 2019.

In FY2020, the DWSRF received $16,179,242 in principal repayments, $1,584,248 in interest repayments, $855,945 in administrative fees, and $1,749,940 in investment income. The weighted average interest rate on DWSRF-executed loan commitments was 2.31%, compared to the state market interest rate of 3.29%. Based on these returns and current DWSRF commitments, roughly $41.3 million will be available in FY2021 for DWSRF applicants. However, the unalotted funding directly reduces the program's ability to provide loans and grants, which reduce public health threats to drinking water. In FY 2020, VDH received 38 applications requesting $66.2 million, but could only offer funding to 15 projects for $20.2 million.

Emergency Preparedness and Security

The susceptibility of critical infrastructure to natural disasters and terrorist attacks makes security and protection of waterworks a priority. ODW's Emergency Preparedness Coordinator works with water utilities throughout Virginia to protect, prepare, mitigate, respond to, and recover from these types of incidents. This work unit engages in emergency response planning, continuity planning, and safety guidance for ODW staff, and works with the Virginia Department of Emergency Management as the primary lead for water and wastewater for the Virginia Emergency Support Team.

ODW also works with the Critical Infrastructure Security Program Coordinator and Cyber Security Program Coordinator in the Public Safety and Homeland Security Secretary's Office to provide training and information to waterworks. This work includes threat information and security assessments that are available through the Federal Department of Homeland Security. This work unit communicates water advisories and helps water utilities during emergency events by establishing partnerships in the local community, the private sector, and other state agencies as subject matter experts in emergency preparedness and security.

In an emergency, response mostly is left up to the waterworks owner and operator who are most familiar with the waterworks' design and operation, condition of infrastructure, system capabilities, and governing resources. ODW typically supports waterworks by providing technical assistance, information to various entities and waterworks, and other compliance assistance as needed. Most incidents involve water main breaks, equipment failures, pressure loss, or boil water notices.

Compliance and Enforcement

ODW uses a decentralized approach for enforcement actions. Field offices, each with one Compliance Specialist, take on most administrative work of formal enforcement actions, such as issuance of Consent Orders, and monitoring of enforcement cases with close support from the division director and staff in the Central Office. Central Office staff coordinate with agency counsel as needed, provide real-time compliance information, and help evaluate enforcement priorities as well as ensure consistent

enforcement actions and collaborate on enforcement strategies with the field offices. Compliance and enforcement staff work with the field offices to determine the best course of action. If there were an imminent and substantial risk to public health, VDH has emergency authorities it can invoke.

The enforcement process starts with a Notice of Alleged Violation (NOAV) to the owner/operator of a waterworks followed by various assistance including informal meetings, issuance of temporary permits, site visits, technical assistance, education, etc. to help the waterworks return to compliance. If not returned to compliance, ODW then considers enforcement strategies that are best suited to the situation. Enforcement actions can be informal (warning letters, enforcement meetings) or formal (bilateral Consent Orders or non-consent procedures such as informal fact-finding proceedings, formal hearings or unilateral Special Orders). Special Orders may include a civil penalty of not more than $1,000 for each day of violation.

Failure to comply with Consent Orders or Special Orders may result in ODW initiating state judicial enforcement actions. ODW refers the cases to agency counsel at the Office of the Attorney General to consider a civil action seeking enforcement of the order, injunctive relief, or a civil penalty; or requesting a direct criminal indictment through the Circuit Court by the local Commonwealth's Attorney. Although never done, ODW could petition the Circuit Court for receivership. ODW may also refer cases to EPA for enforcement. ODW may deploy the capacity development program and the DWSRF staff to assist waterworks with returning to compliance.

Policy and Program Guidance

This division monitors bills during the General Assembly session, provides oversight of FOIA, regulations, policies and procedures that affect ODW and its regulated community. During the 2020 General Assembly session, ODW monitored over 40 bills that could have impacted the drinking water program. ODW was lead analyst for seven bills, all of which passed and imposed responsibilities on ODW. During 2019, ODW proposed significant amendments to the Waterworks Regulations and the Policy and Program Guidance Director helped lead conversations with stakeholders and move the work product through the Administrative Process Act requirements. Public comment on the proposed amendments closed in January 2020. Staff are preparing final amendments to submit to the Board of Health for approval. During the pandemic, the Policy and Program Guidance Director developed program guidance for staff safety and managing permit requirements for waterworks that shut down or significantly reduced operations. The program continues to focus on simplifying business process, reducing paper-based processes.

b. Drinking Water Program in Virginia

EPA's 2019 annual primacy review of Virginia's PWSS program concluded that ODW continues to implement an effective drinking water program. This section provides an overview of the data presented in EPA's 2019 report.[8]

VDH regulates 2,811 public water systems serving 7,509,763 citizens of Virginia. As presented in the table below, these water systems are divided into 1,099 community waterworks (CWS), 512 non-transient non-community waterworks (NTNC), and 1,200 transient waterworks (TNC). The number of community systems continues to decline, reflecting consolidation.

[8] Annual Review of the Public Water System Supervision Program for the Commonwealth of Virginia. Environmental Protection Agency. Report date, August 2020.

Virginia Waterworks Inventory

	CWS	Pop.	NTNC	Pop.	TNC	Pop.	Total Systems	Total Pop.
2019	1,099	7,031,012	512	285,278	1,200	193,473	2,811	7,509,763
2018	1,103	7,004,875	519	286,728	1,173	193,592	2,795	7,485,195
2017	1,117	6,979,954	519	286,979	1,129	182,995	2,765	7,449,928
2016	1,124	6,960,875	512	286,610	1,061	178,860	2,697	7,426,345

Administration and oversight of the drinking water program (i.e., staff salaries and fringe benefits) has been historically funded by the PWSS grant, fees from the regulated community, and "set-asides" from the DWSRF grant. The DWSRF grant allows up to 32% of funding to go towards "set-aside" programs. These set-asides also provide significant funding for ODW programs. With the PWSS funding flat over several years, ODW has increasingly relied on the set-aside funds under the DWSRF to support staff positions that were historically funded by the PWSS grant. The percentage of staff positions supported by the set-asides has steadily increased from 10% in 2006, 15% in 2012, to 31% in 2019.

As of May 2020, ODW had 10 vacancies, which is in line with the historical average. ODW currently has 129 total full time employees (including 10 vacancies) budgeted for FY 2021. ODW estimates $8.4 million per year is necessary for operations to implement core federal grant programs to maintain primacy. ODW currently has a hiring freeze on critical positions as a result of funding concerns.

The Water Infrastructure Improvements for the Nation Act (WIIN) has provided Virginia additional federal funding assistance. Under the Voluntary Lead Testing in Schools and Child Care grant program, Virginia received $737,000 in EPA funding on January 17, 2020. VDH will receive an additional $420,000 as an amendment to the original grant with work plan revisions and supporting documents. ODW can only use 4% of the grant funds for administrative costs. The current grant funding will assist with voluntary testing for lead contamination in drinking water at schools and childcare facilities with a priority in low-income areas. The goals of the grant include:

- Test all potable water outlets (regularly used for consumption) at 35% of all schools and child care facilities in low-income areas by the end of the project period;
- Test 8% of total child care facilities in the state with a plan to continue testing after the project period; and,
- Test 10% of the total schools in the state with a plan to continue testing after the project period; and provide education about lead and the importance of testing to all 132 school divisions in the state.

Under the Assistance for Small and Disadvantaged Communities grant program, Virginia is eligible to receive $691,000 in EPA funding during 2020. ODW submitted grant proposals to EPA in September 2020. Pursuant to the "Reducing Lead in Drinking Water" grant program, EPA expects to provide four to fifteen awards of up to $39.9 million in total under two National Priority Areas (reducing lead exposures through infrastructure and treatment improvements, and reducing children's lead exposure in schools and childcare facilities). The awards are competitive and VDH submitted its proposal on May 30, 2020. EPA announced in October, 2020 that Virginia will receive approximately $1.3 million for reducing lead in drinking water.

ODW reviews performance metrics each month during a leadership meeting with division and field directors. The continued focus on metrics ensures accountability and continuous improvement. In 2019, VDH field office staff conducted 1,294 routine sanitary surveys and responded to 7,320 technical assistance requests. In 2019, VDH averaged only 3.4% of waterworks with a monitoring violation. VDH has reduced this number since implementing performance metrics in 2018 by making sample schedules available to waterworks through the Drinking Water Watch webpage, piloting a sampling reminder auto-dialer project, and by providing additional technical assistance to waterworks.

In the past five years (2015-2019), the number of community waterworks with health-based violations has continued to decline. As of August 2020, only 1.8%, or 20 community waterworks had health-based violations. Stage 2 Disinfection Byproduct Rule violations accounted for most of these violations, followed by issues with fluoride, the Revised Total Coliform Rule, and the Ground Water Rule. For many waterworks listed as potential serious violators on EPA's Enforcement Targeting Tool (ETT) report, ODW actively engages owners to return to compliance. During 2019, VDH issued 1,250 NOAVs, 80 warning letters, and one Special Order. The table shows that ODW successfully met the targets of the EPA National Water Program Measures focusing on community water systems for July 1, 2018 through June 30, 2019.[9]

EPA National Water Program Measures	Virginia Results	National Average: All states	EPA Region 3 Results
Percent of the population served by CWSs that receive drinking water that meets all applicable health-based drinking water standards through approaches including effective treatment and source water protection.	98.0%	91.9%	91.4%
Percent of CWSs that meet all applicable health-based standards through approaches that include effective treatment and source water protection.	96.1%	92.9%	90.7%
Percent of "person months" (i.e. all persons served by CWSs times 12 months) during which CWSs provide drinking water that meets all applicable health- based drinking water standards.	98.8%	94.2%	94.8%
Percent of CWSs that have undergone a sanitary survey within the past three years (five years for outstanding performers or those ground water systems approved by the primacy agency to provide 4-log treatment of viruses).	100%	92.4%	90.7%

[9] Source: SDWIS/FED 2019 Q3 submission.

The Capacity Development Strategy focuses on TMF components to improve a waterworks' ability to reliably produce and deliver safe drinking water to consumers. ODW enforces rules and regulations and provides technical assistance to improve performance and sustainability of waterworks.

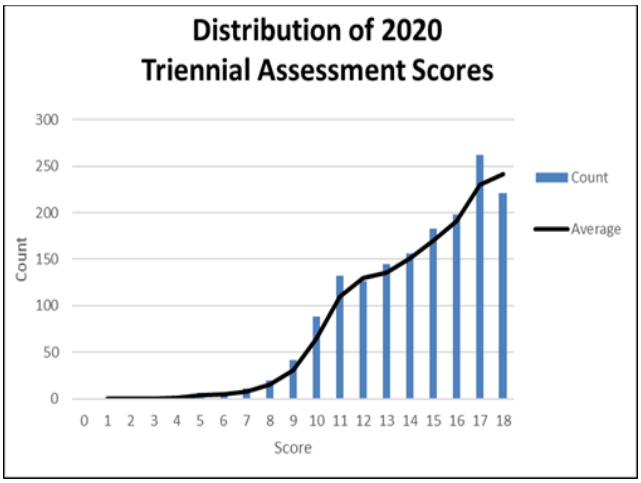
Small waterworks must develop and improve TMF capacity for long-term viability. With the complexity and number of federal drinking water regulations is increasing over time, ODW must implement, monitor, and enforce these changes. Staff provide technical assistance, track routine sanitary surveys, and evaluate the capability of waterworks to ensure compliance with state and federal drinking water standards. The Strategy helps ODW deploy assistance from many technical assistance partners to waterworks responsible for providing safe drinking water to people of the Commonwealth of Virginia.

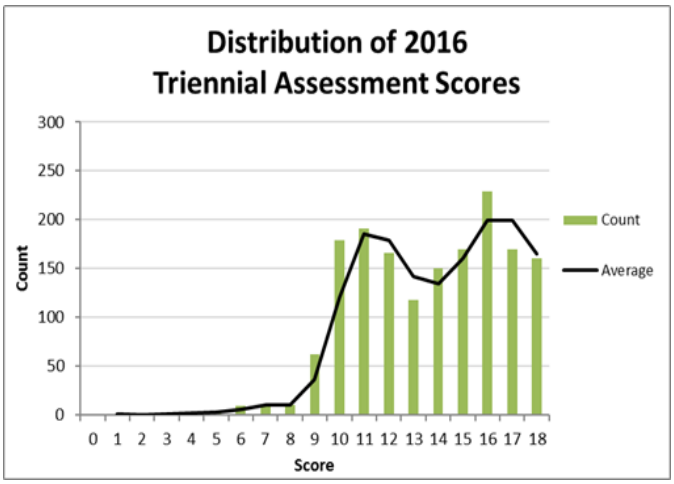
State grant matching funds pay a 20% match to the DWSRF capitalization grant that supports capacity development programs. Technical assistance fees from the regulated community pay less than 25% of salary and benefits for staff positions that offer technical assistance. The DWSRF capitalization grant additionally provides funds for the capacity development, source water, training and security staff through the set-asides. Dedicating more state funding to programmatic initiatives would benefit struggling waterworks.

In the last three years, ODW reclassified one position to make it part of the Capacity Development team and converted an existing position to a supervisory role. The new position focuses on assistance to noncommunity waterworks. The supervisor focuses on strategy implementation and team leadership. Five full-time and one part-time staff actively support the Capacity Development Strategy and accomplished the following in the past three years:

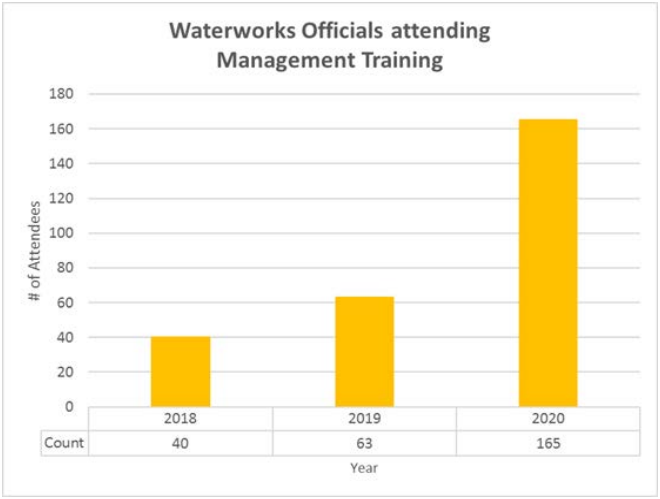
- Published seven articles in industry periodicals;
- Produced Consumer Confidence Report Hip Pocket Tool for waterworks;
- Developed and deployed an "Asset Management for your Waterworks" workshop for small waterworks, collaborating with SERCAP, VRWA, and Draper Aden and Associates;
- Initiated and/or coordinated several training events for waterworks;
- Advanced the use of an Auto-dialer system to remind waterworks to collect samples, thus reducing monitoring violations;
- Made numerous marketing efforts to increase the number of waterworks personnel attending training events;
- Collaborated with United States Department of Agriculture-Rural Development (USDA-RD) and planning district commissions on funding workshops for water and wastewater utilities; and,
- Worked with many utility boards to provide regulatory insight, discuss technical issues, and offer suggestions for funding options.

In 2020, ODW conducted a TMF assessment of all community and NTNC waterworks. The EPA requires an assessment at least once every three years. The current data indicates a general improvement in TMF capacity from 2016, with more waterworks scoring higher overall. Waterworks are given a total of 1 to 18 points based on overall TMF capacity; the higher the score, the better the TMF. In 2016, data peaked around 11 points and 16 points. In 2020, this double peak no longer exists and scores trend upward. These upward trends in the data indicate an increase in overall TMF capacity at waterworks and a positive impact from capacity-building measures ODW implemented in the past three years.





ODW continues to implement an exemplary Operator Certification Program that is responsive to changing circumstances. The number of waterworks requiring licensed operators is 1,637. The percentage of waterworks with a properly licensed operator is over 99 percent in Virginia. The table below shows that the number of waterworks "decision-makers" who have attended ODW-sponsored management training is increasing. Virginia Tech, Mountain Empire Community College, and other service providers hold courses through contracts with ODW. Course offerings vary yearly; however, ODW ensures a core of training courses to develop employees and the waterworks' TMF capacity. Owners and operators find course offerings on the ODW website.



ODW implemented two new rules during FY 2019 – the RTCR and LCR. As such, ODW reviewed and approved 126 Bacteriological Sample Site Reports (BSSRs), reviewed 145 Level 1 assessments, and conducted 66 Level 2 assessments in FY2019. Implementation of the new RTCR rule turned out to be far more resource intensive than expected, particularly evidenced by the number of Level 2 assessments. In 2019, 37 waterworks completed a Material Survey and a sampling plan for lead and copper. Fifty large and 28 medium/small waterworks continued to monitor and report Water Quality Parameters. Eight waterworks had lead action level exceedances during 2019. As of the first quarter of 2020, 33 active waterworks had LCR monitoring/reporting violations and four had LCR treatment technique violations.

During FY 2019, 37% of community waterworks minimized the risk of public health through source water protection (falling short of the national goal, which is 49%), which is 48% of the population served by community waterworks (the national goal was 59%). ODW's Source Water Protection Program executes important work by using two contractors, ODW staff, and Wellhead Protection Implementation Project grants to assist small community waterworks and localities with developing and implementing source water protection plans. During 2019, ODW delivered 826 preliminary or updated assessments, developed Source Water Protection Plans through contracts for five waterworks, and awarded four Wellhead Protection Implementation grants totaling $36,932.

ODW refined the Source Water Assessment Program (SWAP) procedures and geographic information systems database layers in 2020, which resulted in updating SWAP outputs for 826 sources. The program integrates Clean Water Act and Safe Drinking Water Act activities by working with the Virginia Department of Environmental Quality to provide well development data of new public wells to assist with their groundwater characterization and management programs and reviewing 148 Virginia Pollution Discharge Elimination System permits and 24 Virginia Pollution Abatement permit applications. Through the Interagency Environmental Review program, in collaboration with source water protection partners, staff reviewed 260 projects for impacts to drinking water sources.

Drinking water infrastructure is one of the most important aspects of drinking water security and sustainably. Both activities are unregulated in Virginia. The next section provides an overview of aging infrastructure across the nation, sources of contamination in drinking water, indicators of aging infrastructure, and funding sources and needs for addressing improvements to the Commonwealth's vital water infrastructure.

III. Aging Infrastructure

Approximately 300 million Americans rely on public water systems (waterworks) for drinking water every day. Waterworks use an estimated 1.2 million miles of distribution mains to move water from the source, through treatment, and on to the 300 million consumers. Water treatment, storage, and distribution system infrastructure has successfully delivered clean, safe, and reliable drinking water to consumers in the United States for many decades. However, many communities have not updated or replaced their water infrastructure since economic expansion following World War II, which is now near or past its retirement or replacement age.[10] As a result, breaks, leaking pipes, water loss, and contamination are more likely, increasing the health risk to consumers and negatively affecting the reliability of the nation's drinking water system. Virginia's drinking water infrastructure resembles this national trend.

A recent study, funded by the American Concrete Pressure Pipe Association and completed by the College of William & Mary's Public Policy Program, assesses the return on investment for water infrastructure improvements and quantifies the public health benefits resulting from those improvements.[11] The William & Mary report states, in part:

> *There is a severe pattern of underinvestment in water infrastructure across the United States. It is estimated that as much as $1 trillion will be needed to meet the needs of a growing society and*

[10] Walton, B., 2016. Infographic: The Age of U.S. Drinking Water Pipes- Form Civil War Era to Today. https://www.circleofblue.org/2016/world/infographic-the-age-of-u-s-drinking-water-pipes-from-civil-war-era-to-today/ (accessed July 17, 2018).

[11] Murray, S., Aboagye, D., Luketich, A., The College of William and Mary Public Policy Program, 2018. *Investment in American's Drinking Water Infrastructure: Benefits, Financing Mechanisms, and Best Practices.*

repair our rapidly crumbling system. Adequate financing will be essential to keeping pace with this need for investment… The current system for funding upgrades and expansions to drinking water infrastructure relies heavily on user-fees and the operating and maintenance budgets of water structure owners. Because of the large need for investment and low price of water to maintain affordability, this system does not provide enough funding to meet existing needs for upgrading and expansion.

The lack of adequate funding from current sources is compounded when waterworks do not know the extent of maintenance and expansion needs. Distribution systems are usually buried underground, so the condition and structural integrity cannot be easily evaluated. The William & Mary study found that there is not even a standard auditing practice for evaluating the structural integrity of the water system. Each waterworks owner is responsible for developing asset monitoring and evaluation criteria and methods, but for many owners, competing resources prioritize short-term needs over long-term asset management. As a result, waterworks use assets past their usable life and many waterworks owners have a "wait until it fails" mentality.

Public support for asset management is often lacking. Often, consumers are not aware of the resources required to collect, treat, store, and distribute potable water to homes, businesses, and industries, or the associated costs of maintaining, repairing, replacing, and protecting the millions of miles of water lines that deliver water. This lack of awareness makes funding water infrastructure even more challenging, especially when the people who live and work in, or visit Virginia expect drinking water to be clean, safe, and readily available at the turn of the tap. With the public pressure on affordable water that is in sufficient quantity and complies with drinking water standards, waterworks are strapped to invest in future infrastructure needs.

Water loss from failing infrastructure can also be devastating on our finite water resources. One EPA report shows that there are about 240,000 water main breaks in the United States every year, and $2.6 billion are lost from water mains that leak trillions of gallons of treated drinking water.[12] Water loss, or unaccounted (unbilled) water, has other consequences as Virginia tries to protect aquifers within groundwater management areas and address climate change. The Richmond, Tidewater, and Northern Virginia regions have many water mains that are nearly a century old. The materials used for these systems were the best available technology for that time; however, some of those materials can be intrinsically harmful, such as lead lines, while other materials, such as wood, cannot last for a 100-year life span. These old, leaking pipes cost utilities extra money because the waterworks already incurred the cost to treat the lost water, but cannot bill customers for it.

a. Case Studies

A large percent of Virginia's water infrastructure was built in the post-World War II era, over 60 years ago,[13] and a significant portion more predates even that period. According to the Municipal Association of South Carolina, the life expectancy of water distribution lines range from 70-120 years.[14] For Virginia's waterworks and distribution systems to remain viable, we must invest in regular and

[12] US Environmental Protection Agency (USEPA), 2011. Addressing the Challenge through Science and Innovation. EPN600/F-111010, Cincinnati.
[13] American Water Works Association (AWWA), 2012. "Buried no longer: Confronting America's water infrastructure challenge." AWWA, Denver, CO.
[14] Municipal Association of South Carolina (MASC), 2016. Life expectancy of water distribution lines. http://www.masc.sc/Pages/newsroom/uptown/March-2016/Life_expectancy_water_lines.aspx (accessed June 16, 2018).

routine replacement of the aging components. Incidents such as those in Goshen,[15] Petersburg,[16] and Pocahontas,[17] Virginia demonstrate the serious public health consequences that result from a lack of infrastructure maintenance. Despite these examples of failed infrastructure, 91% of Virginia's waterworks still have not reported water quality violations.

City of Petersburg

On January 26, 2018, the City's Acting Director of Utilities reported a major break in a 20-inch water main and four other 6-inch diameter water line breaks in parts of the City. The extent and number of leaks reduced storage capacity. Some city officials expressed concern that crews might not complete necessary repairs to maintain water pressure. City officials contacted local medical facilities and emergency agencies and arranged for backup water supplies. The City ultimately did not issue a boil water notice or advisory because city crews and contractors maintained minimum water pressure through quick repairs. To ensure public safety, ODW required thorough flushing and chlorine residual checks downstream from the breaks. ODW also required bacteriological samples to confirm satisfactory water quality. ODW began meeting with City officials on a quarterly basis to develop and implement capital improvement plans and asset management plans. From this effort, the City has not had significant system-wide leaks.

Town of Goshen in Rockbridge County

In June 2007, the residents of Goshen found themselves without drinking water. Goshen, a rural town located in northern Rockbridge County, has a waterworks consisting of a spring, chlorine disinfection, duplex high service pumps, gravity storage and distribution lines. The town constructed the majority of the waterworks in the 1930's.

On June 13, 2007, the waterworks began to lose water pressure. Storage tank levels dropped. By June 15, significant water was still being lost and by mid-day, the water loss depleted all water storage, leaving the Town's residents without water. Rockbridge County declared a local state of emergency, triggering emergency management activities to support the Town and its residents. ODW and the local health director issued a boil water advisory from the loss of water pressure throughout the Town.

The Virginia Rural Water Association, ODW, and volunteers arrived June 15 and began to search for system leaks. To get water into the system, three 5,500-gallon tanker trucks hauled in water from neighboring waterworks. Over the next several days, workers identified multiple leaks and repaired waterlines. However, the water system could not recover. On June 20, after nearly 6 days without water service, the Governor declared a State of Emergency, allowing additional state resources to become available, including support and resources from the Virginia Department of Emergency Management, the Virginia National Guard, and American Red Cross.

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[15] Virginia Department of Emergency Management (VDEM), June 29, 2007 Goshen Sitrep. http://www.vaemergency.gov/wp-content/uploads/drupal/sitrep10_4.pdf (accessed August 27, 2018).

[16] WTVR.com, 2018. The 2 things causing multiple water main breaks in Petersburg. https://wtvr.com/2018/01/03/the-2-things-causing-multiple-water-main-breaks-in-petersburg/ (accessed August 27, 2018). During the month of January, 2018, several breaks in Petersburg's water mains resulted in significant portions of the City loosing water service for several hours while contractors worked to repair breaks in the primary 20-inch diameter main line.

[17] U.S. Environmental Protection Agency, 2018d. Water Finance Forum. https://www.epa.gov/sites/production/files/2016-06/documents/agenda_water_finance_forum_virginia_6_13_16.pdf (accessed August 27, 2018).

Workers finally restored water service to the residents of Goshen on Sunday June 25, 2007. Over the 10-day ordeal, crews located and repaired 14 major leaks. Based on the amount of water produced at the waterworks before the storage failure, ODW estimates that over 80% of the water leaving the treatment facility was lost before reaching consumers. Direct costs to the Town for personnel overtime, materials and supplies, and contractual services exceeded $49,000. Direct costs to Rockbridge County totaled nearly $11,000 and included personnel overtime, purchases of bottled water, pump rental, lodging, and contractual services.

The long-term solution for Goshen was the replacement of 12,500 feet of 6-inch diameter cast pipe. The total cost of the pipe replacement was approximately $2 million. The Town had very limited resources and was unable to fund the needed pipe replacement. Various funding agencies, including ODW, Virginia Department of Housing and Community Development, Southeast Rural Community Assistance Project and the United States Department of Agriculture – Rural Development, stepped in and offered financial assistance.

Tauxemont in Fairfax County

The Tauxemont Community Association owns a waterworks in Fairfax County that has 114 connections and serves approximately 250 people from three wells to a looped network of distribution mains. The waterworks began operations in the 1940s. In September 2015, contractors drilled a replacement well. After the drilling contractor completed the new well, the engineering firm never finalized plans and specifications for it. In September 2018, ODW matched Tauxemont with an engineering firm through the VDH Small Project Engineering (SPE) program to develop as-built schematic drawings, record components of the pumping system, and provide hydraulic calculations. In January 2019, ODW approved the as-built plans and specifications and Tauxemont began using the well to support its community. The well is vital for the sustainable operation of the waterworks and was only made possible with ODW's technical and financial assistance.

Town of Richlands in Tazewell County

ODW helped the Town of Richlands (population 4,564) in Tazewell County complete an asset management plan (AMP). With the assistance of a contract engineer funded through the Special Projects Engineering (SPE) program, the Town completed an AMP that identified infrastructure in poor condition, which was critical to operations. The Town prioritized the replacement of this infrastructure in a phased approach and paid project costs from revenue generated from water service billings. The Town plans to implement a small rate increase to offset the cost of the remaining projects.

Town of Bluefield in Tazewell County

Staff assisted the Town of Bluefield in Tazewell County complete an AMP using the SPE contract engineer. The Town serves a population of 5,811 persons. Town officials prioritized future capital projects into several phases. The Town also received DWSRF construction funding to complete the first of two project phases. Construction is underway for these projects now. The Town will request additional DWSRF funding in the future to complete projects identified by the AMP. As part of the current funding offer, ODW required the Town to complete a waterworks business operation plan (WBOP). The Town identified gaps from the WBOP. ODW will help produce standard operating procedures for the water treatment plant and distribution system. The Town also plans to build financial reserves for the waterworks, separate from other Town reserve funds.

Town of Port Royal in Caroline County

The Town of Port Royal with a population of 327 is located in rural Caroline County. In 2014, representatives from the Town began seeking funds for several improvements to comply with the Waterworks Regulations and eliminate significant deficiencies with the waterworks. The Town's waterworks pumped groundwater from two drilled wells to a 22,000-gallon elevated water storage tank. The Town obtained the tank in used condition from Fort A.P. Hill in 1967.

During an inspection in August 2013, the Town discovered holes in the storage tank's roof. The Town needed to replace the existing tank and start emergency repairs. While the efforts to secure funding for replacing the tank were ongoing, SERCAP awarded the Town a $30,000 grant and provided technical assistance for emergency tank repairs. The Town subsequently received an award of $990,684 in DWSRF funding. ODW forgave $594,410 as principal forgiveness, and an additional $429,000 grant/loan mix from USDA-RD helped complete the project.

The Town installed a new 20' x 20' precast concrete building for two booster pumps and two bladder tanks with emergency standby power, installed approximately 5,400 linear feet of waterline, and installed new meter box assemblies. In 2019, contractors for the Town carefully took down the elevated water storage tank. ODW staff conducted a final inspection in May 2019. The Town held a ribbon-cutting ceremony in August 2019.

Town of Orange in Orange County

On June 9, 2018, a strong storm hit the Town of Orange. The water treatment plant suffered a lightning strike, which damaged the Supervisory Control and Data Acquisition (SCADA) system and rendered it inoperable. The waterworks, serving approximately 6,584 persons through 3,056 service connections, had substantial damage. The Town's operator managed the treatment system in manual mode for weeks. The Town reached out to the USDA-RD and ODW for funding assistance to replace the SCADA system. USDA-RD had emergency funding available, but limited time to use it. ODW staff quickly began working with field office staff, gathering information from waterworks records, interviewing the Chief Water Operator for specifics about the interim operational conditions, and drafting a letter of support. The Town added that letter of support to the packet and sent it to USDA-RD for approval. USDA-RD approved the project as an "emergency" and provided $115,275 in grant funds to replace the SCADA system.

Town of Monterey in Highland County

In early August 2017, the Town of Monterey waterworks in Highland County suffered a catastrophic event resulting in a water outage to the approximately 450 residents served. The infrastructure impacts included empty water storage tanks, inadequate water pressure, and inadequate well pumping rates from well pump malfunctions and low well water levels. Officials declared a local emergency, and issued a Boil Water Advisory with assistance from ODW. Neighboring localities and VDH (ODW and the local health department) provided assistance.

The Town restored the operation of the waterworks, but did not have adequate monitoring and fail-safes to prevent a repeat occurrence. In April 2019, the Town applied for $215,000 in DWSRF funding to install a SCADA system. Capacity Development staff determined the Town did not have adequate TMF capacity to meet DWSRF funding requirements. The Town recognized that more TMF capacity would require a long-term commitment. ODW requested that the Town complete two action

items for funding: a water rate analysis and a WBOP. In November 2019, the Town presented and adopted a Board resolution committing to the completion of both items. The Town completed a water rate analysis with the Environmental Finance Center Network's help and a draft WBOP with Capacity Development staff's help. The Town's DWSRF construction project is moving forward.

Town of Buchanan in Botetourt County

The Town of Buchanan in Botetourt County, population 1,220, had a major water leak in March 2020. Town officials contacted the Virginia Rural Water Association (VRWA) regarding an estimated 40,000 gallons per day of water loss from the Town's distribution system. A VRWA technical expert, known as a "circuit rider," determined the Town needed an exact location of pipe leakage to make repairs. After isolating a section of pipe and re-pressurizing the system, the Town could not determine a location of leakage. VRWA's circuit rider used a leak correlator to pressure test water mains for leaks. VRWA provided direction about repairs to abate the water loss. ODW provided the leak detection equipment to VRWA through a set-aside grant, showing the success of this funding.

Town of Charlotte in Charlotte County

The Town of Charlotte Courthouse in Charlotte County has a population of about 1,975 people. Maintenance staff from the Town called VRWA and requested help finding a water line. The circuit rider located the water main, found the water leak, and shut the water off at a pool house near a private club to prevent the Town from losing all its stored water. The circuit rider found the water line going to the pool house had its own cut off valve. Town staff shut off the valve to allow the main building to continue getting water. Again, ODW provided the leak detection equipment to VRWA through a set-aside grant.

Rye Valley Water Authority in Smyth County

Rye Valley Water Authority in Smyth County serves approximately 1,276 people. The Authority contacted VRWA on January 13, 2020, to help with a major water loss within the Authority's drinking water distribution system. At the time of the call, Rye Valley had 27% water revenue accountability, meaning that 63% of the costs to treat and distribute drinking water had no revenue generating potential. A VRWA circuit rider arrived on Jan. 16, 2020. After surveying valves, meters, and hydrants, the circuit rider found a leak. VRWA decided that ground-penetrating radar could find the service line better than the use of other water loss detection instrumentation. The circuit rider and Town found a point of interest and marked it for excavation. Rye Valley Water Authority reported that VRWA's circuit rider found the appropriate line leak. The Authority repaired the line, and the circuit rider recommended that the authority replace the aging galvanized pipe service line. The Authority's water revenue accountability improved. Again, ODW provided the leak detection equipment to VRWA through a set-aside grant.

Tangier Island

The Town of Tangier waterworks serves approximately 650 persons. On January 20, 2019, a water line ruptured along a bridge replacement project. The rupture drained the Town's water storage tank and interrupted water service. Town officials issued a Boil Water Advisory and issued a restriction on water use. The Town partially restored some water service about 7 days later by connecting fire hoses to hydrants on each side of the break and began boating bottled water to the Island. Several production meters were not operational, and ODW staff discovered many more leaks in the distribution system. Several isolation valves and fire hydrants were not operable and others could not be located. Town officials speculated that some isolation valves had either been paved over or were covered with

vegetation. The Town's licensed operator for the Waterworks was not available on the Island during the incident. This event took several weeks to resolve. ODW is currently working with the Town to improve its infrastructure.

b. Potential Sources of Contamination in Drinking Water

Aging infrastructure can cause contaminated drinking water. Two sources of potential contamination strongly tied to aging infrastructure are lead and copper and microorganisms (total coliform bacteria and E. coli).[18] Lead was used in water systems, especially premise plumbing, years before the health effects were known. The same conditions that can cause lead contamination in drinking water (primarily water that is too corrosive) can also lead to elevated levels of copper; however, the action level (AL) for copper is higher than lead (15 ppb for lead verses 1300 ppb for copper) and the health effects of copper exposure are not as severe. Microorganisms can persist in the distribution system when low pressure, leaks, and openings occur in the system piping and can cause illness.

Lead and Copper

Lead is a naturally occurring element usually found in small amounts in the earth's crust. While there are certainly some beneficial uses for lead, it is harmful when ingested, especially in young children. Exposure to lead can come from many sources, including the past use of leaded gasoline, lead-based paint, and industrial sources. Additionally, lead and lead-based compounds are present in a wide range of products found in and around homes, including paint, plumbing materials, solders, batteries, ceramics, ammunition, cosmetics, and lead glazed porcelain.[19]

Lead can have significant adverse health effects and affects almost every organ and system in the human body. It can accumulate in the body over time and even low levels of lead in the bloodstream of children can result in behavioral and learning problems, lower IQ, slow growth, hearing problems, and anemia. Children six years of age and younger are especially vulnerable. Lead can also be harmful in adults resulting in cardiovascular effects, increased blood pressure, decreased kidney function, and reproductive problems in both men and women.[20]

Like lead, copper is a naturally occurring element. Copper is widely used and is common in many products, including coins, electrical wiring, and water pipe used in premise plumbing. Copper is an essential element to living organisms. Too much copper, however, can result in adverse health effects, including vomiting, diarrhea, stomach cramps and nausea. Elevated copper has also been associate with liver damage and kidney disease.

Lead and copper are rare in source waters (i.e. wells, springs, rivers, or impoundments). Rather, lead and copper enter drinking water when pipes and premise plumbing fixtures containing lead or copper corrode and leach into the water. This is especially significant when the water has corrosive characteristics, such as low pH and high acidity. These conditions accelerate the corrosion of lead and

[18] Coliform bacteria are organisms that are present in the environment and in the feces of all warm-blooded animals and humans. Total coliform, fecal coliform, and *E. coli* are all indicators of drinking water quality. The total coliform group is a large collection of different kinds of bacteria. Fecal coliforms are types of total coliform that mostly exist in feces. *E. coli* is a sub-group of fecal coliform. When a water sample is sent to a lab, it is tested for total coliform. If total coliform is present additional sampling and testing is required to confirm the result, source of contamination, and if *E. coli* is present.

[19] USEPA, 2018c. Learn about Lead. https://www.epa.gov/lead/learn-about-lead (accessed June 16, 2018).

[20] USEPA, 2018c.

copper containing materials within our plumbing systems. Older homes built prior to the mid 1950's may still have service lines made entirely from lead. Lead service lines were replaced by galvanized piping service lines, which still contained lead and copper. Copper premise piping was commonly joined with lead based solder until the mid-1980's. In addition, brass used in many commonly installed faucets can contain significant amounts of lead.

For most contaminants, EPA sets an enforceable regulation called a "maximum contaminant level" (MCL). In establishing MCLs, EPA considers the costs, benefits, and ability of public water systems to detect and remove contaminants using suitable treatment technologies. However, because lead and copper contamination of drinking water often results from corrosion of the plumbing materials belonging to waterworks' customers, EPA established treatment techniques that are triggered by an action level rather than an MCL for lead and copper. A treatment technique is an enforceable procedure that waterworks must follow to ensure control of contamination.

The Waterworks Regulations follow federal requirements for lead and copper. The Lead and Copper Rule (LCR) contains treatment techniques when the 15 ppb lead AL is exceeded, which includes corrosion control treatment and source water monitoring and treatment. To reduce exposure to lead in drinking water, waterworks must monitor for lead at the point of consumption. Sample locations are selected based on the presence of lead containing piping or plumbing fixtures and the highest risk for elevated lead exposure. The number of samples required is based on the population served. If sampling indicates lead concentrations above the 15 ppb AL, then the waterworks owner must notify its consumers and initiate a series of treatment techniques to reduce the water's corrosiveness.

Lead and copper regulations are complicated and difficult to implement. Even well managed community waterworks have a difficult time meeting all of the lead and copper requirements. The location of lead service line replacement is difficult because water lines are not readily visible for identification, records of pipe materials and construction are missing or incomplete, and waterworks staff who supervised the distribution system construction are no longer available.

ODW ensures compliance with lead and copper requirements by making sure all lead and copper tap samples are collected from identified high-risk locations. Staff carefully review all sample results and determine compliance with the AL. Staff assist waterworks owners in the selection of appropriate corrosion control treatment technologies and the target pH and phosphate residuals necessary to minimize lead corrosion and thus exposure at consumers' taps. Staff review monthly operation reports to ensure that the target water quality parameters are maintained at appropriate levels and ensure that required public education requirements are fully met too.

Staff encourage waterworks owners to voluntary replace their lead service lines as soon as possible and ODW provides grants to remove lead service lines as well. ODW works with VDH health directors and local health department staff on elevated lead issues and prioritizes efforts to address lead in drinking water at schools and day care facilities since they serve particularly vulnerable populations.

Effectively eliminating the use of lead in piping and thus minimizing exposure to lead in drinking water are ultimately a shared responsibility – waterworks owners, consumers, building owners, public health officials, and state legislatures each have important roles to play.

Lead Service Line Replacement Program (LSLR)

ODW supports requirements for water systems to develop distribution system inventories for every service line (both public and private sides), including LSLs in its service area. ODW recognizes

that these inventories will evolve over time, given that the initial inventories will comprise paper and electronic records, not field verification. Developing an inventory that is as accurate as possible over several years is critical to ultimately replacing all lead service lines and lead goosenecks, pigtails, and connectors in the Commonwealth.

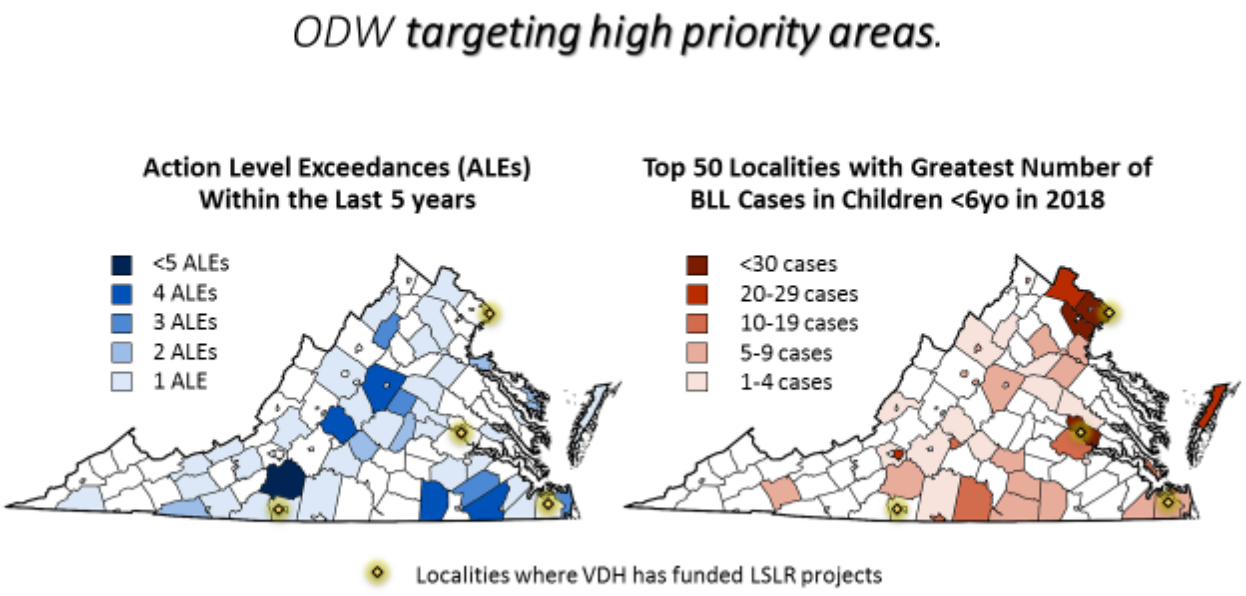
Replacement of galvanized service lines is also covered by the LSLR program and will be included in the inventory, as they have been found to be a source of lead in drinking water. Galvanized service lines can contain lead released from upstream lead service lines, and in addition, their zinc coating contains lead that can corrode and leach into drinking water. Over the past few years, ODW has awarded $3.69 million to Alexandria, Henry County, Richmond, and Chesapeake (see table below). Other localities, including Newport News and Pulaski County, are exploring LSLR funding.

Locality	Phase	Funding Amount	Amount Disbursed
City of Richmond	I	$500,000	$307,845.15
City of Richmond	II	$500,000	
City of Alexandria	I	$425,000	$48,257.08
City of Alexandria	II	$250,000	
Henry Co./Fieldale	I	$500,000	$500,000.00
Henry Co./Fieldale	II	$500,000	$473,734.48
Henry Co./Fieldale	III	$515,000	
City of Chesapeake	I	$500,000	

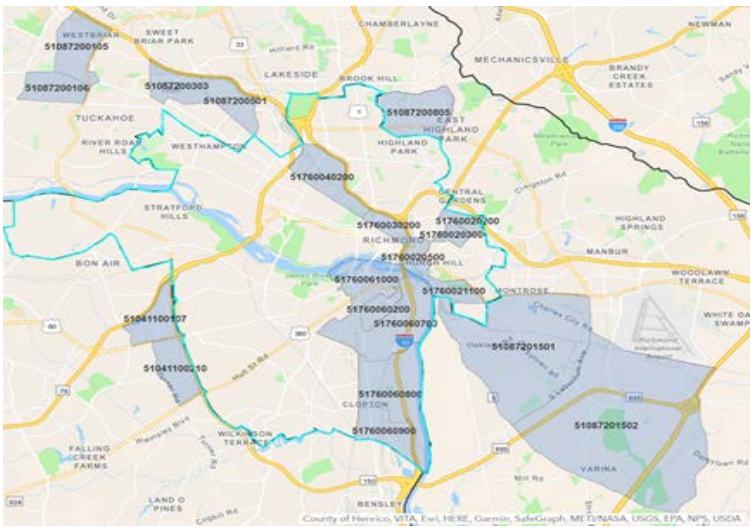
ODW has worked with each of the above localities to develop forms for submitting and documenting reimbursement. Each locality has its own forms and outreach materials, but each disbursement package contains the same elements. In general, the package includes (1) a list of serviced addresses with dates of completion for both the public and private side, (2) photos before and after replacement, (3) any additional supporting documentation including invoices, construction permits, and a signed Contractor Compliance Certification Statement if photos and invoices are not available or are of unsatisfactory quality. Once reviewed and verified by ODW staff, the localities may be reimbursed for their service line replacements.

There are several challenges with funding LSLR projects. Homeowners are reimbursed up to $5,000 per lead service line replacement, but because the federal grant requires payment as reimbursement, property owners can have difficulty. This presents an equity issue for low income areas of the population centers. ODW targets funding by examining Lead Action Level exceedances (ALEs), Blood Lead Levels (BLL) in children, and Qualified Opportunity Zones (QOZs).

In the map below, the darker the color, the higher the value for ALEs and BLLs, respectively. Yellow markers indicate locations of LSLR projects. For ALEs, the blue map, there are more ALEs in the central and southeastern parts of the state. For BLLs, the red map, there is more focus on densely populated areas such as Northern Virginia, the City of Richmond, and Henrico County.



QOZs are low-income census tracts that have been identified by the Commonwealth as areas available to investors to promote economic and community development. Examining QOZs helps ODW to prioritize LSLR needs at a more granular level. While ALEs and BLLs provide an overview at a county level, QOZs are at a neighborhood level. In the map below, the blue shaded areas represent QOZs in and adjacent to the City of Richmond.



Microorganisms

The Revised Total Coliform Rule (RTCR) focuses on eliminating potential pathways for contamination. If analytical results for bacteriological contaminants indicate the presence of total coliform or *E coli* bacteria, owners are required to assess the system to identify and eliminate potential sources of contamination. The assessments, called Level 1 and Level 2 assessments, identify the presence of sanitary defects in the distribution system or in the monitoring practices, and, when possible, the likely reason the waterworks triggered the assessment. A Level 2 assessment is more comprehensive than a Level 1 assessment.

The table below summarizes the number of Level 1 and Level 2 assessments ODW and waterworks owners/operators performed between April 2016 and September 2020.

Year	No. Level 1 Assessments	No. Level 2 Assessments
2016 (8 months)	146	29
2017 (12 months)	189	61
2018 (7 months)	101	39
2019 (12 months)	147	66
2020 (9 months)	81	33

From April 1, 2016 to July 31, 2018, only 10 waterworks failed to conduct a Level 1 assessment. Exceedances of the primary maximum contaminant level (PMCL) for *E. coli* resulted in 29 Level 2 Assessments. The remaining 100 Level 2 assessments were because the waterworks had two Level 1 assessments within a 12 month period. Only four waterworks failed to correct a sanitary defect by the due date established in either a Level 1 or Level 2 assessment during that time.

A deeper examination of the data from April 1, 2016 to July 31, 2018 indicates that the majority of both Level 1 and Level 2 assessments were required at smaller, noncommunity waterworks. Community waterworks accounted for 26% of Level 1 assessments and 18% of Level 2 assessments. Among noncommunity waterworks, transient noncommunity waterworks were required to perform 75% of the Level 1 and Level 2 assessments. Waterworks serving a population less than 50 people accounted for 30% of Level 1 and 2 assessments. Waterworks serving a population less than 100 people accounted for 55% of Level 1 and 2 assessments. Only 2% of Level 1 and 2 assessments were conducted at waterworks serving greater than 1,000 people.

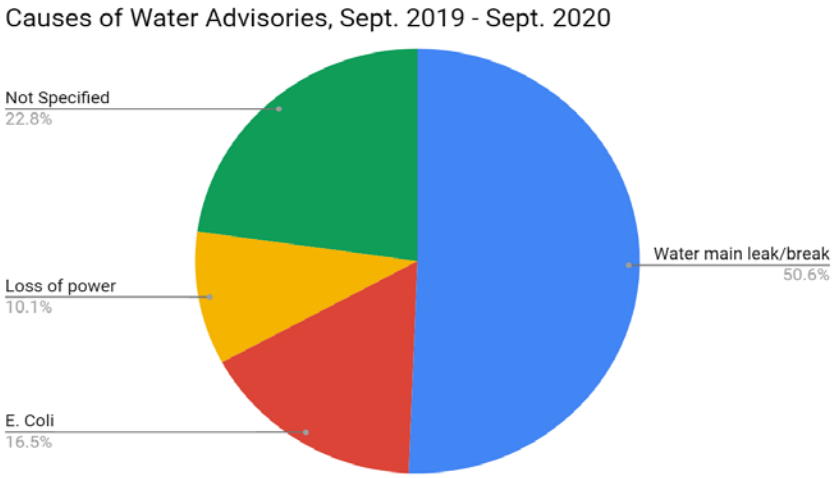
There were 29 *E. coli* PMCL violations between April 1, 2016 and July 31, 2018. Waterworks serving populations less than 50 people had 45% of the violations while waterworks serving less than 100 people accounted for 76% of the violations. Community waterworks had 2% of the *E. coli* PMCL violations and transient noncommunity waterworks had 79% of the noncommunity waterworks violations. Overall compliance with RTCR is excellent for community and nontransient noncommunity waterworks.

c. Indicators of Aging Infrastructure

Boil Water Advisories

In 2019, waterworks reported 51 boil water advisories and three low pressure notices to ODW. From January through September of 2020, ODW has been notified of 47 boil water advisories, four do not drink notices, one do not use notice, and two low pressure notices. In September 2019, ODW

started collecting information to determine the cause for boil water advisories, do not drink notices, and do not use notices. Since implementing the new tracking system in 2019, waterworks have issued boil water advisories for the following reasons: 40 for a water main leak or break, 13 for confirmed E. Coli, eight for a loss of power, and 18 for unspecified reasons. While the waterworks did not report a root cause for the water main breaks, most likely the breaks resulted from aging infrastructure (freezing or deterioration of piping) or construction work that inadvertently broke a water main.



Estimated Water Loss

Water loss may indicate aging infrastructure. Generally, physical water losses from aging infrastructure result from the storage tanks or pressurized system (e.g., water mains and customer service connections) up to the point of the customer's consumption. In metered systems, this is at the meter or service connection. In unmetered systems, it is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows. Many waterworks can determine water loss based on the amount of water (volume per day or month) produced at a treatment facility compared to the amount sold to customers.

Apparent water loss includes all types of inaccuracies associated with customer metering (worn meters, improperly sized meters, or wrong type of meter); data handling errors (meter reading, billing, archiving and reporting); unauthorized consumption (theft or illegal use); and meter under-registration (can be caused by old meters). Real water loss excludes apparent water loss, including approved or authorized water losses due to firefighting activities, construction activities, line flushing, and other maintenance-type activities. All well managed systems have real water loss.

Waterworks do not have a standard for defining the maximum real water loss allowed in quantities, percentages, or gallons per mile of water line. In some cases, the extent of the problem cannot be readily determined, as some waterworks do not meter service connections. Often, real water loss will include estimates, even for metered systems. No national standard exists for excessive real water loss, but some states use 20% of water produced and the American Water and Wastewater Association Standard M36 suggests the goal for unaccounted-for water loss should be zero.

Nationally, public waterworks process nearly 40 billion gallons of water per day. Of this amount, almost 6 billion gallons escapes through real physical water loss.[21] This loss is approximately 15% of production. System water loss can be attributed to pipe material, age, improper installation, excessive external loading, vibrations, freeze/thaw of soil, or corrosion. The costs for correcting real water loss can vary considerably depending on the requirements for repair. ODW estimates line replacement costs ranging from $30 to $80 per linear foot and emergency line replacements costs of about $4,000 to $5,000 per connection. Eliminating leakage from the waterworks not only saves money but also improves public health and reduces the potential for contamination.

ODW does not capture water loss data; however, the DWSRF application requests that the waterworks provide water loss information. For 2018, 2019 and 2020, waterworks provided the following information for water loss as a percent of total production (unbilled, authorized use was excluded):

	2018	2019	2020
Number of Applications:	38	19	25
Mean:	42.5%	38.8%	31.8%
Median:	43%	36.2%	29%
Standard Deviation:	20.1%	18.14%	18.9%
Minimum:	8.7%	10%	2.5%
Maximum:	75%	73.07%	67.53%

Strategies for waterworks to reduce water loss include source-water metering, service connection metering, public use water metering, accounting for water use, and locating and repairing leaks. The cost of water leakage can be measured in terms of the operating costs associated with water supply, treatment, and delivery. Water lost produces no revenues for the utility. Repairing larger leaks can be costly, but it also can produce substantial savings in water and expenditures over a long period. Virginia Rural Water Association (VRWA) has a free program that provides equipment and staff to locate leaks, which is partially funded by the DWSRF grant.

d. Funding Needs

EPA's sixth national assessment of public water infrastructure shows that $472.6 billion is needed in the United States for a 20-year capital improvement.[22] This estimate represents infrastructure projects that are eligible for funds from the DWSRF through December 31, 2034. The national total comprises the infrastructure investment needs for about 49,250 community water systems, and 21,400 not-for-profit, non-community water systems, American Indian water systems, and the Alaska Native Village water

[21] American Water Works Association (AWWA), 2012. "Buried no longer: Confronting America's water infrastructure challenge." AWWA, Denver, CO.

[22] The 1996 SDWA Amendments mandated that EPA conduct an assessment of the nation's public water systems' infrastructure needs every four years and use the findings to allocate DWSRF capitalization grants to states. Throughout this report, information presented in the tables and figures is derived from survey data from the referenced year unless otherwise noted. Data for small systems (serving 3,300 or fewer people) is extrapolated from information collected in 2007; data for American Indian and Alaska Native Village systems is extrapolated from information collected in 2011; and data for not-for-profit non-community water systems is extrapolated from information collected in 1999 (USEPA, 2018a). For the 2015 Assessment, EPA did not directly survey small systems but estimated the infrastructure investment needs for these systems by adjusting the findings from the field survey completed for small systems in states, Puerto Rico, and the U.S. territories for the 2007 Assessment. In making the adjustment, EPA applied 2015 cost models using the current inventory of small systems (USEPA, 2018a).

systems. The survey response rate was 99.7 percent (2,592 responses from 2,600 systems surveyed), which provides a high degree of confidence in findings. Cost estimates reflect comprehensive construction costs, including engineering and design, purchase of raw materials and equipment, construction and installation labor, and final inspection.

EPA captures and assesses the impact of emerging drinking water challenges on the total national need in its Needs Assessments. Survey response data and feedback from the Drinking Water Infrastructure Needs Survey and Assessment (DWINSA) workgroup identifies trends and data gaps, which allows EPA to improve and refine the design of future surveys to more fully capture and assess system needs. The last national survey was performed in 2015 and should have been updated in 2019, but lack of funding and the COVID-19 pandemic have delayed the survey for over a year. The upcoming survey is not expected to be completed until the summer of 2021 and the data released by 2022.

In Virginia, EPA's Needs Assessment identified that $8.02 billion is needed for drinking water infrastructure improvement over the next 20 years, or approximately $401 million per year.[23] Funding agencies in Virginia provide only a fraction of the estimated $401 million per year need. Over the last five years, the total amount of funding requested for DWSRF infrastructure improvement averaged $46 million per annum. The funding requested for federal FY 2017 through 2018 from the four largest funding agencies was only $123.8 million.

Large waterworks often sell bonds or use general funds to self-fund drinking water improvement projects and do not request help from Virginia's funding agencies. In Virginia, 17 very large waterworks typically self-fund capital improvements projects. Other municipalities that own a waterworks will also self-fund infrastructure improvements. ODW estimates annual self-funding to be $31 million. Hence, ODW estimates the following funding gap in Virginia: $401 - ($123.8 + $31) = $246.2 million funding "gap," which represents about half of the total need in Virginia. ODW estimates that at least $1 billion in drinking water revenues are generated in Virginia annually. As such, the possible funding gap might be more easily resolved with better AMPs and CIPs. Deferral of necessary improvements can result in degraded water service, water quality violations, risk of harm to public health, and higher costs. For waterworks to avoid future problems, Virginia needs a more robust plan to maintain drinking water infrastructure.

e. Funding Sources

Waterworks use many different financial tools and income sources to fund ongoing operational expenses and pay for investments in infrastructure. The majority of funding for drinking water infrastructure comes from revenue generated by ratepayers. Additional funding comes from loans and grants from the state and federal governments, commercial lenders, bond markets, and other entities that tend to focus their resources on specific regions or populations. Funding sources, the amount of funding, and their impact on waterworks in Virginia are addressed below.

Waterworks have several methods of self-funding capital improvements. These typically include user rates and fee increases, borrowing in the municipal bond market, taxes, and general funds. User rates represent a primary source of revenue for waterworks. For community waterworks, customers pay monthly or bi-monthly for water and sewer. Waterworks can also charge for in-town and out-of-town customers, connection fees, and capital recovery charges. Publicly owned waterworks are not required to

[23] The March 2018 assessment need is modeled and not based on current data. EPA used data collected in 1999.

seek approval from the State Corporation Commission to increase rates; private/investor owned waterworks must justify rate increases and seek approval.

In early 2018, ODW sent a survey to over 600 waterworks in Virginia for information on financial aspects of operations. The response rate, less than 10%, was too low to determine any statistically significant data. Additional research would help determine the amount of self-funding waterworks in Virginia are dedicating to asset management. This information would help ODW determine whether and to what degree there is a funding gap for replacing aging infrastructure.

Each community waterworks in Virginia has different rate structures and consumption patterns. Given the variability of billing, and no oversight of billing and collections for publicly operated waterworks, ODW cannot determine whether total revenue meets the needs for operations, capital improvements, and asset management. However, using US Census data, EPA water usage data, and a 2017 Draper Aden Associates Water and Wastewater Rate Report (Draper Aden, 2017), ODW can calculate the approximate annual revenue collected from ratepayers.

According to the Draper Aden Report, the median water charge in Virginia for 5,000 gallons per month is $32.28. In Virginia, there are approximately 2,204,000 billable connections.[24] The annual revenue generated by water user rate collections is approximately $854 million.[25] The Draper Aden Report also captures the median connection and capital recovery fees for new connections, which collectively amount to approximately $3,000. The US Census reports there were 33,760 building permits issued for new housing in Virginia in 2017 (US Census Bureau, 2017). Assuming each building permit results in a new connection, the annual revenue generated by combined connection fees would be approximately $101 million[26] and total annual revenue for residential connections would be in the range of $955 million. Adding commercial and industrial connections, ODW expects annual revenue is over $1 billion.

Issuing a municipal bond in the public markets to fund drinking or wastewater system improvements is a capital funding option for local governments (including authorities) that own a waterworks. Often the security is a pledge of water system revenues, but a general obligation pledge may also be used. When the general obligation is used, the bond-offering document may or may not disclose the detailed amounts intended specifically for drinking water system improvements. Additionally, a revenue bond containing both water and sewer system requirements, may comingle amounts for drinking water improvements with sewer improvements. A review of the local government's capital improvement plan can provide additional clarification or a means to estimate how much of a bond issue's proceeds will be used for each type of water system improvements.

Bond offering documents are required to be posted to the Electronic Municipal Marketing Access (EMMA) website (https://emma.msrb.org/) operated by the Municipal Securities Rulemaking Board. Virginia Resources Authority (VRA) estimated the drinking water improvements amounts based on historical information since the drinking water and wastewater amounts were not segregated.

[24] Based on the state FY 2017 VDH Technical Assistance Fee billing to waterworks, total count of billable connections.

[25] $32.28 monthly bill x 2,204,000 connections x 12 months = $854 million

[26] $3,000 total connection fee x 33,760 new connections/year = $101 million.

Fiscal Year 2018 Public Bond Issuance	*Water Improvements Estimate*
$10,735,000 City of Charlottesville General Obligation Public Improvement Bonds, Series 2018	$3,900,000
$102,410,000 County of Henrico, Virginia Water and Sewer System Revenue Bonds, Series 2018	50,000,000
$26,700,000 City of Norfolk Water Revenue Bonds, Series 2018	31,000,000
	$84,900,000

VRA can make loans to local governments including authorities that own a waterworks using its Virginia Pooled Financing Program (VPFP). This program provides an easy, cost-efficient method to access capital for a number of project areas. Since 2005, VRA has funded about $4.6 billion in total. Over the last two years, VRA has funded the following drinking water projects for local governments:

VPFP FY 2020	
Local Government	**Amount (Est.) Millions**
NRV Regional Water Authority	9,900,000
Washington County Service Authority	9,200,000
Total:	19,100,000
Local Government FY2019	
City of Lexington	1,462,500
Rivanna Water and Sewer Authority	20,000,000
Surry County	3,730,000
Western Virginia Water Authority	6,000,000
Total:	$ 31,192,500
Public Issuance Local Government FY 2020	
Spotsylvania County	16,495,058
Local Government FY 2019	
Henrico County	70,000,000

VPFP borrowers realize savings from VRA's unique state credit enhancements based in part on Virginia's moral obligation, shared expenses, and a straightforward and customer-friendly loan process. VRA's high credit ratings, "AAA" for the senior bonds and "AA" for the subordinate bonds, results in favorable access to the capital markets for Virginia localities without the need for additional credit enhancements.

The Rural Utilities Service Water and Environmental Programs (WEP) provides funding for the construction of water and waste facilities in rural communities. WEP is the only federal program exclusively focused on water and waste infrastructure needs of rural communities with populations of 10,000 or less. WEP also provides funding to organizations that provide technical assistance and training to rural communities in relation to their water and waste activities. Rural Development administers WEP

through the National Office staff in Washington, DC, and a network of field staff in each State. For FY 2018, Rural Development appropriated $109,329,000 as loans and $17,259,000 for grants. Out of this total, $4,413,000 in loans and $2,601,000 in grant funding was for drinking water infrastructure.

The Department of Housing and Urban Development (HUD) administers the Community Development Block Grant (CDBG) program to improve the economic, social and physical environment of eligible low- and moderate-income communities. The CDBG program offers general purpose and specialty grants that can fund a wide range of activities that principally benefit low and moderate-income persons. Small, rural cities/towns and counties that are not entitled to receive CDBG funds directly from HUD can apply for a state CDBG grant.

ODW manages two funding sources under FCAP, the DWSRF and Water Supply Assistance Grant Fund Program. FCAP receives and considers construction applications for both funding sources on a year round basis. DWSRF combines federal and state funds to offer a mix loan, grant and refinancing opportunities.

Forty-one percent (41%) of respondents to a recent state and utility survey conducted by the Eastern Research Group for the American Water Works Association indicated demand for DWSRF funding is currently lower than availability of funds. The primary reasons provided by state respondents for why waterworks with existing infrastructure needs may not be pursuing DWSRF funds include a reluctance to take on debt (71%), preference for other sources of funding (67%) and other reasons (49%), including reluctance to work with the federal government, lack of political will to raise rates to cover the cost of debt repayment, and poor credit. (ERG, 2018)

The burden of federal requirements associated with federal grant and loan dollars and the ability of some waterworks, particularly those with strong credit ratings, to obtain interest rates on the bond market that are comparable to or better than the DWSRF mean that some waterworks are seeking outside funding assistance. Federal requirements associated with DWSRF and the Water Infrastructure Finance and Innovation Act (see below) grant and loan dollars can include compliance with the Davis-Bacon Prevailing Wage Act, American Iron and Steel Act Requirements, the National Environmental Review Act, Civil Rights Act, and many others.

The Southeast Rural Community Assistance Project (SERCAP) is one of six non-profit organizations in a national network that are dedicated to empower and assist rural low income people improve the quality of life in their communities by bringing safe drinking water, environmentally sound wastewater disposal facilities, housing rehabilitation, and community development assistance to local residents. SERCAP serves the states of Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida.

SERCAP's Facilities Development program is intended to provide significant financial assistance to Virginia's rural communities for the development and maintenance of their water and wastewater systems. Assistance is provided in the form of grants to local government bodies and water and wastewater systems through SERCAP's state appropriation administered by the Virginia Department of Housing & Community Development. SERCAP's Facilities Development program only funds projects located within Virginia. The current funding level of the annual appropriation is approximately $500,000. SERCAP accepts applications for grant funding on a first-come, first served basis contingent on funding availability. Only units of local government, sub-units of local government, or regional consortia of local governments (e.g. water district authorities, public service authorities, planning district commissions, etc.) and private not-for-profit community systems (e.g. nursing homes, non-profit hospitals, etc.) are eligible to apply. Private for-profit businesses and individuals are not eligible.

The Coalfield Water Development Fund (CWDF) provides grant assistance for waterworks construction in Lee, Scott, Wise, Dickenson, Russell, Buchanan, and Tazewell Counties and the City of Norton. Waterworks have used the fund to expedite water development by providing gap financing, encouraging regional water system development and local investments in water, and addressing public health problems related to the quantity and quality of water. The CWDF is a 501 c (3) non-profit organization created as a national demonstration project from the 1996 amendments to the SDWA. EPA, VDH, Mountain Empire Community College, federal, state, and local elected leaders, and the CWDF's 17-member board support the demonstration project. The CWDF is managed through an administrative contract with a consultant and a private accounting firm. The CWDF has an $8.2 million endowment originating from a $10 million loan with a 30-year term from the DWSRF. It also has a $294,000 endowment originating from an EPA grant. Zero coupon bonds ensure repayment of the loan. Individuals, companies and foundations associated with the coal industry have also made private gifts to the CWDF.

CWDF schedules grant solicitations annually. Local governments, as well as public and private water operators, are eligible to apply for grants. The typical grant "fills in the gaps" in a funding package to allow a water project to go forward. Priority has been given to projects establishing new water service; in the future, it is expected that the focus will be on rehabilitating or upgrading existing service. Since inception, the CWDF has awarded $8 million in grant funding for drinking water projects, which has leveraged $89 million in other funding. The endowment that has been established through the demonstration project will continue to provide grants for drinking water projects in perpetuity.

The Water Infrastructure Finance and Innovation Act of 2014 (WIFIA) established a federal credit program administered by EPA for eligible water and wastewater infrastructure projects. In the Consolidated Appropriations Act, 2018, signed by the President on March 23, 2018, Congress provided at least $55 million in budget authority for the WIFIA program to cover the subsidy required to provide a much larger amount of credit assistance. EPA estimates that this budget authority may provide approximately $5.5 billion in credit assistance and may finance approximately $11 billion in water infrastructure investment, while covering increased costs associated with implementing a larger program. WIFIA and the WIFIA implementation rule outline the eligibility and other requirements for prospective borrowers. Eligible borrowers are local, state, tribal, and federal government entities; partnerships and joint ventures; corporations and trusts; and DWSRF programs.

Private bank lending is possible for credit worthy waterworks. ODW does not have access to data from private lenders. When private lenders make loans, the typical loan term is 15 years or less. Interest rates in the private market are always higher than the rates provided by the DWSRF program and many small and disadvantaged communities only have access to DWSRF funding.

f. Asset Management Plans and Capital Improvement Plans

Data from triennial assessments completed in 2017 indicate that 45.1% of waterworks have some form of an AMP. The new 2020 triennial assessment data demonstrate an increase to 48.6% of systems with an AMP. While AMPs are not required under the SDWA or the Waterworks Regulations, the America's Water Infrastructure Act (AWIA) of 2018 requires AMPs be included and encouraged in the Capacity Development Strategy. ODW requires waterworks without an AMP to develop one as part of the DWSRF loan process. Because this is a new requirement, ODW does not have enough data to estimate funding needs.

ODW formed an ad-hoc committee of interested parties to assist with AMP training and technical assistance to waterworks. Virginia could formalize this committee into an Asset Management Advisory Group to train, educate, lend assistance and direct the emergence of Asset Management in the water utility sector in the Commonwealth. Further, Virginia could demonstrate a comprehensive support of this initiative through the funding of Asset Management Plans for waterworks under 10,000 persons, and associated training for waterworks staff and operators.

Capacity Development provides funding for AMPs through the Planning and Design Grants and the Small Project Engineering Program. FCAP also will provide funding for AMPs. However, waterworks owners often consider ODW's request to obtain copies of financial information about waterworks to be outside the scope of the DWSRF program. Even AMPs and CIPs are considered "intrusive" and so ODW lacks the data to provide estimates of aging infrastructure needs from these planning tools. As AMPs are more commonly adopted, funded, and required as a condition of construction funding, ODW hopes to capture more of this data so it can develop, track, and project aging infrastructure replacement needs in Virginia.

Other states have already enacted similar proposals.[27] For example, the West Virginia Infrastructure and Jobs Development Act created the West Virginia Infrastructure and Jobs Development Council. The Act requires the Council "to develop a comprehensive statewide inventory of water supply systems… and an assessment of current and future needs" at least once every three years.[28] In the assessment, the Council is required to identify areas with inadequate public water systems and recommend construction projects to meet those needs and identify obstacles to developing adequate infrastructure.[29]

Similarly, Ohio enacted legislation requiring that "[a] public water system… demonstrate the technical, managerial, and financial capability of the system to comply with this chapter and rules adopted under it by implementing an asset management plan…" The law is implemented by the state's environmental protection department and requires that it inventory and evaluate all public water system assets, approved capacity projections, contingency planning programs, a capital improvements plan for long-term funding, an asset rehabilitation and replacement program, operations and maintenance programs, and a long-term funding strategy.[30]

While other states imposed regulatory requirements on water systems, Virginia still only has authority to encourage AMPs and CIPs through its Capacity Development program. West Virginia's water infrastructure council and Ohio's inventory of all public water system assets is a novel approach, but requires an enormous amount of effort and resources. VDH would need considerable more staff and funding to maintain such an inventory and support regulatory oversight. Additionally, AMPs and CIPs are expensive and challenging, especially for smaller waterworks with limited TMF capacity. ODW has seen an increasing willingness for waterworks to worth with staff to develop an AMP or CIP through education and training, but smaller systems may require more incentivizing and assistance. In addition,

[27] See, State Asset Management Initiatives, https://www.epa.gov/sites/production/files/2016-04/documents/state_asset_management_initiatives_11-01-12.pdf; see also, https://efc.sog.unc.edu/sites/default/files/2017/Report%205%20-%20How%20States%20Inventory%20Infrastructure%20Needs.pdf.
[28] See, W. Va. Code § 31-15A-6.
[29] Id.
[30] See, 61 Ohio Rev. Code. § 6109.24 (2017), available at http://codes.ohio.gov/orc/6109.24v1.

the state lacks overall funding necessary to manage asset management for waterworks or funding for the regulated community.

IV. Analysis and Discussion

Based on low numbers of health-based violations, the low number of waterworks with ETT scores greater than 10, and other measures including an American Society of Civil Engineers (ASCE) 2015 Report Card score of A- for Compliance and B+ for Capacity Development, VDH has a robust program that is monitoring and protecting public health in the Commonwealth of Virginia. Challenges remain with replacing lead service lines, managing water loss, operator certification, and funding aging infrastructure projects. ODW should publicize its success stories, provide more data visualizations, and continue educating stakeholders and the public.

Funding water infrastructure creates jobs and boosts economic output. The Council of Economic Advisers estimates the economy creates 10,854 full-time jobs with each one billion dollars of water infrastructure spent (includes direct, indirect and induced jobs). The U.S. Conference of Mayor's Water Conference cites that for each additional dollar of revenue (or the economic value of the output) of the water and sewer industry, the increase in revenue (economic output) that occurs in all industries is $2.62 in that year. Further, adding one job in water and sewer creates 3.68 jobs in the national economy to support that job.[31] As such, investment in Virginia's water infrastructure has numerous benefits.

In conducting this study, ODW found that infrastructure expenditures related to replacement, refurbishment, or repair of aging infrastructure are unknown and are not tracked by any agency or organization. EPA demonstrated a need for more funding; however, no organization appears to be tracking the actual financial investments by waterworks across the state. Anecdotal evidence indicates that medium to large waterworks (those serving more than 10,000 consumers) appear to have adequate access to infrastructure funding, whether from federal, state, or local programs, self-funding through bonds and commercial lending, general funds, or reserves. The Virginia DWSRF preferentially directs funds towards small, financially disadvantaged waterworks. However, ODW does not track waterworks' needs unless the waterworks approaches ODW for DWSRF assistance. When waterworks come to the program for construction funding, ODW works with the systems to improve financial strength and provide low interest loans and grants.

Dedicated state funds, above the amount required for state matches on federal grants, appropriated by the General Assembly would provide greater financial assistance to waterworks and individual property owners for expenditure reimbursements associated with aging infrastructure including lead service line replacement. Virginia's LSLR program could use more funding to the Water Supply Assistance Grant Fund and more staff, depending on the size and scope of program implementation. Authority for the program is based on Code of Virginia § 32.1-171.2 B, which states that the Board "shall use the moneys appropriated as matching funds for that purpose and, subject to other available funds, may make Water Supply Assistance Grants from the Fund to localities and the owners of waterworks to assist in the provision of drinking water."

[31] The U.S. Conference of Mayors. Local Government Investment in Municipal Water and Sewer Infrastructure: Adding Value to the National Economy. Richard A. Krop, Ph.D., Charles Hernick, and Christopher Frantz. The Cadmus Group, Inc. August 14, 2008. See also 2017 Drinking Water State Revolving Fund Eligibility Handbook. EPA, June 2017.

ODW urges waterworks owners to establish and fund a capital reserve account that adequately supports capital improvements and asset replacements. Owners are encouraged to raise or adjust water rates to ensure adequate financial resources, as this is crucial to maintaining a successful and sustainable waterworks. Furthermore, ODW suggests that waterworks owners implement a revenue growth model that includes automatic annual rate adjustments that equal or exceed the rate of inflation to provide adequate debt capacity to fund capital improvements. ODW further encourages waterworks self-evaluate their financial position annually. Experience has shown that appropriately structured utility rates gradually increased annually over time are most effective in keeping revenue at pace with costs.

Waterworks that use the DWSRF must have adequate debt coverage through the VRA funding agreement. Other waterworks receiving funding from other lenders may be required to have debt coverage too; however, ODW is not recommending additional authority for requiring adequate debt coverage outside of the DWSRF. Having adequate financial capacity and an acceptable credit review is a DWSRF program requirement, and additional financial coverage outside of the DWSRF to prove a waterworks can operate its facility is not well supported. The debt service coverage ratio is the Net Revenue (revenue minus operations and maintenance) available for debt service divided by applicable debt service. ODW evaluates debt ratio using the first two fiscal years after project completion. A ratio of 1.15 or greater is required for funding under the DWSRF program. ODW and VRA consider a ratio of 1.50 or greater, strong.

ODW works with any waterworks serving a population less than 10,000 consumers on financial indicators regardless of whether the waterworks applies for funding to the DWSRF program for construction funding, or to any of the other funding agencies. However, ODW does not track waterworks that do not seek assistance for construction expenditures. This can include the very large systems (e.g., Fairfax Water, City of Richmond, Loudon County, and Henrico County) and the very small systems. In either case, if the funds spent on aging infrastructure are not part of a federal or state funding program, the amount and type of expenditure is not tracked.

Through the Capacity Development program and other technical assistance providers, waterworks are using AMPs more frequently. The 2020 TMF Assessment revealed a 3.5% increase in waterworks reporting having an AMP, from 45.1% to 48.6%. While this is a sign of progress, additional authority and funding for AMPs may help accelerate the use of this management tool. Virginia has formed an ad-hoc committee of interested parties to assist with AMP training and technical assistance to waterworks. Virginia could formalize this committee into an Asset Management Advisory Group to train, educate, lend assistance and direct the emergence of Asset Management in the water utility sector in the Commonwealth. Further, Virginia could demonstrate a comprehensive support of this initiative through the funding of Asset Management Plans for waterworks serving fewer than 10,000 consumers, and associated training for waterworks staff and operators.

The number and complexity of federal drinking water rules that must be implemented, monitored, and enforced has continued to increase ODW's workload. Staff dedicated solely to capacity development allows engineers and other positions to focus on monitoring and enforcing standards. ODW has an efficient and effective capacity development strategy, which will continue to achieve the fundamental goals of collaborating across Virginia to improve TMF capacity. Adequate funding and staffing are essential to implementing activities most critical to enabling waterworks achieve and maintain sufficient TMF capacity and provide safe, reliable drinking water to all people who are serviced by a waterworks.

V. Recommendations

1. Consider providing Virginia's required 20% match to the DWSRF program. The Governor's 2020 budget amendments unallotted $482,400 from the DWSRF program, which is necessary to provide the full 20% match to the annual federal grant if it reaches its most recent amount of $18.1 million.

2. Consider providing additional funding for the drinking water program to decommission outdated and unsecure data systems. The Governor's 2020 budget amendments unallotted $150,000 in the first year, and $250,000 in subsequent years to decommission and replace outdated systems.

3. Consider appropriating new funding to support Virginia's Lead Service Line Replacement (LSLR) program. This will reflect the General Assembly's dedication to the program and allow easier entry into the program for new participants by avoiding certain federal grant requirements.

4. Consider additional funding to hire more drinking water staff to fully implement the Lead and Copper Rule Revisions (LCRR). ODW estimates that an additional 12 full time employees are necessary to fully implement new federal requirements in the LCRR. ODW expects the LCRR, when released, will have a lower lead action level, will require waterworks to complete inventories of lead service lines and connections, will require waterworks to perform more sampling, and primacy agencies will have to monitor compliance, compile data, and provide additional oversight and technical assistance.

5. Consider additional funding to hire more drinking water staff to fully implement split sampling and more quality assurance, quality control (QA/QC) to ensure waterworks properly sample and take samples in accordance with sampling plans as recommended by the Office of the State Inspector General.

6. Consider amending the Public Water Supplies law, at Code of Virginia § 32.1-171 A, to give the Board of Health authority to include requirements in the Waterworks Regulations for asset management plans (AMPs), inventorying lead service lines, monitoring water loss by waterworks, and other infrastructure monitoring and maintenance.

7. Consider funding for small waterworks to develop AMPs and capital improvement plans.

8. Consider providing statutory authority for VDH to regulate aging infrastructure and water loss as part of its drinking water program. Collaborate with the Environmental Finance Center Network or a similar center of higher education to study infrastructure funding through local general fund, bond fund, reserve fund, and private investor mechanisms.

9. Incentivize counties to assist failing waterworks and struggling and distressed towns (within their county) as a condition for accessing state grant and low interest loan funds through the state agencies. Assistance could be consolidation, purchase, or an aid agreement.

10. Incentivize small and very small waterworks in Virginia to establish capital improvement, emergency management, and operation and maintenance cash reserves.

11. Encourage waterworks to review their water rates and rate setting procedures regularly.

12. Incentivize waterworks, managing utilities, and public service authorities to undertake asset management programs.

13. As funding allows, continue the program's move away from a paper-based program toward an electronic program.

14. Encourage waterworks to conduct TMF self-assessments and compare progress against a benchmark. Expect waterworks below a defined threshold to develop a business operation plan and define strategies to improve TMF performance.

15. As funding allows, develop a process to define and identify communities with aging infrastructure. Provide priority assistance to communities with managerial and technical capacity, but that lack strong financial capacity.

VI. Office of State Inspector General Program Review

The Office of the State Inspector General (OSIG) is performing a programmatic review of Virginia's drinking water program to determine whether ODW effectively monitors waterworks in Virginia. OSIG's interim report and recommendations follow.

COMMONWEALTH OF VIRGINIA
Office of the State Inspector General

Michael C. Westfall, CPA
State Inspector General

P.O. Box 1151
Richmond, Virginia 23218

Telephone 804-625-3255
Fax 804-786-2341
www.osig.virginia.gov

October 15, 2020

M. Norman Oliver, MD, MA
State Health Commissioner
Virginia Department of Health
P.O. Box 2448
Richmond, Virginia 23218-2448

Dear Dr. Oliver,

The Office of the State Inspector General (OSIG) is engaged in a performance audit of the Virginia Department of Health's Drinking Water Regulation program and provides an interim report on the planning of the audit and the first phase of audit fieldwork below. OSIG has completed the interim report at the request of the Office of Drinking Water (ODW) in connection with A Study on Virginia's Drinking Water Infrastructure and Oversight of the Drinking Water Program (HJ92) for issuance to the General Assembly. OSIG is performing the audit in accordance with Generally Accepted Government Auditing Standards (GAGAS) and is focusing on identifying potential improvements to the Commonwealth of Virginia's safe drinking water monitoring and compliance processes.

Virginia Department of Health – Office of Drinking Water Performance Audit
Interim Report – October 2020

The overall objective of the performance audit is to determine whether ODW effectively monitors Virginia's public waterworks in accordance with the U.S. Environmental Protection Agency's Safe Drinking Water Act (SDWA) and the Commonwealth of Virginia Waterworks Regulations.

The scope of the ODW performance audit spans fiscal year 2015 through the current operating environment. OSIG's preliminary methodology, referred to as survey, consisted of interviewing key staff members; documenting processes and procedures related to ODW public water system

monitoring and inspections; reviewing information used to track and maintain Virginia's safe drinking water; and benchmarking with other states.

Based on information obtained during survey, OSIG designed the following objectives to evaluate the efforts made by ODW to enforce the SDWA and to ensure public waterworks are providing the citizens of Virginia water fit for human consumption. OSIG address objectives A, B and C in this interim report.

A. Determine whether ODW effectively monitors public water systems (PWS) in Virginia to ensure safe drinking water by continuous monitoring and water sample testing for various identified contaminates.
B. Determine whether ODW effectively monitors PWS in Virginia to ensure safe drinking water by conducting sanitary surveys (i.e., on-site inspections) of PWS.
C. Determine if ODW conducts systematic reviews of water testing data in the State Drinking Water Information System and if staff reviews results for indications of problems that may develop over time and questionable results that could indicate mistakes or fraud.
D. Examine the violations issued from 2015 through 2019 to assess the effectiveness of ODW monitoring and enforcement efforts.
E. Determine if ODW has taken formal enforcement actions against public water systems that incurred significant violations for maximum containment level, treatment technique, or monitoring and reporting requirements.
F. Determine if ODW is assessing or collecting civil penalties for drinking water violations.

OSIG's summary observation of ODW is that the agency has proactively taken steps to improve current monitoring and compliance processes. ODW has developed and tracks timeliness and health-based performance metrics to evaluate the success of its program. In addition, ODW recently developed and implemented the Drinking Water Enforcement Manual to improve its oversight of the PWS. The implementation of policies and procedures included in the manual will provide consistency among ODW field offices and direction to ODW compliance specialists stationed in field offices.

Based on audit work for objectives A, B and C, OSIG details preliminary findings and recommendations in Attachment #1 and summarizes below. The audit is still in progress and some potential exists that the final phase of OSIG's audit work or discussions with ODW management in preparation of the final report will affect the findings and recommendations. Specifically, OSIG found that:

- ODW should strengthen enforcement practices.

- ODW should use administrative orders and civil penalties as a means of enforcing safe drinking water laws.
- ODW water sampling processes have limited oversight.
- ODW should improve monitoring and analyzing of compliance performance.

While this interim report focuses on objectives A, B and C, OSIG will be issuing a final report on all six objectives following the completion of fieldwork.

Sincerely,

10/15/2020

X Michael C. Westfall

Michael C. Westfall, CPA
State Inspector General
Signed by: Westfall Michael wzg39453

CC: The Honorable Clark Mercer, Chief of Staff to Governor Northam
The Honorable Daniel Carey, M.D., Virginia Secretary of Health and Human Resources
Dwayne Roadcap, Director, Office of Drinking Water
Maisha Beasley, VDH Internal Audit Director

Office of Drinking Water
Interim Report – October 2020
Attachment #1
Preliminary Findings and Recommendations

Items	*Findings*	*Recommendations*
1	Only one of six regional field offices have a formal process for documenting and tracking notices of violations and administrative orders. ODW regional offices employ informal means of communication, e.g. phone call, verbal confirmation during site visits, etc., to notify public waterworks owner operators of a return to compliance.	Assess enforcement processes and develop better management practices and tracking systems to ensure issuance of enforcement actions for all violations and closing of violations in a timely manner, along with the recommendations stated in Item #2.
2	Across the six field offices, OSIG randomly sampled 30 violations. Three of the violations resulted in administrative orders. None of the three administrative orders resulted in civil penalties even though clearing the violations took six months or longer for the public water system to return to compliance. In addition, OSIG noted that serious health-based violations for maximum containment level and treatment technique identified in the sample resulted in one administrative order and, as stated above, no escalated civil penalties.	• Continue the process of finalizing written guidelines for the escalation of enforcement actions from informal to formal, including the imposition of civil penalties. • Clearly define appropriate enforcement timeframes, particularly for health-based violations. • Monitor and report the performance of enforcement actions in annual compliance reports, including the median number of days it takes for violations to return to compliance by violation type and number of violations remaining open at year-end.

	Findings	*Recommendations*
3	ODW has not fully utilized administrative orders and civil penalties as a means of enforcing Virginia waterworks regulations, specifically for public water systems that are habitual and nonresponding violators.	Enforce *Code of Virginia* §§ 32.1-27 and 32.1.175.01 because the purpose of these statutes is to support the agency's efforts to ensure that public water systems comply with Virginia waterworks regulations. Continue implementation of updated administrative order and civil penalty policies and procedures within the new enforcement manual. The following items should be added to ensure that enforcement and reporting is occurring: • A reporting mechanism for ODW management to identify habitual and nonrespondent public water system violators. • An outline of escalation procedures to ensure timely enforcement of water regulations consistently among the regions in the state. • A consent order and civil penalty tracking system shared between ODW central office and regional field offices to monitor assessments, correspondence, collections, etc. • Regular training and guidance for staff, especially compliance specialists, on the new enforcement manual's methodology for calculating, adjusting and recording penalties to ensure practices are appropriate, fair and consistent with statutory requirements.

	Findings	*Recommendations*
4	ODW water sampling processes rely on the integrity of water system owner operators, licensure training and technical assistance to guide the proper collection and submission of water samples. Current processes do not cover the following risk areas: • ODW does not inspect the sample collection process. The department approves a sampling site plan for certain chemicals, but does not check that an individual sample actually came from the designated location on the plan. Although drinking water labs are required to conduct internal audits, any deviations from sampling requirements may go undocumented and therefore go undiscovered. Specific vulnerabilities could include water samples collected from sources outside the actual water supply, taken from the same location or altered to remove impurities. • ODW does not perform an independent systematic sampling of public water systems as a check on the entire system. ODW may conduct internal tests of drinking water under special sampling circumstances, such as consumer complaints. • The sample process for certain chemicals relies on public water system customers. They are provided instructions on how to perform the sampling procedures, but no one knows how well customers actually implement the instructions. • Some certified labs are in-house and are part of a large public water system. Therefore, the in-house lab conducts sample collection, recording, testing and reporting.	Strengthen existing strategies and procedures to maintain or improve the integrity of water sampling processes such as: • Developing a process for checking samples used for analysis to ensure systems took samples from locations on their sampling plan. • Implementing policies and procedures that allow for random water sampling and testing of public water systems to verify and confirm the validity of water samples that are required for monitoring. This could be performed during the course of performing sanitary surveys or by an alternate schedule established by the agency. • Developing oversight policies and procedures to ensure proper and valid collection of water samples.

	Findings	*Recommendations*
5	ODW has developed internal reports that track three timeliness-based and one health-based performance metrics. ODW's current performance metric reports do not include data that will allow management to evaluate the effectiveness of water monitoring and compliance processes. ODW has self-identified the need for expanded performance data analysis.	Develop evaluation, analysis and reporting of monitoring and compliance performance metrics to include: • Days late in reference to inspections, sampling, etc. • Days between sampling, notice of violations and notification of the return to compliance. • Current and historic chemical testing results with a focus on exceedances. • Habitual violators and nonrespondent waterworks. • Other criteria for determining the effectiveness of monitoring and compliance processes. Include performance analysis and reporting in discussions with the Office of Information Management and Global Environmental Consulting to ensure any updates to current software platforms and/or implementation of new software will have the capability to track appropriate monitoring and compliance data.