Reduction of Toxics in State Waters

2023 Biennial Report

Virginia Department of Environmental Quality

January 1, 2023

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Appendices

The complete set of Appendices associated with this report, as well as the text document, are available on the Department of Environmental Quality's website at:

https://www.deq.virginia.gov/water/water-quality/monitoring/toxics-report

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Glossary of Acronyms, Abbreviations, and Technical Terms

Ambient Monitoring	The monitoring of physical and chemical characteristics within the Commonwealth's rivers, streams, lakes, and estuaries. Ambient monitoring and assessment characterize ecological stressors and evaluate their potential impact on aquatic organisms and other wildlife, and on human health and recreational use of Virginia's waters.
AMD	Acid Mine Drainage
AOC	Area(s) of Concern
AQ	Project Code for the Ambient Monitoring Program
Aroclor	Aroclor is a PCB mixture produced from approximately 1930 to 1979.
ALU	Aquatic Life Designated Use
AW	Project Code for the Ambient Watershed Monitoring Program
B4B	Businesses for the Bay Program
BDE	Bromated diphenyl ether
B-IBI	Benthic Index of Biotic Integrity
BN	Project Code for Chesapeake Bay Non Tidal Network Monitoring
BTU	British Thermal Unit - the amount of energy required to increase the temperature of one pound of water by one degree Fahrenheit, at normal atmospheric pressure
C2	Project Code for the Coastal Probabilistic Program
CARITAS	Churches Around Richmond Involved To Assure Shelter
CB	Project Code for Chesapeake Bay Water Quality and Habitat Monitoring
CBP	Chesapeake Bay Program
CEDS	Comprehensive Environmental Data System
CIMS	CBP Information Management System
CL	Project Code for the Clinch River Special Study
CM	Project Code for Citizen Monitoring requests performed by DEQ
Compliance Monitoring	The monitoring of in-pipe concentrations of permitted discharges, which is one element in the prevention of contamination by toxics. Compliance monitoring evaluates whether or not the concentrations of potential pollutants in industrial, municipal or other permitted discharges are within the allowable limits specified in their permits.
CPMI	Coastal Plain Macroinvertebrate Index – used to evaluate the health of freshwater benthic communities in the Coastal Plain Region of Virginia.
CVs	Consensus-Based Sediment Quality Guidelines – critical values for contaminants in freshwater sediment (replace freshwater use of previously utilized ER-L and ER-M values intended for assessment of estuarine and marine sediments; MacDonald et al. 2000). See also PEC, below.
CWA	Federal Clean Water Act (1983) that first described the scope and purpose of water quality standards and defined the authority and responsibility of EPA and the various states in relation to the requirements for, submission of, and establishment of such standards.

CY	Calendar Year (January 1 – December 31)
DCLS	Division of Consolidated Laboratory Services of the Virginia Department of General Services (DGS)
DEQ	Department of Environmental Quality
DGS	Department of General Services
DM	Project Code for the Dominion Virginia City Hybrid Energy Center
DMR	Discharge Monitoring Report
DR	Project Code for the Dan River Fly Ash Spill special study
EDAS	Ecological Data Application System (database)
EEC	Extreme Effects Concentration – the concentration of a contaminant above which adverse effects to sediment-dwelling organisms frequently or always occur.
ELG	Effluent Limitation Guidelines
ELVS	End of Life Vehicle Solutions – corporation created by the automotive industry to promote the industry's environmental efforts in recyclability, education and outreach, and the proper management of substances of concern.
EMAP	Environmental Monitoring and Assessment Program – EPA
EMS	Environmental Management System
EPCRA	Emergency Planning and Community Right-to-Know Act
ER-L	Effects Range-Low
ER-M	Effects Range-Moderate
EPA	Environmental Protection Agency
FI	Project Code for Facility Inspections
FP	Project Code for Freshwater Probabilistic Monitoring
FT	Project Code for the Fish Tissue and Sediment Program
FY	Fiscal year
GW	Project Code for Groundwater Characterization Monitoring
HG	Project Code for the South River-South Fork of the Shenandoah River 100 Year Mercury Study
IBI	Index of Biological Integrity
ICPRB	Interstate Commission for the Potomac River Basin
IM	Project Code for Post TMDL Implementation Monitoring
IR	Program Code for Incident Response Monitoring
IR	"Integrated Report" – abbreviation for the 305(b)/303(d) Water Quality Integrated Assessment Report
IRIS	Integrated Risk Information System
KM	Project Code for Kepone Monitoring
LB	Project Code for Lafayette River Bacteriological Sampling
MAIA	Mid-Atlantic Integrated Assessment carried out by the EPA Environmental Monitoring and Assessment Program (EMAP)
MEC	Midrange Effect Concentration – the concentration of a contaminant above which adverse effects to sediment-dwelling organisms frequently occur.
MGD	Millions of Gallons per Day
Microgram	(µg or ug) One millionth of a gram

MonPlan	Annual Water Quality Monitoring Plan
MY	Monitoring Year
Nanogram	(ng) One billionth of a gram
NARS	National Aquatic Resources Survey
NCCA	National Coastal Condition Assessment
NELAP	National Ecological Laboratory Accreditation Program
NOAA	National Oceanic and Atmospheric Administration
NPEP	National Partnership for Environmental Priorities
NPS	Non-Point Source (pollution)
NRDAR	Natural Resource Damage Assessment and Restoration (Department of the Interior)
OCP	Organo-chlorinated Pesticide(s)
OE	Project Code for Observed Effects monitoring (3C Waters with Observed Effects / Insufficient Data)
OEE	Office of Environmental Education
OPP	Organo-phosphorylated Pesticide
OPP or OP2	Office of Pollution Prevention
PA	Project Code for Probabilistic Ambient Monthly Physical and Chemical Monitoring
PAH	Polycyclic Aromatic Hydrocarbon
PBTs	Persistent Bioaccumulative Toxics – toxic substances that accumulate (bio-concentrate) and persist in the tissues of living organisms.
PC	Project Code for Pollution Complaint Investigation/Spill containment (PREP)
PCB	Polychlorinated biphenyl
PE	Project Code for the Potomac Embayment Network
PEC	Consensus-based *Probable Effects Concentrations* for chemical contaminants in freshwater sediments (MacDonald et al. 2000). See also CV, above.
PF	Project Code for the Pfiesteria Special Study (Inactive)
Picogram	(pg) One trillionth of a gram
PMP	Pollutant Minimalization Plan is an iterative plan with a programmed schedule and final goal for the reduction (minimalization) of toxic discharge (*e.g.*, in particular PCBs) from a permitted point source. It supplants the necessity of establishing a reduced, fixed numerical limit which may be impossible to attain for a permitted discharge.
POTW	Publicly Owned Treatment Works
P2 or PP	Pollution Prevention Program
ProbMon	Probabilistic Monitoring Program
PT	Project Code for Probabilistic Targeted Stress Stations
QA	Quality Assurance – also the Project Code for Quality Assurance monitoring/sampling
QAPP	Quality Assurance Program and Project Plan
QC	Quality Control
RB	Project Code for Benthic Biological Monitoring

RBP	Rapid Bioassessment Protocol
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RL	Project Code for (Regional Lakes) Reservoir Monitoring
SCI	Stream Condition Index - used to evaluate the health of freshwater benthic communities of upland streams based on their macroinvertebrate community.
SFY	State Fiscal Year (July 1 – June 30)
SH	Project Code for the Shenandoah Fish Disease Task Force (inactive)
SIC	Standard Industrial Classification
SOP	Standard Operating Procedure
SPMD	Semi-Permeable Membrane Device
SS	Generic Project Code for Special Studies
STORET	EPA's legacy national ecological database
SV	Screening Value
SWMU	Solid Waste Management Unit(s)
TBT	Tributyltin
TEC	Threshold Effect Concentration – the concentration of a contaminant below which adverse effects to sediment-dwelling organisms are unlikely to occur.
TM	Project Code for the TMDL Program monitoring
TMDL	Total Maximum Daily Load
TMP	Toxics Management Program
TMR	Toxics Management Regulation
TOC	Toxics of Concern
TR	Project Code for the Ambient Trend Program
TRE	Toxics Reduction Evaluation
TRI	Toxic Release Inventory - The Toxics Release Inventory documents the total quantities of EPA-listed toxic compounds that are released annually (to the waters, the air, and the land) by permitted facilities within the Commonwealth. Changes in the quantities of toxics released are indicative of the effectiveness of pollution prevention programs, but are not an adequate or representative measure of environmental impact or impairment.
TRISW	Toxics Reduction in State Waters (report)
TSV	Tissue Screening Value – risk-based screening values used by DEQ and VDH for evaluating fish-tissues for human consumption.
TW	Project Code for Waters of Concern monitoring
USGS	United States Geological Survey
VCPMI	Virginia Coastal Plain Macroinvertebrate Index
VISE	Virginia Information Source for Energy (Website)
VDH	Virginia Department of Health
VEEP	Virginia Environmental Excellence Program
VELAP	Virginia Environmental Laboratory Accreditation Program
VERC	Virginia Emergency Response Council
VIMS	Virginia Institute of Marine Science
VMN	Virginia Mentoring Network

VPDES	Virginia Pollutant Discharge Elimination System
VPI	Virginia Polytechnic Institute and State University
VSCI	Virginia Stream Condition Index is used to evaluate the health of freshwater benthic communities in the Piedmont and Mountainous Regions of Virginia.
WET	Whole Effluent Toxicity
WQBEL	Water Quality Based Effluent Limitation
WQM	Water Quality Monitoring
WQMA	Office of Water Quality Monitoring and Assessment
WQS	Water Quality Standard(s)
WQX	Water Quality Exchange is EPA's new generation water quality information storage database, which has replaced the legacy STORET database.
WTPs	Water Treatment Plants
WWTPs	Wastewater Treatment Plants

1.0 Introduction

The Virginia Department of Environmental Quality (DEQ), on behalf of the State Water Control Board, submits a Toxics Reduction in State Waters (Toxics) Report to the Governor and designated committees of the Virginia General Assembly by January 1st of each odd-numbered year, in accordance with § 62.1-44.17:3 of the Code of Virginia.

1.1 The Report: Toxics Reduction in State Waters

The primary objective of the Toxics Report is to document the state's commitment to improving water quality, specifically in relation to chemical contamination which may induce toxic effects on aquatic life, other wildlife, or on human health.

This commitment includes the following actions:

- The prevention of contamination of the Commonwealth's waters by toxics,
- The persistent monitoring of those waters for the presence of toxics, and
- The implementation of remedial measures to reduce and/or eliminate toxics found in the state's waters.

Although the reduction of toxics in the state's waters is primarily the responsibility of DEQ, various other agencies and organizations participate in the process, including the Virginia Department of Conservation and Recreation (DCR), the Virginia Department of Health (VDH), the U.S. Environmental Protection Agency's (EPA) Chesapeake Bay Program Office (CBPO), and the U.S. Geological Survey (USGS). This report summarizes the results of recent activities directed toward toxics reduction and provides guidance on how to access further resources and information on specific subjects. DEQ submitted the first Toxics Report in January 1998. The January 1999 report provided basic background information related to the report's objectives and a basic model for its continued evolution. Reports now provide a summary of the toxics-related prevention, monitoring, and remediation activities of the prior two Calendar Years (CY) for which data are available at the time of report preparation. The current Toxics Report (January 2023) covers the reporting period of CY20 and CY21 (January 1, 2020, through December 31, 2021).

Historical summaries of results from 1997 through the present are available on the DEQ website at: https://www.deq.virginia.gov/water/water-quality/monitoring

1.2 Functional Definitions: Toxics and Toxicity

The Code of Virginia (Chapter 3.1, Title 62.1, § 62.1-44.17:2) defines toxics or toxic substance as "any agent or material listed by the USEPA Administrator pursuant to § 307(a) of the Clean Water Act and those substances on the 'toxics of concern' list of the Chesapeake Bay Program as of January 1, 1997." It further defines toxicity as "the inherent potential or capacity of a material to cause adverse effects on a living organism, including acute or chronic effects on aquatic life, detrimental effects on human health or other adverse environmental effects." This definition is rather broad, since an excess or even a deficit of many non-toxic substances can also cause adverse effects, both acute and chronic, on living organisms. This report consequently restricts

the definition of toxicity to include only those substances that are directly and chemically detrimental to living organisms when they are in excess. Direct chemical effects would exclude the physical effects of excess sedimentation or the indirect effects of nutrient enrichment, for example, both of which would also be detrimental to aquatic life. Furthermore, the concept of "other adverse environmental effects" must be defined in biological terms, since toxicity can only be observed, described, and quantified in relation to living organisms. The classification of chemical substances (i.e., a material) within the category of toxics (i.e., those that cause toxicity) is always based on the observed effects of their presence on specific living organisms. In fact, the concept of excess itself is defined in terms of the concentrations at or above which living organisms experience detrimental effects. Toxicity varies considerably among chemical substances and can increase or decrease (synergism and antagonism) in the environment based on interactions within pollutant mixtures. Toxicity is generally a function of chemical concentration or dose, and duration of exposure time. In addition, species, life stage, and environmental variables (e.g., temperature, water hardness, organic carbon) can influence toxicity. The Federal Clean Water Act (CWA) defined the responsibility of the EPA in identifying the critical concentrations at which distinct chemical substances begin to elicit a specified degree of deleterious effect, and establishing the associated water quality criteria that the states adapt as water quality standards to identify impaired waters.

1.3 Federal Water Quality Criteria

The CWA first described the scope and purpose of water quality standards and defined the authority and responsibility of EPA and the various states in relation to the requirements for, submission of, and establishment of, such standards. Since then, EPA has published various lists of toxic materials for which the movement, use, and/or release into the environment must be documented or for which concentrations in the environment must be monitored and their effects assessed and subsequently controlled. EPA reviews the results of peer-reviewed published studies and conducts its own research to determine what concentrations of chemical substances are detrimental to aquatic life, other wildlife, and human health, and to what degree. Based on the results of this evaluation, water quality criteria may be established for freshwater, saltwater, or drinking water, identifying the concentrations that induce direct chronic (long-term exposure) or acute (short-term exposure) toxic effects on aquatic life, subsequent poisonous effects on wildlife or humans, or long term carcinogenic (cancer producing) effects on human health.

On December 22, 1992, the EPA published in the Federal Register a comprehensive list of 126 chemical substances for which it had established water quality criteria related to aquatic life in freshwater and saltwater and/or to human health risks. Subsequent studies often (1) identified additional toxics for which criteria were established, or (2) resulted in the establishment of new criteria for previously defined toxics. The list has been repeatedly modified during the ensuing years. For example in 2016, the Frank R. Lautenberg Chemical Safety for the 21st Century Act updated the Toxic Substances Control Act, which governs how EPA addresses existing and new toxic chemicals. Additional modifications of existing criteria, as well as the establishment of criteria for new substances, continue to update the EPA list and help maintain or improve the quality of the nation's waters.

Supplemental Information: Federal Water Quality Criteria
EPA provides its most recent complete list of nationally recommended water quality criteria for both priority (P) and non-priority (NP) toxic pollutants in electronic form on the EPA website at: https://www.epa.gov/wqc

For information about updates to the Toxic Substances Control Act, please visit: https://www.epa.gov/laws-regulations

Detailed information on recent updates concerning Aquatic Life may be found at: https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table

1.4 Virginia's Water Quality Standards

Once recommended federal water quality criteria have been established for a chemical substance, it is the responsibility of the individual states to establish water quality standards (WQS) for each waterbody. A WQS includes a specification of how that waterbody is to be used (designated use) and the water quality criteria to protect that use. The most common designated uses include the support of aquatic life, other wildlife, fish consumption, shellfish consumption, human primary contact (swimming) or secondary contact (fishing, boating) recreation, and public water supplies (where applicable). The Commonwealth of Virginia has established and periodically revises water quality standards, which EPA reviews and must approve prior to their application. These standards are set forth at 9VAC25-260 (Virginia Administrative Code Title 9. Environment, Agency 25. State Water Control Board, Chapter 260). Virginia's designated uses are recreational uses, e.g., swimming and boating; the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them; wildlife; and the production of edible and marketable natural resources, e.g., fish and shellfish.

The most recent revisions to the Water Quality Standards Regulation pertaining to toxics included amendments to 94 human health criteria, which represent specific levels of chemicals or conditions in a waterbody that are not expected to cause adverse effects to human health due to water or fish tissue ingestion. The amendments were based on EPA's nationally recommended criteria updates issued in 2015, which reflected the latest scientific information and EPA policies, including revised body weight, drinking water intake, health toxicity values, fish consumption rate, bioaccumulation factors, and relative source contributions. EPA has approved Virginia's human health criteria amendments and they became effective on October 21, 2020. These criteria were first used for water quality assessment in the biennial 2022 Water Quality Assessment Integrated Report.

Virginia's Water Quality Standards are available online at: https://law.lis.virginia.gov/admincode/title9/agency25/chapter260/

1.5 Federal Reporting Requirements

In addition to the biennial 305(b)/303(d) Water Quality Assessment Integrated Report, federal law requires reporting procedures for the production, movement, storage, use, and release of many of these toxic substances. The annual Toxics Release Inventory (TRI) Report, discussed in Chapter 3, compiles and summarizes those reports, including discharges of toxic substances to waters of Virginia.

DEQ's activities directed toward the reduction of toxics in state waters fall into three general categories: the prevention of toxic inputs to the Commonwealth's waters, the monitoring for toxics in water, sediment, and fish tissues, and the implementation of remediation activities to reduce or eliminate toxics found in the state's waters.

2.0 Activities Directed Toward the Prevention of Toxic Inputs

The primary prevention activities carried out by DEQ may be characterized as regulatory, non-regulatory, and educational. The non-regulatory programs of the Office of Pollution Prevention (OPP) encourage industries, commercial enterprises, governmental and private facilities throughout the Commonwealth to establish Environmental Management Plans (EMPs) to minimize the use of hazardous materials, and to maximize the recycling of wastes and the use of "green products and services." This program, and two special programs associated with toxics, the Chesapeake Bay Program Toxic Contaminants Workgroup and the Salt Management Strategy (SaMS) initiative, are discussed in this section. The regulatory Virginia Pollutant Discharge Elimination System (VPDES) is discussed below, in Section 3.

2.1 Pollution Prevention Program (P2)

The DEQ Office of Pollution Prevention (OPP) contributes to the reduction of toxics in state waters through its multimedia (i.e., air, water, and waste) non-regulatory Pollution Prevention (P2) Program. The multimedia approach reduces the movement, use, and release of toxic materials. OPP relies heavily on outreach and education to help improve environmental performance and protect Virginia's resources. As part of this outreach OPP recognizes, rewards, and supports facilities that are going above and beyond regulatory compliance.

The Pollution Prevention Annual Report, submitted to the Governor and the General Assembly in December of each year, provides an overview of OPP activities for that calendar year. Reports are available online:

The 2020 Pollution Prevention Annual Report is available from Virginia's Legislative Information System at:
https://rga.lis.virginia.gov/published/2020/rd566

The 2021 Pollution Prevention Annual Report is available from Virginia's Legislative Information System at:
https://rga.lis.virginia.gov/published/2021/rd696

The most recent Pollution Prevention Annual Report is available on DEQ's website at:
https://www.deq.virginia.gov/get-involved/pollution-prevention

2.2 Virginia Environmental Excellence Program (VEEP)

VEEP is a voluntary program that recognizes and rewards participants for going beyond regulatory compliance. There are two separate tracks in VEEP. The Environmental Management System (EMS) Track is facility-based and promotes the use of an EMS to improve environmental performance. An EMS is a formal plan for adopting, implementing and documenting environmentally-responsible practices. The organization-based Sustainability Partners (SP) Track focuses on organizations that are striving for environmental sustainability, but does not require an EMS.

The VEEP EMS Track maintains approximately 193 members covering roughly 520 facilities. The VEEP SP Track is administered at the organization level, as participants are typically larger

organizations with multiple facilities, such as universities, municipalities, military installations, and some state agencies. In 2021 VEEP Sustainability Partners had 11 members.

VEEP members take a multimedia approach to reducing environmental impacts that may directly or indirectly impact water quality. Some VEEP successes include:

In calendar year 2020 VEEP members reported the following:

- Recycled water use increased by 157,921,020 gallons
- Green House Gas emissions reduced by 10,416 tons
- Waste recycled increased by 24,121 tons

In calendar year 2021 members reported the following:

- Recycled water use increased by over 224,000,000 gallons
- Green House Gas emissions were reduced by 883 tons
- Hazardous waste disposed decreased by 14 tons

2.3 Virginia Green Travel

Virginia Green consists of a network of tourism-related organizations that are committed to protecting the environment while promoting responsible tourism. The statewide program works to reduce the environmental impacts of the Commonwealth's tourism industry and raises awareness about green tourism.

The program is a partnership between DEQ, the Virginia Tourism Corporation, the Virginia Restaurant, Lodging and Travel Association and the Virginia Green Travel Alliance (VGTA). The Office of Pollution Prevention provides technical resources and oversight of the certification content. The VGTA manages the certification process and helps members promote their green efforts.

Virginia Green Travel Partners commit to implementing sustainable practices in core areas, including:

- Waste Reduction
- Recycling
- Eliminating polystyrene disposables
- Energy conservation and efficiency
- Water conservation and efficiency
- Green events and meetings
- Consumer engagement

As of 2021, over 1,800 tourism operations have self-certified their environmental practices and been recognized as Certified Virginia Green Travel Partners.

For more information visit:
https://www.deq.virginia.gov/get-involved/pollution-prevention/virginia-green

2.4 Case Studies

The Office of Pollution Prevention has compiled a set of pollution prevention case studies that show real world examples and identify technologies and techniques that have been successful in reducing environmental impacts. These examples showcase the effectiveness of pollution prevention projects by quantifying pollution reduction, cost savings, and other benefits. The entities highlighted in the success stories have improved environmental performance by going above and beyond the industry standard.

For more information visit:
https://www.deq.virginia.gov/get-involved/pollution-prevention/case-studies

2.5 Outreach

Outreach, education, and recognition of performance are primary tools used by the Office of Pollution Prevention (OPP) for raising environmental awareness and driving beyond compliance improvement across the Commonwealth. Aside from the voluntary programs described elsewhere in this report, OPP maintains many web-based resources including:

- The Governor's Environmental Excellence Awards which recognize successful and innovative efforts that improve Virginia's environment: https://www.deq.virginia.gov/get-involved/pollution-prevention/governor-s-environmental-excellence-awards
- DEQ is committed to the Commonwealth's Greening of Government efforts: https://www.deq.virginia.gov/get-involved/pollution-prevention/governor-s-environmental-excellence-awards
- OPP also maintains Resources and Examples to help develop an Environmental Management System and access to past webinars coordinated by OPP to assist facilities moving toward environmental sustainability: https://www.deq.virginia.gov/get-involved/pollution-prevention/virginia-environmental-excellence-program/resources-and-examples

2.6 Chesapeake Bay Program

EPA's Chesapeake Bay Program hosts a Toxic Contaminants Workgroup on which DEQ staff collaborate and contribute. The main objectives of the workgroup are toxics research, policy and prevention in the Chesapeake Bay and its watershed.

Specific policies and objectives are described in the Toxic Contaminants Policy and Prevention Outcome Management Strategy 2015–2025 which can be found at:
https://www.chesapeakebay.net/documents/22048/toxic_contaminanats_policy_and_prevention_management_strategy_v3.pdf

Additional information specific to progress on implementing the outcomes presented in the Management Strategy can be found at:
https://www.chesapeakebay.net/who/group/toxic_contaminants_workgroup

2.7 Salt Management Strategy (SaMS)

SaMS is Virginia's first comprehensive effort by a diverse stakeholder body to design, in a cohesive and collaborative manner, a strategy seeking to improve the balance between the impacts and benefits of salt application. Recognizing the public safety and economic benefits of salt use, SaMS seeks to strike a better balance between these benefits and the associated negative costs and impacts from winter salt to our drinking water, environment, infrastructure, and vehicles and human health.

The SaMS initiative is a non-regulatory, voluntary, and largely proactive approach to address this emerging issue in Northern Virginia. It is guided by the below three goals, developed by the Stakeholder Advisory Committee (SAC) and embodied in the SaMS Toolkit.

- Uses a stakeholder-driven process to proactively address salt loads in the region and address the Accotink Creek chloride (salt) TMDLs.
- Generates increased public awareness that leads to positive behavior changes, and long-term support for the continual improvement of deicing/anti-icing practices and actions.
- Ensures continued protection of public safety, improves water quality and terrestrial habitat, and lessens the effects of deicing/anti-icing salts on drinking water resources, property and road infrastructure through information sharing and implementation of best practices over time.

The SaMS Toolkit is a resource to aid the initiative and continually advance efforts towards achieving SaMS goals. It encompasses winter road maintenance, large and smaller scale winter property maintenance, commercial and residential communities and individual residents' winter maintenance of roads, driveways, steps, and sidewalks. It includes technical information as well as background and practices related to communications. It is designed to meet the interests and needs of senior organizational decision makers, maintenance supervisors, maintenance professionals, and individuals. It is also intended to be adaptive and continually improved upon as knowledge is gained over time.

More information on SaMS and the SaMS Toolkit is available at:
https://www.novaregion.org/1399/Northern-Virginia-Salt-Management-Strate
https://www.novaregion.org/1498/SaMS-Toolkit

3.0 Permitted Dischargers & Compliance Monitoring

3.1 Virginia Pollutant Discharge Elimination System Permit Program

The Virginia Pollutant Discharge Elimination System (VPDES) permit program requires that limits be established for all potentially toxic substances in permitted discharges from industrial, institutional, and/or municipal wastewater treatment facilities. Permit limits are set so that discharges do not cause or contribute to exceedances of Virginia's water quality standards for the pollutants being released into the receiving waterbody.

The record of permitted facilities discharging toxics to waters of the Commonwealth is determined through discharge monitoring reports (DMRs) submitted by each permittee at the end of each monitoring interval specified in their permit. Monitoring intervals may be, for example, one month, six months, one year, etc. as specified in the permit. The number of facilities discharging toxics was quantified by compiling submitted DMR data for permits with any monitoring period or portion thereof falling within the CY20 – CY21 reporting period. Based on that DMR record, 242 facilities held 243 permits for discharging toxics into Virginia waters during CY20 – CY21 and did so through 590 outfalls (Table 1).

Table 1. Number of facilities during the CY20 – CY21 reporting period holding active permits to discharge toxic parameters and submitting discharge monitoring reports.

Facilities	Permits	Outfalls
242	243	590

Appendix 1 of this report lists facilities that were authorized under a VPDES permit to discharge toxics during the CY20 – CY21 reporting period and for which we received DMRs reporting those discharges. The geographic location, river basin, and receiving waterbody for each facility and outfall are also included in Appendix 1. It is important to note that unless coordinates are given for each outfall distinct from those of the facility, the coordinates of each outfall are usually fixed to the facility location and should only be used for spatial analysis at coarse resolutions.

A VPDES permit has a five-year term. The permits are evaluated and reissued at the end of each permit term. Some permits may be delayed in the reissuance process. These permits are granted an administrative continuance which continues the authorization to discharge while the reissuance process occurs. Appendix 1 identifies all facilities with authorization to discharge toxics to surface waters, including administratively continued permits and those which have been or soon will be reissued. Several facilities had permits expiring or reissued during the CY20 – CY21 reporting period (Table 2**Error! Reference source not found.**). The full list of toxic parameters with permitted discharges during CY20 – CY21, along with their discharge limits, can be found in Appendix 2.

Table 2. Number of expired and reissued permits during CY20 and CY21.

Year Permit Expired	Facilities	Permits	Reissued Permits
2020	49	49	34
2021	43	43	18

The number of outfalls associated with each permit can vary among facilities according to their size and complexity. Permits for military installations, power stations, and large industrial facilities tend to have a greater number of outfalls discharging toxics (Table 3).

Table 3. Top 10 facilities without Administrative Continuances and with active permits to discharge toxics during CY20 – CY21 arranged in descending order by number of outfalls discharging toxics. Facility locations can be found in Appendix 1.

Facility	Permit No.	Number of Outfalls
Celanese Acetate LLC	VA0000299	12
Perdue AgriBusiness LLC - Chesapeake	VA0004448	7
RES dba Steel Dynamics Roanoke Bar Division	VA0001589	6
US Navy - Joint Expeditionary Base - Little Creek	VA0079928	6
Dominion - Bremo Power Station	VA0004138	5
Jewell Coke Company Coke Plants 2 and 3	VA0050351	5
Maneuver Training Center Fort Pickett	VA0091766	5
Chesapeake Bay Bridge and Tunnel District	VA0006203	4
General Dynamics NASSCO-Norfolk - Ligon Facility	VA0073091	4
Hoover Treated Wood Products	VA0088714	4

There were 96 facilities with 96 permits and 353 outfalls under Administrative Continuances during all or part of CY20 – CY21, indicating that they received authorization to continue their discharges without yet receiving a permit reissuance. Some of those facilities had permits reissued during CY20 – CY21, while others did not. Of the 96 facilities, 58 began their Administrative Continuance during CY20 – CY21, with 170 outfalls; the other 38 facilities with 183 outfalls extended Administrative Continuances granted prior to CY20. Details of Administrative Continuance status for each permit are included in Appendix 1. Permits with Administrative Continuances for military installations and large industrial facilities generally have the most outfalls. The top 10 Administrative Continuance facilities ranked by number of outfalls accounted for 50% (178) of all outfalls (353) with Administrative Continuances during CY20 – CY21 (Table 4).

Table 4. Top 10 facilities with Administrative Continuances and with active permits to discharge toxics during CY20 – CY21 arranged in descending order by number of outfalls discharging toxics. Locations of facilities with administrative continuances can be found in Appendix 1.

Facility	Permit No.	Number of Outfalls
Huntington Ingalls Incorporated - NN Shipbldg Div	VA0004804	68
US Navy - Norfolk Naval Shipyard	VA0005215	20
US Navy - Naval Station Norfolk	VA0004421	18
US Army - Fort Belvoir	VA0092771	17
DuPont Specialty Products USA LLC - Spruance Plant	VA0004669	10
Goodyear Tire and Rubber Co - Danville	VA0001201	10
Lyon Shipyard Incorporated - Norfolk Facility	VA0092495	10
AdvanSix Resins and Chemicals LLC	VA0005291	9
Colonnas Shipyard Inc	VA0053813	8
Dominion - Chesapeake Energy Center	VA0004081	8

During CY20 and CY21, facilities with active permits and active Administrative Continuances had one or more limits for toxics in their permits and submitted Discharge Monitoring Reports (DMRs) (Table 5). The effective limits (when specified) and reporting frequencies for toxics may vary, depending upon the chemical parameters involved. Note that in some years, permit limits may be modified, reissued, or adjusted relative to limits within the past year. Details of toxics parameters included in each permit active in CY20 – CY21, along with their limits and required DMR frequencies, are listed in Appendix 2.

Table 5. Count of facilities, permits, and Discharge Monitoring Reports (DMRs) applicable for each year in the reporting period. Totals may exceed sum of years due to activity in both years.

Calendar Year	Facilities	Permits	Outfalls	DMRs
2020	240	241	582	1,538
2021	229	230	555	1,511
Total	242	243	590	3,033

In CY20 – CY21, there were 251 reported exceedances of average concentration and/or maximum concentration limits on discharges of a toxic substance (Table 6). Zinc and copper compounds accounted for 96% of all exceedances reported for toxic substances (Table 6). The permit compliance monitoring results for each permitted facility and outfall during the reporting period are found in Appendix 3.

Table 6. Summary of permit limit exceedances by calendar year, analyte, and exceedance type.

	Exceedance Concentration		Total Exceedances	
Analyte	**Average**	**Max**	**by Analyte**	**by Year**
CY 2020				**113**
COPPER, TOTAL (AS CU)	1	2	3	
COPPER, TOTAL RECOVERABLE	27	30	57	
LEAD, TOTAL RECOVERABLE	0	1	1	
NAPHTHALENE (AS C10H8)	0	3	3	
ZINC, TOTAL (AS ZN)	2	2	4	
ZINC, TOTAL RECOVERABLE	22	23	45	
CY 2021				**138**
COPPER, TOTAL RECOVERABLE	35	38	73	
NAPHTHALENE (AS C10H18)	0	6	6	
ZINC, TOTAL (AS ZN)	2	2	4	
ZINC, TOTAL RECOVERABLE	27	28	55	

3.2 Virginia Toxics Release Inventory

Under the provisions of Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA), also known as SARA Title III, Virginia manufacturing and federal government facilities that release certain chemicals to the air, water, or land, or that transfer these chemicals for off-site treatment, disposal, recycling, or energy recovery, are required to submit reports to EPA. This information is reported on Form R - Toxic Chemical Release Inventory Reporting Form and is collectively referred to as the Toxic Release Inventory (TRI). Although the Report itself is a “hindsight” monitoring tool, the intent of the program is to minimize the quantity, movement, and disposal of toxic materials.

This summary of the TRI includes the most recent reports available since those covered in the 2021 Toxics Report: the 2019 TRI Report published March 2021, and the 2020 TRI Report published March 2022. The number of reporting facilities decreased by 6 from 425 in 2019 to 419 in 2020. Individual reports decreased by 26 from 1272 in 2019 to 1246 in 2020 (Table 7).

Table 7. Count of facilities, submitted reports, and total chemical classes for the previous three TRI publicly available reports.

Calendar Year	Reports	Facilities	Chemical Categories
2018	1,322	423	139
2019	1,272	425	135
2020	1,246	419	137

Releases to surface waters within the boundaries of the facilities increased from 2019 to 2020 both in pounds released, and as a percent of total releases (i.e., air, water, land) (Table 8).

Table 8. Reported on-site releases of TRI chemicals to surface waters 2016-2018.

Calendar Year	Million lbs.	% Water Releases
2018	9.14	32.35
2019	10.82	39.52
2020	12.22	43.16

The top ten chemicals and/or classes of chemicals released each year are summarized in Table 9 along with the relative changes in the quantities released between 2019 and 2020. The top ten chemicals or chemical categories contributed approximately 99.8% of the total releases to water in 2019 and 2020. The top ten chemicals were the same in both years, with the exception being Copper making the top 10 list in 2019 and not in 2020. Likewise, n-methyl-2-pyrrolidone made the top 10 in 2020 but not in 2019 (Table 9).

Nitrate compounds, which are typically of more concern because of nutrient enrichment rather than for direct toxicity, constituted approximately 10.5 million pounds (96.7%) of the total release of TRI chemicals to water in 2019 and 11.9 million pounds (97.1%) in 2020. This was followed by ammonia, another nitrogen compound, with approximately 105 thousand pounds (0.98%) in 2019 and 105 thousand pounds (0.86%) in 2020. The industrial wastewater treatment process is the largest source of surface water pollution from nitrate compounds.

Additional information on specific groups of chemicals and the quantities and other details of their releases is available in the original reports (see link below for these and previous years' reports). The next Virginia TRI report, summarizing toxic releases for calendar year 2021, will be available in March 2023.

Table 9. Top ten TRI Chemicals released to water on-site in CY 2019 and CY 2020. Chemicals are sorted in descending order based on CY 2020 releases.

Chemical/Group	CY 2019		CY 2020		% Change in lbs. Released to Water 2019 to 2020
	Thousand lbs. Released to Water	% of Total Toxics Released to Water	Thousand lbs. Released to Water	% of Total Toxics Released to Water	
Nitrate Compounds	10,460	96.67	11,870	97.12	13.48
Ammonia	105	0.98	105	0.86	0.00
Manganese & Manganese compounds	94	0.88	95	0.78	1.06
Cyclohexanol	61	0.57	55	0.46	-9.84
Dimethylamine	23	0.21	21	0.17	-8.70
Sodium nitrite	8	0.08	16	0.13	100.00
Nitroglycerin	9	0.09	15	0.12	66.67
Methanol	10	0.09	10	0.08	0.00
Zinc & Zinc compounds	13	0.13	6	0.05	-53.85
N-Methyl-2-pyrrolidone			4	0.04	
Copper & Copper compounds	5	0.06			
Other	27	0.25	24	0.20	-11.11
Total	*10,820*		*12,220*		*12.94*

Supplemental Information: Toxics Release Inventory

Current and past Virginia TRI Reports are available on the DEQ website at: https://www.deq.virginia.gov/land-waste/superfund-amendments-and-reauthorization-act-sara/toxics-release-inventory

TRI Toxics Tracker is an interactive web application hosted by EPA. Virginia's TRI data are available through this application which can be queried by facility and watershed, available at: https://edap.epa.gov/public/extensions/TRIToxicsTracker/TRIToxicsTracker.html

Additional sources of information on the TRI: Community Right-to-Know, including the access and use of TRI data and fact sheets for individual states, are available on EPA's website at: https://www.epa.gov/toxics-release-inventory-tri-program

4.0 Ambient Monitoring

Samples analyzed for toxics were collected during CY20 – CY21 as part of 18 different monitoring programs, TMDLs, and Special Studies. Depending on the experimental design and research objectives, toxics were analyzed in water column, sediment, and/or fish tissue samples. The vast majority of DEQ samples collected and analyzed for toxics were water column samples. Parameters included metals, major ions (calcium, magnesium, sodium, potassium, chloride, sulfate), nitrogen compounds (nitrate, nitrite, ammonia), pesticides, PAHs, and PCBs.

4.1 The Annual Water Quality Monitoring Plan

The Annual Water Quality Monitoring Plan provides a complete list of the ambient WQM stations that will be actively sampled during the corresponding calendar year and the types of samples that will be collected at each. This includes samples for non-toxic parameters in addition to the toxic substances that were included in this report. The DEQ monitoring year corresponds to the calendar year in order to synchronize various ambient monitoring program schedules with one another, with the ecological and water year cycles, and with the assessment window or monitoring period considered for each 305(b)/303(d) Water Quality Assessment Integrated Report (see Chapter 5).

The current Annual Water Quality Monitoring Plan and contact information for obtaining older plans are available at:
https://www.deq.virginia.gov/water/water-quality/monitoring/water-quality-monitoring-plan

4.2 Monitoring Toxics in the Water Column (excluding PCBs)

During CY20 – CY21, 716 unique monitoring stations were sampled for toxic substances through 18 different DEQ monitoring programs collecting 6,956 water samples. During the CY20 – CY21 reporting period, 37,872 water column data points were obtained for one of 128 different parameters consisting mostly of trace metals, nitrogen compounds, and organochlorine pesticides. The full list of water column parameters is in Appendix 4. PCBs collected in the water column, and toxics measured in sediment or fish tissue are described in Sections 4.3 and 4.4, respectively. Program codes and descriptions for all water column samples are in Appendix 5. Results of non-PCB water column monitoring are in Appendix 6.

The top 5 DEQ programs ranked by number of stations monitoring for toxics in the water column account for over 72% of the 793 total program-station combinations sampled during the reporting period (Table 10). These programs constitute the most extensive monitoring efforts of DEQ, covering the greatest number of monitoring locations across the Commonwealth. Such programs, like the Freshwater and the Estuarine Probabilistic Monitoring programs, may only sample a station once, but provide information about water quality across a broad geographic area. In contrast, the most intensive monitoring efforts are programs with a more constant network of fewer stations but which are monitored more frequently. This includes programs monitoring the Chesapeake Bay and its non-tidal tributaries – programs with goals that include characterizing water quality parameters that can change frequently, such as nitrogen compound

concentrations. Consequently, the top 5 DEQ programs by number of samples collected account for over 88% of all samples collected during the CY20 – CY21 reporting period (Table 10).

Water column results for all parameters (excluding PCBs) including the Station ID, watershed name, and coordinates for monitoring stations can be found in Appendix 6. Water column metals samples are assessed against Virginia's Water Quality Standards during the biennial 305(b)/303(d) water quality assessment. The CY20 data presented in this report were used in the 2022 Water Quality Assessment. Data from CY20 and CY21 will be used for the 2024 Water Quality Assessment.

Table 10. Top 5 most intensive (most samples) and top 5 most extensive (most stations) DEQ programs, ordered by decreasing number of samples analyzed during CY20 – CY21 for toxic parameters in the water column. Numbers of samples and stations, as well as code descriptions for all programs are in Appendix 5.

Number of toxics samples analyzed	Number of toxics monitoring stations	DEQ Program Code	DEQ Program Description
1,716	47	CB	Chesapeake Bay Program Water Quality and Habitat Monitoring (CBM)
1,153	138	TM	TMDL Planning
1,102	38	BN	Chesapeake Bay Non-Tidal Network Monitoring
1,093	121	RL	Reservoir Monitoring
1,088	105	TR	Ambient Long Term Trend Program
161	112	FP	Ambient Freshwater Probabilistic Monitoring
100	100	C2	Ambient Estuarine Probabilistic Monitoring

4.3 Monitoring PCBs for TMDLs and Special Studies

Sediment and/or water samples were analyzed for PCBs at 48 different monitoring stations in CY20 and CY21. This information is used in the development of TMDLs to address waters listed as impaired due to fish consumption advisories. A total of 245 PCB samples were collected, the majority of which were whole-water (unfiltered) samples (Table 11). The location of each monitoring station where TMDL and Special Study PCB sampling occurred in CY20 and CY21, along with sample results, can be found in Appendix 7. Narrative overviews of each individual PCB TMDL and Special Study can be found in Chapter 6.

Table 11. Count of TMDL and Special Study PCB monitoring stations and samples for each matrix type.

Sample Matrix	PCB Stations	PCB Samples
Sediment	25	28
Water (whole)	47	217

4.4 Monitoring for Fish Tissue and Sediment Contamination

During CY20 and CY21, DEQ conducted fish tissue monitoring for Total PCBs (671 samples) and 17 metal analytes (705 samples) at 149 monitoring stations (Table 12). Fish were collected at routine annual statewide (Routine Statewide) sites to support multiple Special Studies and TMDLs. Additionally, fish were collected for a National Fish and Wildlife Foundation (NFWF) grant funded project to sample selected sites in the Dan River and Roanoke River watersheds.

The statewide TMDL follow up collections were concentrated primarily within watersheds of the Shenandoah River and the Tennessee River (Clinch, Powell, and Holston) including sites on five impoundments, James River (Chickahominy River, Elizabeth River system, four impoundments), the New River, and three impoundments in the Tennessee River drainage. Additional fish samples were gathered from sites on tidal small coastal streams and tributaries of the Chesapeake Bay (Mobjack, Pocomoke, etc.,) and tidal Rappahannock River plus main stem Chesapeake Bay as part of the 2020 USEPA National Coastal Condition Assessment project. Samples were also collected from the Maury River (smallmouth bass) – a special follow up site requested by the VDH. The availability of EO6 supplemental funding allowed for expanded fish collections in CY21 from additional sites within the James River watershed as well as the Roanoke River watershed including several large reservoirs (Smith Mountain Lake, Leesville Lake, J. H. Kerr Reservoir and Lake Gaston).

Collections for the NFWF project were performed at sites located on the Dan River, Roanoke River, and the following impoundments: Lovills Creek Lake, Philpott Reservoir, Fairystone Lake, Banister Lake, Lake Burton, Conner Lake, J. H. Kerr Reservoir and Lake Gaston.

Table 12. Number of sites and samples analyzed in CY 2020 and CY 2021 for routine statewide fish tissue monitoring, and on behalf of the National Fish and Wildlife Foundation grant.

Year	Project	Sample Sites	No. Fish Samples for Total PCBs	No. Fish Samples Metals
2020	Routine Statewide	55	175	175
	NFWF	13	65	65
2021	Routine Statewide	79	366	400
	NFWF	38	65	65

The fish tissue monitoring program may also collect sediment samples for analysis of PCBs and metals as study objectives dictate. In CY20, limitations and restrictions from COVID-19 protocols prevented sediment sample collection. In CY21, 33 sediment samples were collected for PCB analysis as part of the routine statewide monitoring program. Monitoring results for fish tissue PCBs are in Appendix 8 and results for fish metals are in Appendix 9. Results for sediment PCBs are in Appendix 10.

Following receipt and review of fish tissue data, DEQ shares the data with the Virginia Department of Health (VDH), posts results on the DEQ website, and issues formal announcements of the availability of fish tissue data in the Virginia Town Hall and Virginia Register of Regulations. VDH is responsible for issuing Fish Consumption Advisories and Restrictions for Virginia Waterways based upon its review of fish tissue results. After reviewing

fish tissue data from CY20 and CY21, VDH concluded no changes to fish consumption advisories for PCBs or mercury were warranted.

4.4.1 Total PCBs in Fish Tissue

Eating contaminated fish is the most significant pathway for PCB uptake in humans. All fish tissue data are evaluated by the Virginia Department of Health (VDH) and could result in the agency lifting current fish consumption advisories or in the issuing of new ones. For consumption advisories based on Total PCB concentrations, exceedances of VDH screening values are considered when setting advisories (Table 13).

Table 13. Number of exceedances of Total PCB screening values compared against DEQ (18 ppb) and VDH (Lower = 100 ppb, Upper = 500 ppb) thresholds. Exceedances for each year include both Routine Statewide and NFWF sites.

Year	PCB Concentration Range (ppb)	Exceedances	Percent of Total Samples
2020	> 18 & ≤ 100	33	13.8
	> 100 & ≤ 500	8	3.3
	> 500	3	1.3
2021	> 18 & ≤ 100	124	28.8
	> 100 & ≤ 500	38	8.8
	> 500	0	

In 2020 only 1.3% of the total fish samples exceeded the upper VDH threshold of 500 ppb Total PCBs and none of the total fish samples exceeded the upper VDH threshold in 2021. Three stations had 1 sample each exceeded the highest VDH Total PCB consumption screening value of 500 ppb. Shenandoah River had two stations (station 1BSHN028.15 near Lockes Landing Boat Launch, and station 1BSHN053.63 downstream of Interstate 66) with 1 composite sample each of Carp exceed 700 ppb Total PCBs; Dan River/Kerr Reservoir had 1 station (4ADAN001.18 near the State Park) with 1 individual Flathead Catfish specimen exceed 900 ppb Total PCBs. Results of all fish tissue PCB sampling are in Appendix 8.

Samples are usually composites of multiple fish of the same species and similar size class. With larger species such as Carp and Flathead catfish a single fish is analyzed more frequently than a composite. Benthopelagic (i.e., bottom dwelling) fish often accumulate PCBs in higher concentrations than pelagic (i.e., open-water) fish (Table 14).

DEQ compares fish tissue contaminant levels against fish consumption hazard screening values for the Biennial 305(b)/303(d) Water Quality Integrated Assessment (see Chapter 5). The CY20 fish tissue data were assessed in the 2022 Integrated Assessment and the CY21 fish tissue data will be assessed in the 2024 Integrated Assessment. In addition, the Virginia Department of Health (VDH) is responsible for issuing Fish Consumption Advisories and Restrictions for Virginia Waterways based upon the results from the DEQ Fish Tissue and Sediment Monitoring Program and other sources. Fish tissue advisories are also considered in the Biennial 305(b)/303(d) Water Quality Integrated Assessment. Based on the PCB concentrations observed

in fish tissue samples collected by DEQ in CY20, VDH issued a consumption advisory for Common Carp from the Upper James River, effective October 13, 2020. VDH advised the consumption of no more than two meals a month of carp taken from the head of the James River near Iron Gate (at the confluence of Jackson River and Cowpasture River) to Balcony Falls Dam downstream of Glasgow (near the Maury River).

Table 14. Number of fish samples by species that exceeded VDH lower screening value (100 ppb) for Total PCBs. Number of samples are summed for 2020 and 2021.

Species	No. Samples	Species	No. Samples
Flathead Catfish	11	Hickory Shad	1
Carp	10	Northern Hogsucker	1
Gizzard Shad	8	Shorthead Redhorse Sucker	1
Blue Catfish	7	Smallmouth Bass	1
Channel Catfish	2	Spot	1
Largemouth Bass	2	Spotted Bass	1
American Eel	1	Striped Bass	1
Black Redhorse Sucker	1		

4.4.2 Metals in Fish Tissue

Fish tissue metal levels are compared to screening values (SVs) for fish consumption risk to human health. Metal levels are screened against 16 DEQ SVs and 9 VDH SVs (Table 15). Arsenic and mercury were the only metals to exceed VDH and/or DEQ SVs in 2020 and 2021 (Table 16). Of 705 fish tissue metals samples collected during CY20 – CY21, 25.4% exceeded the VDH screening value threshold for arsenic. It is important to note that VDH and DEQ screening values are based off of the amount of inorganic (i.e., hazardous) arsenic present in fish tissue, whereas DEQ fish tissue results are reported as total arsenic. Generally the proportion of inorganic arsenic is less than 10% of the total arsenic found in fish tissue, thus rendering the screening values exceptionally protective. Sample results for metals in fish tissue can be found in Appendix 9. After assessing the fish tissue metals results from CY20 and CY21, VDH concluded the data did not warrant any changes or additions to VDH fish consumption advisories. DEQ assessed CY20 data as part of its 2022 Water Quality Assessment, the broad results of which are discussed in the context of toxics-related designated use impairments in Chapter 5 of this report. The CY21 data, along with CY20 data, will be assessed by DEQ as part of its 2024 Water Quality Assessment.

Table 15. DEQ and VDH screening values (SV) and practical quantification limit (PQL) for metals in fish tissue. All values are displayed in mg metal per kg wet weight fish sampled (i.e., mg/kg or ppm). Lead is the only metal without a screening value for DEQ or VDH.

Metal	DEQ SV	VDH SV	PQL	Metal	DEQ SV	VDH SV	PQL
Aluminum	3600	5286	0.5	Manganese	510	53	1
Antimony	1.5	-	0.5	Mercury	0.3	0.5	0.5
Arsenic	0.24	0.09	0.5	Nickel	73	-	0.5
Barium	720	-	0.5	Selenium	18	26	0.5
Beryllium	7.2	-	0.5	Silver	18	-	0.5
Cadmium	3.6	0.53	0.5	Thallium	0.25	-	0.5
Chromium	11	4.76	0.5	Vanadium	36	-	0.5
Copper	36	52	0.5	Zinc	1100	1585	1
Lead	-	-	0.5				

Table 16. Fish tissue screening value exceedances for all metals in 2020 and 2021. Screening values for arsenic are based on the amount of inorganic arsenic in fish tissue. Exceedances below were counted against total arsenic in fish tissue and represent overly cautious estimates of human health risk.

Year	Metal	Screening Value (ppm)	Number of Screening Value Exceedances	Percent of Total Annual Samples
2020	Arsenic	DEQ (0.24)	33	13.8
		VDH (0.09)	42	17.5
	Mercury	DEQ (0.30)	93	38.8
		VDH (0.50)	63	26.3
2021	Arsenic	DEQ (0.24)	75	16.1
		VDH (0.09)	137	29.5
	Mercury	DEQ (0.30)	82	17.6
		VDH (0.50)	29	6.2

Supplemental Information: Fish Tissue Monitoring

For more information about DEQ's fish tissue monitoring program visit:
https://www.deq.virginia.gov/water/water-quality/monitoring/fish-tissue-monitoring

The latest Water Quality Assessment Guidance Manual is available at:
https://www.deq.virginia.gov/water/water-quality/assessments/wqa-guidance-manual

To search an interactive table of waters with current VDH fish consumption advisories visit: https://www.vdh.virginia.gov/environmental-health/public-health-toxicology/fish-consumption-advisory/

To view an interactive map of waters with current VDH fish consumption advisories visit: https://virginiahealth.maps.arcgis.com/apps/webappviewer/index.html?id=9ac625009b224f818268c3fdd4e5cb9d

NOAA Screening Quick Reference Tables
https://response.restoration.noaa.gov/sites/default/files/SQuiRTs.pdf

4.4.3 Total PCBs in Sediment

In CY21 the fish tissue monitoring program collected 33 sediment samples that were analyzed for Total PCBs (Appendix 10). Owing to limitations and restrictions from COVID-19 protocols, sediment samples were not collected in CY20.

DEQ compares sediment contaminant levels against screening values (SV) for the Biennial 305(b)/303(d) Water Quality Integrated Assessment. The SVs identify the range of sediment PCB concentrations that are likely to cause adverse effects in benthic communities. Virginia primarily uses two SV classes to characterize sediments: consensus-based Probable Effects Concentrations (PECs) for freshwater sediments and Effects Range Median (ER-M) concentrations for estuarine and marine sediments. Screening values for Total PCBs and other contaminants can be found in DEQ's Water Quality Assessment Guidance Manual and are consistent with NOAA's Screening Quick Reference Tables (see links in Supplemental Information in Section 4.5). The CY21 sediment PCB data will be assessed in the 2024 Integrated Assessment.

PCBs were detected in 20 of the sediment samples and the only notable site was in the James River near Chippokes Pt. (Buoy 71), where 435 ppb of Total PCBs was measured in the sediment. That James River site was the only sample to exceed the Effects Range Median (180 ppb), the screening value indicating a high probability of causing adverse effects to benthic organisms (Table 17).

Table 17. Count of Total PCB sediment samples and exceedances of Effects Range Median (ER-M and Probable Effects Concentrations (PEC) screening values. James River at Chippokes Pt. is the lone exceedance for ER-M.

Year	No. PCB Sediment Samples	No. PCB Sediment Stations	No. Samples with PCBs Detected	ER-M Exceedances (> 180 ppb)	PEC Exceedances (> 676 ppb)
2020	0	0			
2021	33	33	20 (60%)	1 (3%)	0

4.5 Estuarine Probabilistic Monitoring of Sediment Toxics

DEQ's estuarine probabilistic monitoring program is a geographically extensive one, collecting water and sediment from July 1 – September 30 at approximately 50 monitoring stations randomly selected anew each year and spread across the estuarine waters of Virginia. In both CY20 and CY21, 50 monitoring stations were sampled once each.

Sediment samples are analyzed for PCBs, PAHs, metals, and pesticides. Approximately 125 toxic analytes are measured from each sediment sample (Appendix 11). Information about each monitoring station, including location, can be found in Appendix 12. Water sample results are addressed in Section 4.2 of this report, and results are in Appendix 6, under Survey Program Code C2 (Appendix 6 column FDT_SPG_CODE). Sediment chemistry results are presented separately, in Appendix 13.

Concurrently with regular estuarine probabilistic monitoring in 2020, DEQ conducted Virginia's portion of USEPA's quintennial National Coastal Condition Assessment (NCCA). In addition to the usual water and sediment samples, DEQ collected fish tissue samples at 29 stations for toxics analysis as part of the NCCA. Those data will be available publicly after USEPA completes its review and publishes its report. See the USEPA NCCA website link below for more information.

Weight-of-Evidence Assessments

Virginia does not have numeric criteria or sediment standards for which to assess sediment and alternatively uses a weight-of-evidence (WOE) based approach to evaluate estuarine waters during the biennial 305(b)/303(d) water quality assessment process. The three lines of evidence in the WOE are sediment chemistry, toxicity testing, and benthic community. In most cases two or more lines of evidence must show adverse effects before the station is listed as impaired in the Water Quality Assessment Integrated Report. Benthic community is weighted most in the WOE because the objective of assessment is to protect the aquatic life designated use. The estuarine probabilistic monitoring program also samples for metals in the water column at some stations as deemed essential and as budget allows (Appendix 6). Water column metals samples from probabilistic stations are assessed against Virginia's Water Quality Standards separately from the weight-of-evidence approach applied to sediment.

Supplemental Information: Estuarine Probabilistic Monitoring Program

The 2022 305(b)/303(d) Water Quality Assessment Integrated Report includes assessments of water column metals data, fish tissue data and completed WOE assessments for estuarine probabilistic monitoring data collected 2015-2020. The draft report can be found at: https://www.deq.virginia.gov/water/water-quality/assessments/integrated-report

A detailed explanation of Virginia's Weight-of-Evidence (WOE) Aquatic Life Use Assessment in Estuarine Waters can be found in Appendix G of the DEQ 2020 Water Quality Assessment Guidance Manual available at: https://www.deq.virginia.gov/water/water-quality/assessments/wqa-guidance-manual

Information about the USEPA National Coastal Condition Assessment (NCCA), in which DEQ participates through its estuarine probabilistic monitoring program, is available on the USEPA NCCA website at: https://www.epa.gov/national-aquatic-resource-surveys/ncca

5.0 The 305(b)/303(d) Water Quality Integrated Assessment Report

5.1 Overview

Under the Clean Water Act, EPA requires that each state develop a program to monitor the quality of its surface and ground waters and prepare a report every two years describing the status of its water quality. Each state identifies waters of concern as having observed effects and schedules additional monitoring, if appropriate, to determine if designated uses are being met. Referring to the applicable Clean Water Act sections, this 305(b)/303(d) process is the principal means by which the EPA, Congress, and the public evaluate current water quality, the progress made maintaining and restoring water quality, and the extent of remaining work to be done. The 305(b)/303(d) process is an integral part of Virginia's water quality management program, for which requirements are set forth in federal regulations (40 CFR 130).

Virginia bases its water quality assessments on the ability of the waters to support the associated designated uses. Designated use support is based on the waters meeting the criteria for each use as defined in the numeric and/or narrative water quality standards as described in the water quality assessment guidance manual that is published ahead of each biennial water quality assessment. During the assessment process, concentrations of toxic contaminants found in surface waters, sediment, and fish tissue are evaluated in accordance with the procedures described in the assessment guidance manual to determine the appropriate assessment category for the associated bodies of water. The results of Virginia's water quality assessments are summarized in a comprehensive biennial report called the Water Quality Assessment Integrated Report (IR). The IR summarizes assessments made using data from the six consecutive years ending two years prior to the reporting year (e.g., the 2022 IR used data from 2015 through 2020).

There are three IRs with activity and/or data relevant to the CY20 – CY21 reporting period of this Toxics Report. On December 9, 2020, EPA approved the final 2020 IR (data from 2013 – 2018). Toxics-related results from the 2020 IR were summarized in the 2021 Toxics Report. Data from CY20 were assessed as part of the 2022 IR (data from 2015 – 2020), the final version of which was approved by EPA on October 21, 2022. Results from the 2022 IR are summarized in this Toxics Report, but note that although CY20 data were used for the most recent IR, the assessment results presented here are not based solely on CY20 data. Data from CY21 will be assessed as part of the 2024 IR (data from 2017 – 2022), which will be completed by late 2024.

5.2 Toxics-Impaired Segments

Waterbodies may be assessed as impaired from non-toxic causes (e.g., sediment, bacteria), as well as from toxic causes (the focus of this report). The extent (waterbody length or surface area) of waters impaired for toxics was greater for the 2022 IR cycle as compared to the 2020 IR cycle, but the percentage of that extent impaired for toxics remains remarkably unchanged from cycle to cycle (
Table 18). The name, location, and impairment cause for each toxics impaired segment for the 2022 IR cycle can be found in Appendix 14.

Table 18. Summary of waterbody length or surface area impaired for any cause compared to toxic causes. Each cycle represents a 6-year dataset.

Integrated Report Cycle	Impaired Extent All Causes			Impaired Extent Toxic Causes			% Extent Impaired Toxic Causes		
	Lake or Reservoir (sq mi)	River (mi)	Estuary (sq mi)	Lake or Reservoir (sq mi)	River (mi)	Estuary (sq mi)	Lake or Reservoir (sq mi)	River (mi)	Estuary (sq mi)
2006	31,820	1,247		24,186	141		76.0	11.3	
2008	30,253	7,025	1,787	25,348	1,304	1,724	83.8	18.6	96.5
2010	96,651	12,101	2,157	85,926	2,830	2,088	88.9	23.4	96.8
2012	94,041	13,127	2,134	85,518	2,828	2,061	90.9	21.5	96.6
2014	94,754	15,677	2,136	86,000	3,657	2,058	90.8	23.3	96.3
2016	93,523	15,282	2,132	86,012	3,669	2,049	92.0	24.0	96.1
2018	95,366	15,553	2,133	87,262	3,744	2,049	91.5	24.1	96.1
2020	94,789	15,871	2,137	88,082	3,714	2,097	92.9	23.2	96.2
2022	101,172	16,205	2,138	88,332	3,718	2,058	87.3	22.9	96.3

The overwhelming majority of the 1,383 toxics-impaired segments in the 2022 IR are the result of fish consumption advisories for PCBs in Fish Tissue or Mercury in Fish Tissue (1,357 segments), which together account for approximately 98% of toxics-impaired segments (Table 19). Both contaminants are persistent and likely to bioaccumulate in higher concentrations in fish tissues than in the surrounding environment. The number of segments impaired for each toxic cause in the 2022 IR cycle is in Appendix 15. Note that a waterbody segment can be impaired for multiple causes simultaneously; 147 segments are impaired for both PCBs in Fish Tissue and Mercury in Fish Tissue.

Table 19. Top five toxic impairment causes by number of toxics-impaired segments for the 2022 Integrated Report cycle. Note 147 segments were impaired for both PCBs and Mercury in Fish Tissue.

Toxic Cause of Impairment	No. Impaired Segments
PCBs in Fish Tissue	1,150
Mercury in Fish Tissue	354
PCBs in Water	54
Dioxin	23
Copper	9

5.3 Toxics-Impaired Segment Delistings

For the 2022 IR cycle, 19 toxics-impaired segments were proposed to EPA for delisting (Appendix 16). The proposed delistings include:

- 3 segments for Mercury in Fish Tissue based on new data indicating decreased contaminant levels sufficient to meet water quality criteria
- 1 segment for Copper based on new data indicating decreased contaminant levels sufficient to meet water quality criteria
- 4 segments for PAHs (fish consumption) based on revised water quality standards

Pending EPA approval, the proposed toxics-impaired segments will be removed from the impaired waters list.

Supplemental Information: 305(b)/303(d) Water Quality Assessment

The final 2022 Integrated Report is available on DEQ's website at:
https://www.deq.virginia.gov/water/water-quality/assessments/integrated-report

6.0 Total Maximum Daily Loads (TMDLs) and Special Studies

6.1 Overview

Total Maximum Daily Loads (TMDLs) pinpoint the maximum pollutant load (i.e., loading capacity) a waterbody can receive and still meet water quality standards. TMDLs, once implemented, help lower the risk contaminants pose to humans and the ecosystem. Pollution limits, or load allocations (LAs) for nonpoint sources and waste load allocations (WLA) for point sources, are set to meet the loading capacity identified in the TMDL. To establish the LAs and WLAs for a contaminant such as PCBs, water and sediment samples are collected for use in the development of a PCB fate and transport model. The modeled output is used to set allocations of the different PCB sources from which reductions are assigned.

The TMDL Program is the primary program for addressing impairments caused by pollutants – including toxic substances – in aquatic environments on a watershed scale. TMDLs are prioritized for development based on the national 303(d) Program Vision (for additional information see link below). For PCB TMDLs, the WLA implementation process involves permitted dischargers developing Pollutant Minimization Plans (PMPs). PMPs are used to reduce or prevent releases of contaminants into a waterbody in order to achieve effluent quality at or below the applicable water quality standard or TMDL endpoint. Other implementation actions related to the LA portion of the TMDL equation may be possible depending on the PCB sources identified during the TMDL development process.

EPA approved 27 new TMDL equations between CY20 and CY21. The TMDLs approved during this period addressed a mixed group of pollutants that included excessive sedimentation and nutrients, bacterial contamination, and PCBs. The Lewis Creek (Shenandoah River basin) PCB TMDL was due to an impairment by a toxic contaminant. DEQ currently has various TMDL projects underway to address toxics (including PCBs) in fish tissue. Included are the non-tidal portion of the James River extending from the headwaters to the Interstate 95 bridge, the tidal portion of the James River watershed that stretches to the mouth and includes the Elizabeth River watershed, Mountain Run (Rappahannock River basin) described below, and the Bluestone River (New River basin). In addition, DEQ is developing several TMDLs for benthic aquatic life use impairments. These impairments may be due to a number of potential stressors, including toxics. To identify the specific stressors, DEQ performs monitoring to support Stressor Analysis studies which are used to select the target pollutant for TMDL development.

Special studies are often initiated independently at the DEQ Regional Office (RO) level in response to locally recognized problems. Often, these regional special studies are related to TMDL development for impaired waters based on impacts to aquatic life, but they may also be initiated to evaluate new monitoring or analytical methods, or to investigate potential problems with new practices. The TMDL Program is an important component of DEQ’s efforts to remediate toxics in aquatic environments.

Supplemental Information: TMDLs

For information on EPA's Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program visit:
https://www.epa.gov/sites/default/files/2015-07/documents/vision_303d_program_dec_2013.pdf

Completed TMDLs are available via the search form on the "TMDL Development" link on the DEQ website at:
https://www.deq.virginia.gov/water/water-quality/tmdl-development/approved-tmdls

The list of TMDLs under development is also available on the DEQ website at:
https://www.deq.virginia.gov/water/water-quality/tmdl-development/tmdls-under-development

Guidance for developing Pollutant Minimization Plans (PMPs) can be found at:
https://www.deq.virginia.gov/water/water-quality/tmdl-development/tmdls-under-development/pcb-tmdls

6.2 TMDL and Special Study Narratives

This section includes updates on activities and toxics data collected during CY20 – CY21 to support TMDLs and special studies regarding toxic parameters addressed by DEQ's ambient monitoring programs described in Chapter 4. Also included are Stressor Analysis studies because they often collect water samples for analysis of toxic parameters, even if toxic parameters are ultimately not identified as a probable cause of impairment. Raw data collected in CY20 – CY21 for each study are included in the appendix cited in each narrative.

Statewide Special Study: Legacy Non-PCB Impairments
Legacy toxic fish consumption impairment listings have been included in past 305(b)/303(d) Integrated Reports for non-PCB organic contaminants. Statewide, thirty-five (35) distinctive water segments with forty-six (46) listings were identified in fish tissue samples collected from 1996 through 2007. The pollutants associated with the 46 listings include one or more contaminants from the following groups: PAHs [Benzo[a]pyrene, Benzo[b]fluoranthene, and Benzo[k]fluoranthene], chlorinated pesticides [Aldrin, Chlordane, Heptachlor Epoxide, DDD, DDE and DDT], and/or dioxin. Fish have not been monitored for these pollutants since 2007 as the Fish Tissue Monitoring Program was suspended in FY 2008 due to the lack of funding needed to cover programmatic costs. When the program was reactivated in 2012, the target areas and contaminant was limited to existing PCB fish tissue impairments. As such, follow-up monitoring to determine the status of the forty-six (46) fish tissue based impaired waters for non-PCB pollutants has not occurred in approximately fourteen (14) years.

The sampling design for this project was to revisit the appropriate fish tissue stations that were analyzed for the contaminants of interest from 1996-2007 (Appendix 17). The targeted fish species largely included those that were identified as containing levels of contamination above the fish tissue threshold values (TVs). In situations where identical species could not be collected, replacement fish included those that had a similar trophic status and feeding strategy. Fish collection procedures adhered to DEQ's standard procedures.

The data generated from this effort will be used as part of the 305(b) Assessment process in determining the status of these impairments. The analytical methods utilized have reporting levels below the fish tissue TVs of interest that allow a direct comparison. Knowing that the

impairments are old and several of the pollutants are considered legacy, the objective is to determine if these waters can be delisted, but only as supported by the data. Since the Virginia Department of Health identified and listed the dioxin consumption advisory, tissue residue data covering a two year period are required to remove the advisory.

Fish tissue samples were collected during latter period of the CY20 – CY21 timeframe. Given that the sample holding period is up to a year for these contaminants, the sample results have only recently been received by DEQ and are currently under internal review.

Mountain Run: PCB TMDL

The Mountain Run impairment extends from the Route 15/29 bridge crossing, near the City of Culpeper, approximately 19 miles downstream to the confluence with the Rappahannock River. This waterbody was included in the 2004 Virginia Department of Health PCB fish consumption advisory and was first listed with a fish consumption impairment in DEQ's 2006 Integrated Report. The special study monitoring has entailed sampling throughout the watershed to identify potential areas of elevated PCB concentrations in both water column and sediment. In 2017, a review of the existing data was performed to assist with the selection of additional stations around the Culpeper area to target areas of potentially elevated PCB concentrations. Collections of the initial round of samples occurred during April 2018. In July 2018, DEQ completed the main sampling effort concentrating data collection around the Culpeper area.

During the CY20 to CY21 timeframe, DEQ collected follow-up PCB samples at five locations bracketing possible contaminated sites identified in the watershed to help inform the Source Assessment component for the impending PCB TMDL study. A total of five (5) water column samples and two (2) sediment samples were collected and analyzed for PCBs during this effort (**Appendix 7)**. Development of the PCB TMDL is scheduled for completion during late 2022.

Mountain Run: Benthic Stressor Analysis

DEQ started monitoring the Mountain Run watershed in Culpeper County to collect information in support of preparing a stressor analysis to identify the cause(s) of the benthic impairment in Mountain Run and Jonas Run. Mountain Run was first listed as impaired for the aquatic life use due to poor health in the benthic biological community in the 2008 Integrated Report. The impairment is approximately 19.90 river miles in length and extends from the confluence with the Rappahannock River upstream to the Route 15/29 crossing. Jonas Run, a tributary to Mountain Run, is approximately 3.78 miles in length. It was first listed as impaired for the aquatic life use due to poor health in the benthic biological community in the 2012 Integrated Report.

Sampling for this stressor analysis was completed in CY20, to include water samples for toxics analysis collected from Mountain Run from the following stations: 3-MTN005.79, 3-MTN014.88, 3-MTN021.11 (Appendix 6).

Lewis Creek: PCB TMDL

Lewis Creek was listed as impaired for PCBs due to exceedances of the Virginia Department of Health's (VDH) fish consumption threshold in 2004, and the Virginia Department of Environmental Quality's (DEQ) fish tissue-screening value in 2012. The PCB impairment begins near its headwaters and extends downstream 12.53 miles through the City of Staunton to its confluence with Middle River near Verona. Lewis Creek is in the Shenandoah River basin. The Lewis Creek PCB TMDL was completed and posted for public comment on August 16, 2021.

DEQ submitted the report to EPA for approval on January 5, 2022. The TMDL endpoint of 440 pg/L was derived using a site specific bioaccumulation factor. The selected allocation scenario includes a 99% reduction in PCB loads from contaminated sites, a 91% reduction in loads from MS4 service areas, and an 82% reduction in direct drainage from non regulated areas. Following completion of the TMDL study, DEQ began planning for follow up monitoring to identify unknown sources in the watershed. Water and sediment data collected between 2017 and 2019 will be used to identify tributaries to target with follow up monitoring. No samples were collected during CY20 or CY21.

Elizabeth River and Lower James River: PCB TMDL

The Elizabeth River and lower James River and their tributaries have VDH fish consumption advisories for PCBs, and thus are impaired waters for PCBs. Field studies began in 2009 with numerous monitoring events also taking place in 2010 and 2013. Ambient water samples were collected from locations throughout this section of the watershed during periods of "dry" weather and "wet" weather conditions. A low-level analytical procedure, capable of parts per quadrillion detection level was used to analyze all samples. The results are being used in support of TMDL development by delineating possible source areas and to provide information for model development to establish the fate and transport of PCBs in the watershed.

During CY20 – CY21, twenty-six (26) ambient water samples were collected from headwater locations in the Elizabeth River watershed (Appendix 7). The recent PCB data will enhance the development of the watershed model in support of the TMDL study. The PCB TMDL is scheduled for completion by 2024.

Elizabeth River Supplemental Information

In 1997, in response to indications of water quality impairment by toxics in the Elizabeth River and its tributaries, DEQ and a group of stakeholders through the non-profit group Elizabeth River Project (ERP) collaborated to produce a comprehensive Water Quality Monitoring plan for the waterbodies of concern. Under guidelines included in that plan, a baseline environmental study began in January 1998 with the goal of allowing the future assessment of trends in contaminant concentrations and their effects. Scientists from the Virginia Institute of Marine Science, Old Dominion University, and DEQ worked with representatives from state, federal, and local authorities, and other stakeholders to design and conduct the monitoring effort. DEQ continues to monitor for conventional pollutants and nutrients, however, most studies specifically involving toxics and their effects in the Elizabeth River system have been concluded.

The Elizabeth River Project in December 2020 released its 2020 State of the River Scorecard, which concludes the river is holding steady overall with a "C" grade (A to F scale), the same as during the last assessment in 2014. Most branches improved overall since the last assessment; as ERP Lead Scientist Joe Rieger notes: "Out of the 11 parameters evaluated for 10-year river health trends in each branch (55 overall trends analyzed), only three show declining health. All other parameters show improving trends or no change in the trends.". In addition to water quality parameters the scorecard includes letter grades for biological indices such as benthic community health and cancer rates in fish (mummichogs). Dr. Daniel Dauer at Old Dominion University gave the benthic community in Elizabeth River an overall grade of "D" ("Degraded"), the same as in 1999. The ongoing research of Dr. Wolfgang Vogelbein at Virginia Institute of Marine

Science indicates liver cancer is more prevalent in the mummichogs that live in the most industrialized branches.

For more information on monitoring activities and water quality improvement strategies visit the Elizabeth River Project website: https://www.elizabethriver.org

The 2020 State of the Elizabeth River Scorecard is available on the Elizabeth River Project website at: https://elizabethriver.org/wp-content/uploads/2022/09/FINAL_STATE_Of_THE_RIVER_w._APPENDIX.pdf

Middle and Upper tidal James River: PCB TMDL

The middle and upper tidal James River and its tributaries have VDH fish consumption advisories for PCBs and have been listed as impaired for that use. Ambient water samples were collected from locations throughout the watershed during 2009 – 2013 with primary focus on "dry" weather and "wet" weather conditions. Several additional samples were collected during spring 2016 at the Richmond fall line. A low-level analytical procedure, capable of parts per quadrillion detection level was used to analyze all samples. The results are being used in support of TMDL development by delineating possible source areas and to provide information for model development to establish the fate and transport of PCBs in the watershed.

During CY20 – CY21, 31 ambient water samples were collected from headwater locations in the middle and upper tidal James River watershed (Appendix 7). The recent PCB data will enhance the development of the watershed model in support of the TMDL study. The PCB TMDL is scheduled for completion by 2024.

Bluestone River PCB Source Investigation

The Bluestone River is in the New River Basin in southwestern Virginia. Currently a Virginia Department of Health fish consumption advisory exists from the Route 460 bridge just south of Bluefield, Virginia downstream to Virginia/West Virginia state line near the town of Yards in Tazewell County, Virginia. This advisory exists for carp, white sucker, rock bass and largemouth bass. Initial TMDL studies to delineate the geographic distribution and possible sources of the PCB contamination began in 2002.

As part of the initial source assessment evaluation in fall of 2005, semi-permeable membrane devices (SPMDs) were deployed during low flow conditions. A PCB report for the Bluestone River in Tazewell County was released by USGS in 2007. The results of this PCB study were also presented at the 7th Passive Sampling Workshop and Symposium in Reston, Virginia (April 24-26, 2007), which was cosponsored by the Columbia Environmental Research Center, U. S. Geological Survey and DEQ.

These previous investigations resulted in USEPA removal actions at two facilities in West Virginia known to have been releasing PCB contamination (the Lin Electric Site and the former Joy Manufacturing Site, also known as the Route 52 Site). In December 2008, sampling results indicated that the stormwater migrating from the Lin Electric Site was found to contain the highest levels of PCBs compared to other surface water samples collected in the area. Surface water monitoring completed by DEQ since the removal actions indicates that the concentration of PCBs migrating from the Lin Electric Site has steadily declined. However, concentrations of the PCBs detected in the Bluestone River have remained somewhat consistent.

DEQ water sampling during periods of high and low flows in 2017 and 2018 along Whitley Branch, a tributary of the Bluestone River, show improving PCB conditions likely as a result of EPA PCB removal efforts at the Lin Electric site. However, corresponding samples collected along Beaverpond Creek continue to show elevated PCB concentrations.

The Route 52/Joy Electric site property is located just upgradient of the Beacon Cave system. PCB contamination was likely to have been released into the environment by the operators of the former Joy Manufacturing Site resulting in the release of unknown quantities of PCB contaminated oil into the Beacon Cave system. The Beacon Cave system is a karst groundwater system that begins in West Virginia. Groundwater moves rapidly through this system and exits to surface water in Virginia. The still elevated PCB concentrations in Beaverpond Creek suggest that the Beacon Cave system itself could be the current source of the PCB contamination impacting this creek and migrating via surface water to the Bluestone River. There may be an additional unknown source impacting the Beacon Cave System.

USEPA Region 3 tasked the Tetra Tech, Inc. Superfund Technical Assessment and Response Team (START) to assist in conducting a removal site evaluation at the Bluefield Beacon PCB Groundwater Site. On September 28, 2021, START collected: (1) sediment and surface water samples from Beaverpond Creek and the Bluestone River, (2) a sediment and groundwater sample within the Beacon Cave, and (3) composite soil samples from open sinkholes. The sampling was conducted during dry weather conditions. PCB contamination was limited for this dry weather sampling event showing a downward trend for the water column PCB result – with the exception of the sample collected at the cave resurgence which was slightly higher than previous sampling in 2018. A draft report of the September 2021 sampling was submitted to USEPA by Tetra Tech, Inc. in March 2022.

The Biological Systems Engineering Department at Virginia Polytechnic Institute and State University has been contracted to provide support for the development of a PCB TMDL for impaired segments of the Bluestone River and tributaries in southwestern Virginia. Coordinated discussions continue among West Virginia DEP, DEQ, and EPA to address the Bluestone River PCB impairment.

For more information on Bluestone River PCBs, see this USGS 2007 PCB report for the Bluestone River in Tazewell County: https://pubs.usgs.gov/of/2007/1272/pdf/OFR2007-1272.pdf

Catharpin Creek Benthic Stressor Analysis

DEQ started monitoring Catharpin Creek in Prince William County to collect information in support of preparing a stressor analysis to identify the cause(s) of the benthic impairment. Catharpin Creek was first listed as impaired for the aquatic life use due to poor health in the benthic biological community in the 2012 Integrated Report. The impairment is approximately 6.81 river miles in length and extends from the confluence with the Little Bull Run upstream to the route 601 crossing.

The sampling for this project was completed at the end of CY20. In February 2020, storm flow clean dissolved metals sampling of the water column was performed once at the following stations: 1ACAA001.18 and 1ACAA007.32. Routine water samples for toxics analysis were collected approximately monthly in CY20 at two stations in the watershed: 1ACAA001.18 and 1ACAA007.32 (Appendix 6).

Sand Branch Benthic Stressor Analysis
Sand Branch was first listed as impaired for the aquatic life use due to poor health in the benthic biological community in the 2018 Integrated Report. The impairment is approximately 1.54 river miles in length and extends from the confluence with Cub Run upstream to the headwaters. DEQ started monitoring Sand Branch in Fairfax and Loudoun Counties to collect information in support of a stressor analysis to identify the cause(s) of the benthic impairment. The stressor analysis study began in October 2020 and concluded in August 2021. The results of the analysis identified conductivity (from total dissolved solids), sediment, sulfate, and total phosphorus as the probable stressors. TMDL development for three pollutants (sediment, total dissolved solids, and total phosphorus) was initiated in June 2021. TMDL development is anticipated to be completed in 2023. During CY20 and CY21, DEQ collected water samples for toxics analysis at 2 stations: 1ASAN000.34 and 1ASAN001.45 (Appendix 6).

Pohick Creek Benthic Stressor Analysis
Sections of Pohick Creek and its tributaries in Fairfax County (Potomac River basin), are impaired due to an altered benthic macroinvertebrate community. DEQ monitored to collect data in support of preparing a stressor analysis to identify the cause(s) of the benthic impairment.

During CY20 – CY21, water samples for analysis of various toxic parameters were collected from the following streams and monitoring stations: Pohick Creek - 1APOH004.79, 1APOH005.36, 1APOH007.65, 1APOH013.12; South Run - 1ASOH001.71; Middle Run - 1AMID000.75; Sideburn Branch - 1ASID001.35. Results of water sample analysis are in Appendix 6.

Broad Run TMDL Benthic Stressor Analysis
Sections of Broad Run and its tributaries in Loudon County (Potomac River basin), are impaired due to an altered benthic macroinvertebrate community. DEQ monitored to collect data in support of preparing a stressor analysis to identify the cause(s) of the benthic impairment.

During CY20 – CY21, water samples for analysis of various toxic parameters were collected from the following streams and monitoring stations: Broad Run - 1ABRB002.15, 1ABRB006.33, 1ABRB015.38; Beaverdam Run - 1ABED000.87, 1ABEM000.60; Horsepen Run - 1AHPR003.87; South Fork Broad Run - 1ASOR000.59; Indian Creek - 1AINI000.80; Frying Pan Branch - 1AFRY000.60; Russell Branch - 1ARUS000.33. Results of water sample analysis are in Appendix 6.

Fourmile Run TMDL Benthic Stressor Analysis
Sections of Fourmile Run and its tributaries in Alexandria and Arlington (Potomac River basin), are impaired due to an altered benthic macroinvertebrate community. DEQ monitored to collect data in support of preparing a stressor analysis to identify the cause(s) of the benthic impairment.

During CY20 – CY21, water samples for analysis of various toxic parameters were collected from the following streams and monitoring stations: Fourmile Run - 1AFOU001.92, 1AFOU005.16; Lubber Run - 1ALUB000.08; Doctors Run - 1ADOC000.16. Results of water sample analysis are in Appendix 6.

James River Tributaries Benthic Stressor Analysis and TMDL
Sections of Bailey Creek, Nuttree Branch, Oldtown Creek, Proctors Creek, Rohoic Creek, and Swift Creek in Chesterfield, Dinwiddie, and Prince George Counties are impaired due to an

altered benthic community. DEQ monitored to collect data in support of preparing a stressor analysis to identify the cause(s) of the benthic impairment. The stressor analysis has been completed and the TMDL is under development.

During CY20 – CY21, various toxic parameters were collected at the following stations: 2-APP016.38, 2-BLY003.42, 2-BLY005.73, 2-NUT000.62, 2-OTC001.54, 2-PCT002.46, 2-RHC000.58, 2-SFT019.15, and 2-SFT025.32. In addition, toxics sampling was conducted at 2-JOH004.04 to serve as a reference station for the stressor analysis. Results of water sample analysis are in Appendix 6.

Henrico Benthic Stressor Analysis

Various tributaries in the James River Basin in Henrico County, the City of Richmond, and Goochland County are impaired due to an altered benthic community. DEQ monitored to collect data in support of preparing a stressor analysis. The stressor analysis is currently under development.

During CY20 – CY21, DEQ collected toxics samples at stations 2-DOV003.96, 2-DPR003.75, 2-NTR000.23, 2-SNJ000.19, 2-XNJ001.77, 2-SNJ001.88, 2-XYT000.29, and 2CJOP000.34 as well as at: 2-NTR004.77, 2-UPM008.76, 2-UPM005.26, 2-UPM000.26, and 2-XYT000.04. Results of water sample analysis are in Appendix 6.

Moores and Mill Creek Benthic Stressor Analysis

Water quality data collected by DEQ from 2005 to 2020 in the Moores and Mill Creek watersheds were used in the benthic stressor analysis. Seventy-one (71) samples were collected from two ambient monitoring stations in the project area (2-MRC002.14 and 2-MIS000.04). Results of water sample analysis are in Appendix 6.

South Fork Rivanna River Benthic Stressor Analysis

Sections of South Fork Rivanna River and its tributaries in Albemarle County and Lynchburg (James River basin), are impaired due to an altered benthic macroinvertebrate community. DEQ monitored to collect data in support of preparing a stressor analysis to identify the cause(s) of the benthic impairment.

During CY20 – CY21, water samples for analysis of various toxic parameters were collected from the following streams and monitoring stations: Broad Axe Creek - 2-BRX000.66; Ivy Creek - 2-IVC005.19; Mechums River - 2-MCM005.12; Moormans River - 2-MNR000.39, 2-MNR011.69; Powell Creek - 2-PLC001.49; Slabtown Branch - 2-SBT000.17; South Fork Rivanna River - 2-RRS001.81; Spring Creek - 2-SIN002.70; Tye River - 2-TYE008.77. Results of water sample analysis are in Appendix 6.

Future Benthic Stressor Analyses

During CY20 – CY21, DEQ conducted water sampling of toxic parameters in multiple watersheds to collect data for future benthic stressor analyses. Results of water sample analysis are in Appendix 6. Samples were collected at the following stations:

Appomattox River watershed: Big Guinea Creek - 2-BGU005.67, Briery Creek - 2-BRI004.01, Bush River - 2-BSR017.69, Rice Creek - 2DRCE002.44; Sandy River - 2DSDY008.80; Horsepen Creek - 2-HRE000.44; 2-HRP000.42; Plum Creek - 2-PUM000.29; North Branch

Sandy River - 2-SNN001.19; Nibbs Creek South Branch - 2DNBX002.33; Winticomack Creek - 2-WTK001.50.

Nottoway River watershed: Big Hounds Creek - 5ABHC006.57; Little Nottoway River - 5ALNT009.80; Mallorys Creek - 5AMLL001.27; UT to Nottoway River - 5AXEJ001.86; UT to Big Hounds Creek - 5AXIV000.01.

Meherrin River watershed: Blackstone Creek - 5ABKS001.60; Couches Creek - 5ACHS006.33; Finneywood Creek - 5AFNY004.54; Flat Rock Creek - 5AFRC013.25; Kits Creek - 5AKTS002.63; Little Genito Creek - 5ALTG007.00; Middle Meherrin River - 5AMMR008.77; North Meherrin River - 5ANMR007.90, 5ANMR013.95; Rocky Run - 5ARYR000.62; Wilson Creek - 5AWIL002.42.

Blackwater River watershed: UT to Blackwater River - 5AXFM000.88.

Powhite Creek and Pocoshock Creek: Powhite Creek - 2-PWT001.97; Pocoshock Creek - 2-PSK006.53

Roanoke River Pre-TMDL Special Study

The Roanoke River is impaired for the aquatic life use general standard from Niagara Dam downstream to the mouth of Back Creek. This segment was listed in 2008 for benthic impairment based on samples collected in 2005 and 2006 (Assessment Unit: VAW-L04R_ROA01A00). Additional sampling indicated the segment remains impaired yet water quality data suggests that the stressor to the benthic community is different than the stressor identified for the benthic impairment upstream on the Roanoke River. For this reason, DEQ has worked with the primary point source discharger in the watershed, Western Virginia Water Authority (WVWA) to identify data gaps in the existing dataset to inform the stressor identification process prior to TMDL development. The special study attempts to address some of the identified data gaps. As a partner on this special study, WVWA collected ambient toxicity samples and utilized their DEQ approved laboratory for analysis. A composite river water sample was collected at two sites on the Roanoke River (4AROA202.20 and 4AROA198.08) to represent a pre- and post- outfall environment. Samples collected on November 15, 17, and 18, 2021 were combined for a composite sample. A short term chronic toxicity test was conducted on Pimephales promelas and Ceriodaphnia dubia. Both the pre outfall and post outfall water samples passed all tests. DEQ and WVWA plan to collect an additional ambient toxicity sample at the same locations in the fall of 2023. DEQ also collected bimonthly samples in CY21 at 4AROA198.08 to inform TMDL development. Results of water sample analysis are in Appendix 6.

7.0 Other Initiatives

In addition to the programs described for addressing chemicals meeting the codified definition of toxic substances, DEQ also undertakes various initiatives to monitor and evaluate risks from substances present in waters of the Commonwealth that are potentially toxic. These may include contaminants of emerging concern (CECs) – substances that historically have typically not been regulated as water pollutants, but which have been detected at levels of potential concern in waterbodies as indicated by advancing science that is revealing their potential to cause adverse effects to ecosystems and/or humans. Substances of potential toxic concern also include toxins produced by certain nuisance algae in waters with excessive nutrient pollution. This chapter describes two such initiatives undertaken by DEQ during the CY20 – CY21 reporting period to address such potentially toxic substances.

7.1 Toxins from Harmful Algal Blooms (HABs)

Harmful algal blooms (HABs) produce toxins which may cause skin, eye, and digestive tract irritation, kidney and liver damage and neurotoxic effects. DEQ and the Virginia Department of Health (VDH) serve as lead partners on the HAB task force, along with Old Dominion University, Virginia Institute of Marine and members from other local, state, and federal agencies and universities. The HAB task force responds to public complaints, conducts scientific investigations on potential HAB events, and provides information to the public on HAB events and their associated health risks. These investigations inform VDH health advisories and DEQ water quality assessments. DEQ serves the HAB task force primarily by conducting field investigations of potential HABs in freshwater systems. The aim of these investigations is to determine if cyanobacteria cell counts or toxin concentrations in water samples exceed VDH safe swimming thresholds, which may trigger VDH swimming advisories and DEQ assessments that a waterbody is impaired for the recreational designated use. DEQ also serves in an advisory role to task force partners on technical issues and policies related to HABs. As resources and staff availability allow, DEQ also responds to reports in marine waters and may provide limited support for drinking water authorities.

For complete information on freshwater thresholds and advisories, see VDH Guidance at: https://www.vdh.virginia.gov/content/uploads/sites/178/2022/01/FINAL_SIGNED_Guidance_for_Cyanobacteria_Recreational_Advisory_Mgt.5Aug2021-1.pdf

For information on DEQ water quality assessments, see DEQ assessment guidance at: https://www.deq.virginia.gov/water/water-quality/assessments/wqa-guidance-manual

In calendar years 2020 and 2021, DEQ and HAB task force partners collected 255 samples for HAB cell count evaluations in fresh waters (i.e., counts of the cells of potentially toxic cyanobacteria species). These samples were analyzed for some or all of the following toxins: microcystin, cylindrospermopsin, anatoxin-a and saxitoxin, as needed for each specific case, for a total of 876 toxin analyses.

HAB task force activities in calendar years 2020 and 2021 resulted in the issuance of several HAB notifications to the public to avoid algae blooms while recreating, as well as 15 official VDH health advisories to the public to avoid primary contact recreation such as swimming. Recreational advisories occurred in 6 fresh waterbodies; Aquia Creek at Widewater State Park (Stafford County), Woodstock Pond (James City County), Pandapas Pond (Montgomery County), the North Fork of the Shenandoah River (Shenandoah and Warren Counties), an unnamed tributary of the Chickahominy River (Henrico County), and Lake Anna (Spotsylvania, Louisa, and Orange Counties).

In DEQ's 2022 303(d)/305(b) Integrated Water Quality Assessment Report to EPA (2022 IR), the agency began using information on VDH HAB advisories to assess Virginia waters against the recreational designated use. For the calendar years 2019 and 2020 (last 2 years of the 6-year 2022 IR assessment cycle), 7 waterbodies for which VDH HAB advisories persisted for 30 days or longer were assessed as impaired, and not meeting the recreational designated use due to HABs. All of the impairments were due to cyanobacteria blooms in the following fresh waterbodies: Lake Anna (Spotsylvania, Louisa, and Orange Counties), Mint Springs Lake (Albemarle County), Aquia Creek (Stafford County), Wilcox Lake (City of Petersburg), Woodstock Pond (James City County), Prince Edward Lake (Prince Edward County), and an unnamed tributary of the Chickahominy River (Henrico County). The 2022 IR is available at: https://www.deq.virginia.gov/water/water-quality/assessments/integrated-report

The VDH Division of Shellfish Safety and other HAB task force partners also conduct routine investigations for marine HABs and associated toxins. These investigations are primarily conducted to determine if health criteria associated with algae and algal toxins in shellfish tissue are exceeded. Although toxin-producing algae do occur in Virginia's marine waters, to date there have been no exceedances of the VDH shellfish thresholds, no human illnesses attributed to HABs in shellfish, and no recreational advisories due to HABs in marine waters.

In 2021, DEQ led an effort in collaboration with VDH and the Virginia Department of Agriculture and Consumer Services, to develop a report to the Virginia General Assembly entitled: "Harmful Algal Blooms in Virginia". For more information on the programs described above, and more detailed information on HABs in the commonwealth, please see that report at: https://rga.lis.virginia.gov/Published/2021/RD411/PDF and the supplemental information listed below.

In 2022, the Virginia General Assembly allocated $3.5 million to the Commonwealth's 2022-2024 biennium budget to investigate potentially harmful algal blooms observed in Lake Anna and the Shenandoah River (see: 2022 Special Session I Virginia Acts Of Assembly, Chapter 2, Item 374, B.1, page 429 at: https://budget.lis.virginia.gov/get/budget/4623/HB30/). The agency has partnered with VDH, USGS and the Interstate Commission on the Potomac River Basin (ICPRB) and is currently in the project design phase, with implementation to begin in 2023.

Supplemental Information: Harmful Algal Blooms

Data from HAB investigation sampling events may be requested from VDH by calling **804-864-7480** or visiting the division's contact page at: https://www.vdh.virginia.gov/environmental-health/environmental-health-services/shellfish-safety/shellfish-division-staff/

For a VDH Fact Sheet on HABs, visit:
https://www.vdh.virginia.gov/epidemiology/epidemiology-fact-sheets/harmful-algal-blooms/

For more information on the VDH HAB program, visit:
https://www.vdh.virginia.gov/waterborne-hazards-control/harmful-algal-blooms/

For more information on the Virginia HAB Task Force, visit:
https://www.vdh.virginia.gov/waterborne-hazards-control/harmful-algal-blooms/virginia-hab-task-force/

To report a potential Harmful Algae Bloom visit:
https://www.vdh.virginia.gov/waterborne-hazards-control/harmful-algal-bloom-online-report-form/

For current HAB advisories, notifications and surveillance activities visit:
https://www.vdh.virginia.gov/waterborne-hazards-control/algal-bloom-surveillance-map/

7.2 Per- and Polyfluoroalkyl Substances (PFAS)

Per- and polyfluoroalkyl substances (PFAS) are a class of human-made compounds which may have adverse human health effects. These compounds are considered emerging contaminants as the science behind how they act in the environment continues to evolve.

The 2020 Acts of Assembly Chapter 611 (HB586) required the Commissioner of Health to convene a work group to study the occurrence of perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), perfluorobutyrate (PFBA), perfluoroheptanoic acid (PFHpA), perfluorohexane sulfonate (PFHxS), perfluorononanoic acid (PFNA), and other perfluoroalkyl and polyfluoroalkyl substances (PFAS), as deemed necessary, in the Commonwealth's public drinking water. The findings of the work group were published December 1, 2021 in the report available at: https://rga.lis.virginia.gov/Published/2021/RD877/PDF

In SFY 2019, DEQ collaborated with the Virginia Water Quality Academic Advisory Committee (AAC) and the Virginia Water Resources Research Center (VWRRC) to develop a report reviewing the available information on the sources, occurrences, environmental interactions, and human and ecological health effects of a group of emerging contaminants, including PFAS, other flame retardants, hormones and endocrine disruptors, pharmaceuticals and personal care products, antibiotics and micro- and nanomaterials. This report is available at:
https://www.vwrrc.vt.edu/wp-content/uploads/2019/10/SR63-2019_Emerging-Contaminants-in-the-Waters-of-Virginia.pdf

In SFY 2022, DEQ again collaborated with the AAC and the VWRRC to review recommendations for ambient monitoring of PFAS. The study aims to help best determine how to evaluate water quality for the Commonwealth's surface freshwaters with regard to PFAS. This report is available at: https://www.vwrrc.vt.edu/wp-content/uploads/2022/08/SR-66_2022_PFAS-Monitoring-Options-to-Evaluate-Virginias-Surface-Waters.pdf

In early fall CY 2021, DEQ was informed of elevated levels of PFAS observed in surface waters in the middle Chickahominy River watershed which is one of the sources of drinking water for the Newport News Waterworks. DEQ has worked with the Virginia Department of Health (VDH) and Henrico County since learning of the elevated PFAS levels in surface waters to verify the existing information, identify potential human health exposure and identify potential sources of PFAS. DEQ partnered with the United States Geological Survey (USGS), Virginia and West Virginia Water Science Center (VA/WV WSC) in late CY 2021 to collect environmental data consisting of surface water, fish tissue and sediment samples in the Chickahominy River watershed. Initial sampling was completed in December 2021. In CY 2022, this partnership was expanded to begin a statewide PFAS program, to include probabilistic sample locations to evaluate concentrations that occur in Virginia waters and targeted sample locations to address areas of potential concern. This effort also included samples at multiple timepoints to evaluate the variability of PFAS concentrations in time and the effects of varying environmental conditions on these concentrations.

Supplemental Information: PFAS
More information about USGS VA/WV WSC studies of PFAS in Virginia can be found on the main project website at: https://www.sciencebase.gov/catalog/item/624de6d8d34e21f82766baff Analytical results from those studies will be accessible from the main project website as they become available. The results from the first study, on the middle Chickahominy River watershed, are available at: https://doi.org/10.5066/P9LCSF2J

References

A cumulative bibliography of general references and publications cited in this and previous Toxics Reports is included in Appendix 18.