2017-2018 Report on Toxics Reduction in State Waters

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:

http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx.

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

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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.
Aroclor	Aroclor is a PCB mixture produced from approximately 1930 to 1979. (https://www.epa.gov/pcbs/learn-about-polychlorinated-biphenyls-pcbs)
B-IBI	Benthic Index of Biotic Integrity
Compliance Monitoring	The monitoring of 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.
CWA	Clean Water Act
DCLS	Division of Consolidated Laboratory Services of the Virginia Department of General Services (DGS)
DMR	Discharge Monitoring Report
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
IBI	Index of Biological Integrity
IR	305(b)/303(d) Water Quality Integrated Assessment Report.
IRIS	Integrated Risk Information System - a database of human health effects that may result from exposure to various substances found in the environment IRIS is provided online by EPA and its Office of Research and Development, National Center for Environmental Assessment. (https://www.epa.gov/iris).
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
Nanogram	(ng) One billionth of a gram
NARS	National Aquatic Resources Survey
NCCA	National Coastal Condition Assessment
NELAP	National Ecological Laboratory Accreditation Program
NPS	Non-Point Source (pollution)
NRDAR	Natural Resource Damage Assessment and Restoration (Department of the Interior)
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated biphenyl

PEC	Consensus-based *Probable Effects Concentrations* for chemical contaminants in freshwater sediments (MacDonald et al. 2000)
Picogram	(pg) One trillionth of a gram
POTW	Publicly Owned Treatment Works
ProbMon	Probabilistic Monitoring Program
QAQC	Quality Assurance Quality Control
QAPP	Quality Assurance Program and Project Plan
RBP	Rapid Bioassessment Protocol
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
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)
SOP	Standard Operating Procedure
SPMD	Semi-Permeable Membrane Device
STORET	EPA's legacy national ecological database (short for data 'STOrage and RETrieval' system)
TBT	Tributyltin
TEC	Threshold Effect Concentration – the concentration of a contaminant below which adverse effects to sediment-dwelling organisms are unlikely to occur.
TMDL	Total Maximum Daily Load
TMP	Toxics Management Program
TMR	Toxics Management Regulation
TRE	Toxics Reduction Evaluation
TRI	Toxic 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.
TSV	Tissue Screening Value – risk-based screening values used by DEQ and VDH for evaluating fish-tissues for human consumption.
VCPMI	Virginia Coastal Plain Macroinvertebrate Index
VELAP	Virginia Environmental Laboratory Accreditation Program
VERC	Virginia Emergency Response Council
VIMS	Virginia Institute of Marine Science
VPDES	Virginia Pollutant Discharge Elimination System
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
WQM	Water Quality Monitoring
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 the General Assembly of the Commonwealth 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, more specifically in relation to chemical contamination which may induce toxic effects on aquatic life, other wildlife or on human health. This commitment includes:

1. The prevention of contamination of the Commonwealth's waters by toxics,
2. The persistent monitoring of those waters for the presence of toxics, and
3. 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 Environmental Protection Agency's (EPA) Interstate Chesapeake Bay Program Office (CBPO), and the U.S. Geological Survey (USGS). This report summarizes the results of current 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. The current, nineteenth Toxics Report (January 2019) provides a summary of the toxics-related prevention, monitoring and remediation activities of the previous two State Fiscal Years (SFY) and contains tables of both raw data and statistical summaries of SFY17 and 18 monitoring results. Historical summaries of results from 1997 through the present are available on the agency's website at https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx.

1.2 Functional Definitions: Toxics, Toxicity, Water Quality Criteria, and Water Quality Standards

1.2.1 Defining "Toxics" and "Toxicity"

The Virginia Code (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. The absolute amount and relative concentration of a specific substance necessary to demonstrate deleterious effects also varies. The Federal Clean Water Act (CWA) defined the responsibility of the Environmental Protection Agency 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.

1.2.2 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 published studies (both academic and commercial) 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 or acute 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.
- 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 .
- On June 22, 2016, President Obama signed the Frank R. Lautenberg Chemical Safety for the 21st Century Act, which updates the Toxic Substances Control Act. For information about updates to the Toxic Substances Control Act, please visit: https://www.epa.gov/laws-regulations.
- 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. Detailed information on recent updates may be found at:

  Aquatic Life: https://www.epa.gov/wqc/aquatic-life-ambient-water-quality-criteria
  Human Health: https://www.epa.gov/wqc/human-health-water-quality-criteria

1.2.3 State Water Quality Standards (WQS)

Once federal water quality criteria have been established for a chemical substance, it is the responsibility of the individual states to establish water quality standards that are protective of the designated use(s) assigned to each body of water within state's laws and regulations. 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 revised its water quality standards, which EPA reviews and must approve prior to their application. These standards are set forth at 9VAC25-260. The standards undergo a formal triennial review for periodic updating. In reality, the Commonwealth's Water Quality Standards are almost constantly under review.

Cadmium criteria, and 94 human health criteria, are part of a carry-over rule making from 2016, and went before the State Water Control Board in late August of 2018 for final adoption. At its August 21, 2018 meeting, the Board adopted the revised criteria for cadmium. The Board also adopted proposed criteria amendments for 94 human health parameters in surface waters in 9VAC25-260-140. The updated criteria protect human health through the uptake of drinking water and fish consumption. These new criteria will become effective after they are approved by EPA.

Aquatic life criteria for ammonia in freshwater are being addressed in a separate rulemaking. Amendments to the ammonia criteria (9VAC25-260-155) were recommended for further deferral due to recent legislation adopted by the 2018 General Assembly. Virginia Code now requires that ammonia criteria amendments cannot be adopted unless the Board includes in such adoption a phased implementation program that addresses the potential adverse impact on permitted dischargers across the State. A Phased Implementation Program has been presented to the public for public comment, and proposed amendments are expected to be presented to the State Water Control Board at its December 2018 meeting.

The currently effective version of Virginia's Water Quality Standards regulation is available at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityStandards.aspx.

1.3 Federal Reporting Requirements

In addition to the biennial 305(b)/303(d) Water Quality Integrated Report, federal law requires reporting procedures for the production, movement, storage, use, and release of many of these toxic substances. These procedures, as well as Virginia's annual Toxics Release Inventory (TRI) Report, are discussed more fully below.

2.0 Activities Directed toward Toxics Reduction

DEQ's activities directed toward the reduction of toxics in state waters fall into three general categories: the prevention of contamination of the Commonwealth's waters by toxics, the monitoring of those waters (including sediment and fish tissues) for the presence of toxics, and the implementation of remediation activities to reduce and/or eliminate toxics found in the state's waters. All three classes of activity are geared toward maintaining the concentrations of potentially toxic substances in the state's waters below those concentrations that result in toxic effects, *i.e.*, within the bounds defined by water quality standards (or applicable screening values), with the knowledge that many such substances can never be completely eliminated from the environment.

2.1 Prevention

The primary prevention activities carried out by DEQ may be characterized as regulatory, non-regulatory, and educational. The regulatory Virginia Pollutant Discharge Elimination System (VPDES) requires that concentration limits be established for all potentially toxic substances in permitted discharges from industrial, institutional, and/or municipal wastewater treatment facilities to ensure that Virginia's water quality standards are not violated in the water bodies receiving such discharges. 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."

2.2 Monitoring and Assessment

The VPDES Program performs compliance monitoring in the form of announced and unannounced facility inspections, as well as requiring permitted facilities (industrial and municipal) to monitor their discharges and to file periodic electronic Discharge Monitoring Reports (DMRs) to document their compliance with permit limit requirements.

DEQ's integrated ambient Water Quality Monitoring (WQM) Program collects water, sediment, benthic organisms, and fish tissue samples from the Commonwealth's streams, rivers, lakes and reservoirs, and estuaries to determine whether waters meet water quality standards and sediment and fish tissue screening values. The structure and integration of the various components of the ambient WQM Program are described in detail in DEQ's Water Quality Monitoring Strategy. The revised 2013 edition is available on the DEQ website at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx . Revisions to this strategy will be posted in 2019. The major components involved with toxics monitoring normally include the fish tissue monitoring network, freshwater and estuarine probabilistic monitoring networks, and special studies, including the Total Maximum Daily Load (TMDL) Program. Some program-specific monitoring also contributes to the toxics monitoring efforts: the Chesapeake Bay Program, the Lakes Monitoring Program, the Biological Monitoring Program, and the Targeted Fish Tissue and Sediment Monitoring Program. These and other activities related to toxics monitoring are included in the 2018 Annual Water Quality Monitoring Plan available at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/AnnualWaterQualityMonitoringPlan.aspx.

In addition, pursuant to the federal Emergency Planning and Community Right-to-Know Act (EPCRA, also called the Superfund Amendments and Reauthorization Act (SARA) Title III), the Commonwealth maintains a Toxics Release Inventory (TRI). DEQ's SARA Title III Program receives annual electronic TRI summaries from reporting facilities statewide, and produces an annual TRI Report, as prescribed by federal regulations, that documents the movement, on site disposal, off site transfer, and release of toxic materials to the air, water and land. The Virginia EPCRA/SARA Title III Program is not a federally delegated program; it is a federal program that was established to assist communities in emergency planning and response and communities' right-to-know. The Commonwealth of Virginia does not have enforcement authority over the program. The current TRI Reports for 2015 (March 2017) and 2016 (March 2018), as well as other past reports, are available online at: https://www.deq.virginia.gov/Programs/Air/AirQualityPlanningEmissions/SARATitleIII/SARA313ToxicsReleaseInventory.aspx. Future reports will be posted on the same website in March of each year.

2.3 Remediation

DEQ implements several programs that deal with the remediation of toxic contamination (*e.g.*, Brownfields Program, Federal Facilities Program, Superfund Program) on a site-specific basis. In addition, DEQ implements the Total Maximum Daily Load (TMDL) Program, which is the primary program for addressing toxics-related impairments in aquatic environments on a watershed scale. Once impaired waters have been identified, it is the responsibility of the TMDL Program to confirm the cause of the impairment, identify its geographic extent and its source(s), and develop plans to restore and maintain the water quality. TMDL is a term that represents the total pollutant (toxicant) a waterbody can assimilate and still meet water quality standards. Once a TMDL has been reviewed and approved by EPA, an implementation plan (based on the TMDL) is developed for reducing the input of the associated toxics into the system. Depending on the type of toxicant, its source(s), and the historical background of the contamination, implementation may include reducing permit limits for a toxicant in the discharge from permitted facilities or, in the specific case of PCBs, establishing Pollutant Minimization Plans (PMPs) with permitted point sources, encouraging and funding the implementation of Best Management Practices (BMPs) for non-point sources or, on occasion, the physical removal of contaminated substrate from legacy sources through the site-specific remediation programs.

2.4 Analysis of Toxics from Ambient Waters

The majority of toxics-related samples collected by the ambient WQM Program are analyzed by the Division of Consolidated Laboratory Services (DCLS) of the Virginia Department of General Services, although academic or commercial laboratories are commonly contracted for some specialized analyses. Toxic elements and chemical compounds are generally categorized into several primary groups, each of which has specific codes to identify the procedures necessary for its complete chemical analysis by DCLS. The primary groups considered include:

- Clean dissolved and total trace metals in the water column
- Metals in the sediment
- Dissolved organic contaminants
- Organic contaminants in the sediment
- Ammonia, Nitrate, Nitrite, and Chlorides in water column
- Metals and organics in fish tissues

The data summaries provided in the following sections of this report are organized to correspond to these categories. Various groups of toxic organic compounds (*e.g.*, PCBs, PAHs, and other semi-volatiles) are often evaluated together with pesticides.

3.0 Toxics-Related Results – SFY17 and SFY18

3.1 Prevention

3.1.1 Reduction of Toxics by Pollution Prevention

DEQ's Office of Pollution Prevention (OPP) contributes to the reduction of toxics in the state's waters through its multimedia (*i.e.*, air, water, and waste) non-regulatory Pollution Prevention (P2) Program. The P2 Program focuses primarily on the reduction of resource consumption and solid wastes, which, in turn, reduces the movement, use, and release of toxic materials. Such reductions occur not only within the consumer population but also within retail outlets and industries using or producing toxic materials.

The annual Pollution Prevention Report, submitted to the Governor and the General Assembly in December of each year, describes OPP's activities for the year. The calendar year 2016 and 2017 reports summarize the pollution prevention strategies developed and implemented by the Virginia Pollution Prevention Program and characterize activities carried out by the major components of the P2 Program during the past two calendar years. Several of these are briefly summarized below. The 2017 report is available online at: https://www.deq.virginia.gov/Portals/0/DEQ/PollutionPrevention/Publications/2017PollutionPreventionAnnualReport.pdf?ver=2017-12-20-165754-127. For previous years reports, contact Meghann Quinn at: meghann.quinn@deq.virginia.gov or 804-698-4021.

Virginia Green Travel - Virginia Green is the Commonwealth's voluntary initiative to promote pollution prevention within the tourism industry. In 2017 there were 1,650 participants in the program (second largest in the country), and in 2018, the participant total grew to 1,829 making it the largest program among the 27 states that have green lodging or tourism programs. Participating facilities include lodging facilities, restaurants, attractions, conference facilities, campgrounds, visitor centers, wineries, golf courses and transportation facilities. In order to be a Virginia Green member the applying entity is required, among other things, to be conserving, use water efficiently, engage consumers and promote Virginia Green. There is an annual Virginia Green Conference and Awards to help educate and motivate members.

Virginia Green does not require annual reporting of environmental results but does estimate pollution reductions based on practices members are required to implement compared to standard practices. For the calendar year 2016 results include over 29,000 tons of solid waste reduced or diverted from landfills, over 300 million fewer kilowatt hours of electricity used and over 1.3 billion fewer gallons of water consumed. For the calendar year 2017, results include over 30,000 tons of solid waste reduced or diverted from landfills, over 320 million pounds of carbon dioxide emissions avoided and over 1.3 billion fewer gallons of water consumed. Results for 2018 will be available in early 2019.

Virginia Environmental Excellence Program (VEEP) - VEEP is a program focused on encouraging individual facilities and organizations (*e.g.*, governments and universities) to employ environmentally sound practices above and beyond their legal responsibilities. The facility-based program has three tiers from E2 (Environmental Enterprise) to E4 (Exemplary Environmental Enterprise), which are based on a facility's progress in developing and implementing an environmental management system (EMS). An EMS is a formal plan for adopting, implementing and documenting environmentally responsible practices. The organization-based SP (Sustainability Partners) program encourages organizations to make environmental sustainability part of their culture through leadership, innovation, and continual improvement (but does not require an EMS). Efficient water use and water quality are major focus areas for VEEP, though it should be noted that not all members have achieved measureable results in these areas. Member recognition and success stories are summarized in the 2017 reports on the P2 website at: http://www.deq.virginia.gov/Programs/PollutionPrevention.aspx.

Successes of the program reported by DEQ OPP for this reporting cycle include:

- In 2017 VEEP members reported the following for calendar year 2016:
    - Total water use was reduced by 566,083,852 gallons
    - 1,072,734,676 gallons of water was recycled
    - BOD was reduced by 455 pounds
    - Nutrient Discharges were reduced by 1,068,487 pounds
    - Greenhouse gas emissions were reduced by 99,717 tons

    - 64,153 tons of hazardous waste was recycled
- In 2018 VEEP members reported the following for calendar year 2017:
    - Total water use was reduced by 133,249,578 gallons
    - 341,357,190 gallons of water was recycled
    - BOD was reduced by 430 pounds
    - Nutrient Discharges were reduced by 1,165,098 pounds
    - Solid waste disposed was reduced by 18,060 tons
    - Sulfur oxide emissions were reduced by 18.99 tons (though members reported an increase of 49.51 tons in 2016)

Virginia provides performance-based permit fee discounts for VEEP member facilities (depending on tier of membership), including 5-10% discounts for hazardous waste reduction, 10-20% for solid waste reduction, and 2-5% for reduction of water use and release. In 2017 VEEP facilities received a total of $ 152,920 in discounts.

Mercury reduction - OPP provides extensive information on reducing mercury pollution through best management practices associated with mercury in schools, fluorescent lights containing mercury, and dental amalgams (see: http://www.deq.virginia.gov/Programs/PollutionPrevention/MercuryReduction). The mercury switch program, focused on the collection and recycling or proper disposal of mercury automobile switches, was previously administered by DEQ and included in past RTISW reports. The program has now been adopted by End of Life Vehicle Solutions, which now maintains all information about the effort (see: http://elvsolutions.org/).

3.1.2 Reduction of Toxics from Permitted Discharges and Compliance Monitoring of Permitted Facilities

Both private and public facilities that discharge effluents into the state's waters are required to obtain permits. The Virginia Pollutant Discharge Elimination System (VPDES) Program requires the establishment of limitations for such permits to ensure that Virginia's water quality standards are not violated in the water bodies receiving such discharges.

Appendix 1 of this report lists facilities that currently have, or have applied for, permits that contain limits on the quantity or concentration of discharged toxics in their effluents. The geographic locations, discharge-receiving streams and river basins are included for each outfall. The second tab (Administrative Continuance) in the same appendix lists 13 facilities with 282 outfalls that have Administrative Continuances, indicating that they received authorization to continue their discharges without a formal permit renewal. Two hundred thirty-nine of those outfalls were associated with the U. S. Naval Station, Norfolk. During SFY17 & SFY18, 953 facilities with 3,040 outfalls had one or more toxics limits in their permits and submitted Discharge Monitoring Reports (DMRs). The effective limits (when specified) and reporting frequencies for toxics may vary, depending upon the chemical parameters involved. In some years, a permit may be modified, reissued, or adjusted in terms of the current limits within the past year. Two hundred ninety-four facilities renewed permits at one or more outfalls during the period (see columns B and column D in Appendix 1). The current toxics parameters included in each permit, along with their limits and required reporting frequencies, are also listed in Appendix 2. The compliance results of each permitted facility's DMRs during the period are reported in Appendix 3. Some facilities may hold permits requiring only that they report, without a limit-specified value with which they must comply

Annual summaries for permit exceedances in SFY17 and SFY18 are provided in Table 3.1.2-1 below. The percentages of total DMR exceedance filings during SFY17 and SFY18 were similar to those

observed in SFY15 and SFY16 (see: https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/ToxicsReport-January2017.aspx).

Of 7,379 parameter-specific DMRs filed in SFY17, 89 (1.21%) exceeded the permitted limits for average concentrations of a toxicant, and 93 (1.26%) exceeded the permitted limits for maximum concentration. In most cases, the same DMR identified exceedances of both limits, since the specified limit was identical for both average and maximum concentrations. Individual single parameter maximum concentration exceedances during SFY2017 consisted of copper (N = 66, 70.97% of 93 violations), zinc (N = 22, 23.66%), naphthalene (the only organic compound violation in SFY2017, N = 4, 4.30%), and silver (N = 1, 1.08%). Exceedances of the average concentration limit and their relative proportions were similar except that 1 exceedance for arsenic occurred and there were no exceedances of the average limit for naphthalene.

Of 7,294 parameter-specific DMRs filed in SFY18, 83 (1.14%) exceeded the permitted limits for average concentrations of a toxicant, and 99 (1.36%) exceeded the permitted limits for maximum concentration. As in SFY2017 (and earlier), most violations occurred at WWTPs and STPs. Individual single parameter maximum concentration violations during SFY2018 consisted of Copper (N = 54, 54.55% of 99 violations), Zinc (N = 36, 36.36%), naphthalene (N = 5, 5.05%), ethylbenzene (N = 2, 2.02%), toluene (N = 1, 1.01%), and chloroform (N = 1, 1.01%). Exceedances of the average concentration limit and their relative proportions were similar except that there were no exceedances for naphthalene, ethylbenzene, or toluene.

Table 3.1.2-1 – Summary of permit limit exceedances during State Fiscal Years (SFY) 2017 and 2018.

	SFY2017				SFY2018			
	Average Concentration		Maximum Concentration		Average Concentration		Maximum Concentration	
Analyte	Exceedance Count	% of Total DMRs	Exceedance Count	% of Total DMRs	Exceedance Count	% of Total DMRs	Exceedance Count	% of Total DMRs
Copper - Total Recoverable	56	0.76%	56	0.76%	47	0.64%	52	0.71%
Copper - Total	10	0.14%	10	0.14%	1	0.01%	2	0.03%
Zinc - Total Recoverable	20	0.27%	21	0.28%	31	0.43%	33	0.45%
Zinc - Total	1	0.01%	1	0.01%	3	0.04%	3	0.04%
Naphthalene	0	0.00%	4	0.05%	0	0.00%	5	0.07%
Silver - Total Recoverable	1	0.01%	1	0.01%	0	0.00%	0	0.00%
Arsenic - Sludge	1	0.01%	0	0.00%	0	0.00%	0	0.00%
Ethylbenzene	0	0.00%	0	0.00%	0	0.00%	2	0.03%
Toluene	0	0.00%	0	0.00%	0	0.00%	1	0.01%
Chloroform	0	0.00%	0	0.00%	1	0.01%	1	0.01%
Total Exceedances	89	1.21%	93	1.26%	83	1.14%	99	1.36%
Total DMRs Filed	7379		7379		7294		7294	

3.1.3 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.

The most recent Virginia TRI Reports are reviewed here (SARA Title III TRI, March 2017 for the 2015 calendar year and March 2018 for the 2016 calendar year; see: http://www.deq.virginia.gov/Programs/Air/AirQualityPlanningEmissions/SARATitleIII/SARA313ToxicsReleaseInventory.aspx). In 2015, 1,359 individual reports from 439 facilities and in 2016 1,345 reports from 434 facilities were filed on the release, transfer, or management of TRI chemicals. The number of reporting facilities increased by 0.7% from 2014 to 2015, followed by a decrease of 1.1% from 2015 to 2016. During the same period, the number of individual reports filed decreased by 0.2% (2014-2015) and 1.0% (2015-2016). The 2015 report included 148 out of more than 650 chemicals and chemical categories for which TRI reporting is required (known collectively as the TRI chemicals) and the 2016 report included 153 of these chemicals.

Statewide, on-site releases to water (*i.e.*, releases to surface waters within the boundaries of the facility) totaled approximately 11.54 million pounds in 2015 and 13.57 million pounds in 2016. These releases accounted for 35.5 % and 37.9% of all releases to land, water in air in 2015 and 2016, respectively. According to the TRI report, the majority of the reported releases occurred under a federal or state permit program designed to protect human health and the environment.

The top ten chemicals and/or classes of chemicals released each year are summarized in Table 3.1.4-1 below along with the relative changes in the quantities released between 2015 and 2016. The top ten chemicals or chemical categories contributed approximately 99.8% of the total releases to water in each of the two years. The top ten chemicals were the same in both years, with the exception that sodium nitrite was the 8th most common in 2015 and did not occur in the top 10 in 2016, and phenol was the 8th most common in 2016 but not in the top 10 in 2015. Nitrate compounds, which are typically of more concern because of nutrient enrichment rather than for direct toxicity, constituted approximately 11.2 million pounds (97.3%) of the total release of TRI chemicals in 2015 and 13.2 million pounds (97.6%) in 2016. This was followed by ammonia, another Nitrogen compound, with approximately 0.13 million pounds (1.2%) in 2015 and 0.10 million pounds (0.7%) in 2016.

Additional information on specific groups of chemicals and the quantities and other details of their releases is available in the original reports (see link above for these and previous years' reports). 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: http://www.epa.gov/tri/. The next Virginia TRI report, summarizing toxic releases for calendar year 2017, will be available in March 2019.

Table 3.1.3-1 Top Ten TRI Chemicals Released to Water On-site in 2015 and 2016.

TRI Chemical or Class	Annual Release to Water 2015		Annual Release to Water 2016		% Weight Change 2015 - 2016
	Percent	Weight (lbs x 10^6)	Percent	Weight (lbs x 10^6)	
Nitrate compounds	(1) 97.30%	11.220	(1) 97.63%	13.240	18.00%
Ammonia	(2) 1.17%	0.130	(2) 0.71%	0.096	-26.15%
Manganese and Mn compounds	(3) 0.477%	0.055	(3) 0.684%	0.093	69.09%
Dimethylamine	(5) 0.202%	0.023	(4) 0.243%	0.033	43.48%
Barium and Ba compounds	(7) 0.099%	0.011	(5) 0.198%	0.026	136.36%
Cyclohexanol	(4) 0.212%	0.025	(6) 0.126%	0.017	-32.00%
Zinc and Zn compounds	(6) 0.171%	0.019	(7) 0.099%	0.013	-31.58%
Sodium nitrite	(8) 0.079%	0.009	---	---	N/A
Phenol	---	---	(8) 0.059%	0.008	N/A
Methanol	(9) 0.068%	0.008	(9) 0.058%	0.008	0.00%
Lead and Pb compounds	(10) 0.049%	0.006	(10) 0.041%	0.006	0.00%
All other chemicals	0.175%	0.020	0.152%	0.020	0.00%
Totals	100.00%	11.526	100.00%	13.560	17.65%

3.2 Monitoring of Toxics in Ambient Waters – SFY17 and SFY18

3.2.1 Surface Waters and Sediments

Toxics-related parameters were collected at hundreds of monitoring stations in 2017 and 2018 (Appendix 4). During this period, DEQ collected the following data at select sites:

- Clean dissolved and total trace metals in the water column
- Metals in the sediment
- Dissolved organic contaminants
- Organic contaminants in the sediment
- Ammonia, Nitrate, Nitrite, and Chloride in water column
- Metals and organics in fish tissues

The analysis of toxic substances in ambient samples can be expensive, especially for the analysis of organic compounds such as pesticides, PAHs and PCBs. Exceedances of water quality standards or of sediment quality guidelines are rare, except where known legacy contamination exists. Consequently, with the recurrent reductions in agency resources during the last decade, the ambient monitoring of toxics in sediments and in the water column has been considerably reduced, and few new results are listed in the following sections except where additional resources were available (*e.g.*, targeted federal grants and grant supplements for probabilistic monitoring and for targeted TMDL monitoring).

The raw and summarized monitoring results are described in the following sections of this report. The referenced appendices contain all the descriptive information relative to each monitoring station, the raw data results for each analyte, and descriptive statistical summaries for many of the results from each major river basin during SFY17 and SFY18[1]. As discussed in Chapter 4, data summarized in this

[1] DEQ also maintains folders with cumulative historical summaries of the results from each year in which a Toxics Report has been produced. The historical data summaries are available on the agency's website at: https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx.

section of the Toxics Report will be assessed against water quality standards and screening thresholds with results reported in the 2020 Water Quality Assessment Integrated Report.

Dissolved Metals in Surface Waters

DEQ's dissolved clean metals protocols (DEQ-WQA, 2017) are applied in the collection and analysis of 24 dissolved trace metals in freshwater and of 17 metals in brackish and saltwater samples. Special studies may specify other parameters, as needed. Appendices 5a and 5b present the results of clean, dissolved metals monitoring during SFY17 and SFY18. The appendices also include individual summaries for the probabilistic monitoring program and various special studies, including the Shenandoah River Basin Mercury study, the Duke Energy/Dan River coal-ash spill study, and the Clinch River study.

Total Metals in Surface Waters

For several years, total clean metals were sampled along with dissolved metals at most freshwater probabilistic monitoring stations. During SFY17 and SFY18, DEQ researchers also collected clean total mercury samples from the Shenandoah River basin for the purpose of monitoring the transport of mercury at many of the same sites where clean dissolved mercury samples were collected. Additional total metals samples were collected for Mercury TMDL studies in the Chowan Basin (Blackwater and Nottoway basins), and for several incident response studies and for industrial compliance monitoring. The resultant data from these samples are included in the spreadsheets of Appendices 6a and 6b.

Total Metals in Sediments

Appendix 7 presents tabular results and a statistical data summary of the WQM sediment metals data collected in freshwater. The targeted monitoring for total metals in freshwater sediment during SFY17 and 18 was associated with the Dan River special study in response to the Duke Energy coal ash spill.

Appendix 8 includes results from 55 estuarine sediment metals analyses (including 5 quality assurance analyses) from 50 sites annually in the estuarine probabilistic monitoring program. Samples that were collected during July – September 2016 (SFY17) and 2017 (SFY2018) were analyzed by a DEQ-contracted commercial laboratory (RTI Laboratories Inc., Livonia, Michigan). All estuarine probabilistic sediment chemistry results from 2017 and 2018 (as well as those from 2013 – 2016) will be utilized in the weight-of-evidence assessment of the 50 annual estuarine sites for the 2020 Water Quality Assessment Integrated Report. Appendix 8 also includes a tab with the sediment metals results for the Potomac Embayments Special Study completed in 2017, which was completed at the same time that DEQ conducted estuarine probabilistic monitoring.

Dissolved Pesticides and Other Organic Contaminants in Water

The concentrations of dissolved organic compounds in the water column are generally extremely low, often at or below the detection limits of analytical methods. For this reason, DEQ has suspended ambient monitoring of dissolved organics using traditional methods. Monitoring for these parameters only occurs for special studies to support TMDL development or incident response, or through DEQ's Groundwater monitoring program, as described below.

> Polychlorinated Biphenyls (PCBs) in water: To assist in the generation of PCB data for use in the development of TMDLs, DEQ now utilizes EPA's low-detect Method 1668. EPA has recommended the use of Method 1668 for TMDL development since it is capable of detecting much lower concentrations of PCBs. It uses clean sampling techniques and a congener-specific, high resolution/low detection analytical method to measure concentrations in the pg/L (one picogram or one trillionth of a gram per liter) range. Data have been generated using this method

for TMDL development within PCB impaired water bodies in the tidal Potomac River, the Roanoke (Staunton) River, Levisa Fork, New River, the lower tidal James River and the Elizabeth River watersheds. Additional monitoring was conducted during SFY17 and SFY18, primarily in the upper James, Rappahannock and New River basins, and in Lewis Creek of the Shenandoah Basin. Recent results from the James basin, the Rappahannock basin (Mountain Run), and from a number of locations in the New River basin are presented in Appendix 9.

Polycyclic Aromatic Hydrocarbons (PAHs) in water: During SFY17, DEQ monitored six sites related to two incident responses for semi-volatile organic compounds in water. The results are included in Appendix 10.

Dissolved volatile organics in groundwater: Dissolved volatile organics in freshwater were only sampled and analyzed by the Groundwater Characterization Monitoring Program during SFY17 and SFY18. The results from analyses of 2829 analytes from 32 wells are presented in Appendix 11 (see the Organics, Volatile & Other tab).

Pesticides and Other Organics in Sediment

No ambient freshwater sediment samples were collected or analyzed for pesticides and other organics in sediment during SFY17 or SFY18. However, DEQ did collect this data at 50 sites as part of the estuarine probabilistic monitoring program (summarized below). All estuarine probabilistic sediment results from 2017 and 2018 will be utilized in weight-of-evidence assessment of the 50 estuarine sites for the 2020 Water Quality Assessment Integrated Report.

Chlorinated Pesticides in Sediment: Appendix 12 summarizes the results of chlorinated pesticides in sediment.

Polycyclic Aromatic Hydrocarbons (PAHs) in Sediment: Appendix 13 summarizes the results of PAHs in sediment.

Polychlorinated Biphenyls (PCBs) in Sediment: Some sediment PCBs samples[2] were collected in tandem with water samples for the Watershed Program's targeted monitoring for TMDL development (results summarized in Appendix 9), and with fish tissue monitoring (results summarized in Appendix 16, and section 3.2.2). However, the majority of monitoring for PCBs in sediment occurred as part of the estuarine probabilistic monitoring program, and this data is summarized in Appendix 14. Results were expressed as Total PCBs, the sum of observed concentrations among the 21 congeners evaluated.

Nitrate, Nitrite, Ammonia, and Chloride in Water

Nitrate, nitrite, and ammonia samples are commonly collected by the agency's various water quality monitoring programs. These compounds rarely pose a toxicity risk in Virginia surface waters (though the potential for toxicity from the compounds exists). The nitrogen parameters are generally of greater concern for causing nutrient enrichment in surface waters. Chloride is less commonly collected, but may be evaluated when the ionic constituents are suspected to pose a risk to aquatic life. In SFY 2017 and 2018 a total of 3,827 sampling events were conducted wherein one or more of the three nitrogen parameters were collected. A total of 1,409 chloride samples were collected in SFY 2017 and 2018. All

[2] Sediment PCB samples are occasionally collected (when substrate is appropriate) concurrently with water or fish tissue samples to facilitate potential future studies, such as TMDL model development.

results associated with the three nitrogen parameters and chlorides in surface waters are included in Appendix 15.

3.2.2 Fish Tissue Monitoring

DEQ's Fish Tissue and Sediment Monitoring Program was suspended in 2009 because of significant state budget reductions. The program was re-designed and re-started in 2012 on a much smaller scale than previous monitoring efforts, with a limited focus on TMDL support and follow-up monitoring of watersheds that were under existing fish consumption advisories. Beginning in 2014, DEQ's Fish Tissue monitoring program also supported monitoring at eight sites in the Dan River following the Duke Energy coal ash spill. In 2017, the agency secured funding through a 5-year agreement with the National Fish and Wildlife Foundation to support continued fish tissue monitoring efforts in the Roanoke River basin. The agency continues to pursue options for dedicated funding to support fish tissue monitoring in Virginia in the long-term. Additional information about the objectives and activities of DEQ's fish tissue monitoring program is available at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/FishTissueMonitoring.aspx.

Results from fish tissue collections occurring during calendar years 2016 and 2017 are summarized in this report. This is because analytical results are received approximately one year following sample collection, which means that samples collected in 2016 and 2017 fall within the window of this report. Fish tissue sampling sites are included in Appendix 16, and results are summarized in Appendix 17. Current and historical fish tissue results are also posted on the agency's website here: https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/FishTissueMonitoring/FishTissueResults.aspx .

In calendar year 2016, fish tissue collections occurred in waters covered by existing fish consumption advisories due to PCBs. Twenty-six sites were selected from locations in the James River Basin (lower tidal James and the Elizabeth River) and the lower Rappahannock River. Additional collections were gathered from eight sites on the Dan River as part of the Duke Energy Coal Ash Spill response and from four Potomac River embayments in response to a Department of Game and Inland Fisheries (DGIF) request related to the distribution of the introduced Northern Snakehead fish. Upon review of the 2016 results, the Virginia Department of Health (VDH) issued a Letter Health Consultation (Appendix 18), which concluded that the current fish consumption advisories in place for segments of the Rappahannock River, James River, and Dan River remain in effect. VDH also concluded that the concentrations of PCBs in the northern snakehead tissue collected from the Potomac River embayments are not a health hazard. A summary of the 2016 results is available in Appendix 17.

During 2017, fish tissue samples were collected from the upper portions of the James River including sites on the Maury and Jackson Rivers, three major tributaries to the Chowan River (Meherrin, Nottoway and Blackwater), and sites on Lake Anna, Lake Gordonsville and Motts Run Reservoir. These samples were analyzed for polychlorinated biphenyls (PCBs) and a suite of metals, including arsenic, mercury, and lead. DEQ also conducted two special monitoring studies for fish tissue metals in 2017, one in the Potomac Embayments and a second on the Dan River.

A summary of the 2017 results is included in Appendix 17. The 2017 data will be evaluated by the Virginia Department of Health (VDH) and could result in the lifting of current fish consumption advisories or in the issuance of new ones. Information on fish consumption advisories can be found at: http://www.vdh.virginia.gov/environmental-epidemiology/public-health-toxicology/fish-consumption-

advisories/. This data will also be used for assessment determinations in Virginia's 2020 Water Quality Assessment Integrated Report.

The 2018 fish tissue monitoring season is currently underway. DEQ is collecting data from 51 sites, primarily located in the Roanoke River, Rappahannock River, Chowan River, and James River basins (2018 sites are also listed in Appendix 16). Results from the 2018 sampling effort will be available in mid-2019. Prospective sites for Fish Tissue monitoring in 2019 will be identified in January 2019.

Citizens may recommend sites for DEQ monitoring by following the nomination process on DEQ's Follow-up Monitoring website located at: https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring/FollowupMonitoring.aspx .

3.2.3 Benthic Monitoring

Benthic macroinvertebrates are bottom-dwelling invertebrates that can be seen without magnification (*e.g.*, insects, crustaceans, worms and mollusks). They are used by DEQ to determine whether free-flowing, wadeable freshwater streams and rivers meet the aquatics life designated use (9VAC25-260-10; https://law.lis.virginia.gov/admincode/title9/agency25/chapter260/section10/). Benthic community impairment may be caused by toxics or by unrelated factors, such as habitat degradation. Follow-up evaluation is required to confirm the cause of the observed impairment.

Freshwater Benthic Monitoring - Streams and Rivers

Because different species vary with respect to their mobility, life spans and tolerance to pollutants, they are integrative of multiple spatial and temporal scales and of multiple stressors in a manner that single chemical measurements are not. Because natural environmental variability results in naturally varying benthic macroinvertebrate communities across the state, the agency uses three different numerical indices to rate water quality based on multiple aspects of each evaluated community.

The Virginia Stream Condition Index (VSCI) is used for all non-coastal streams and rivers – the majority of the state's free-flowing freshwaters (see Burton and Gerritsen 2003; https://www.deq.virginia.gov/Portals/0/DEQ/Water/WaterQualityMonitoring/BiologicalMonitoring/vsci.pdf for more information on the VSCI). Two indices, collectively known as the Virginia Coastal Plain Macroinvertebrate Index (VCPMI) are used to evaluate streams and rivers of the Coastal Plain Physiographic Province. The Mid-Atlantic Coastal Plain index (MACP) is used to evaluate all of the coastal Chowan river basin and the easternmost portion of the Coastal Plain in other basins. The Southeastern Plains index (SEP) is used to evaluate the remainder of the Coastal Plain (see Dail et al. 2013; https://www.deq.virginia.gov/Portals/0/DEQ/Water/WaterQualityMonitoring/ProbabilisticMonitoring/vcpmi.pdf for more information on the VCPMI).

Systems whose benthic communities receive VSCI scores less than 60 or VCPMI scores less than 40 (of 100 possible points) are typically considered impaired. Final listing of a site as impaired or unimpaired based on the benthic results is based not only on the index score but also the professional judgement of experienced biologists and assessors on the factors responsible for the observed conditions. For more information on benthic impairments, please refer to the agency's most recent 305(b)/303(d) Integrated Report to EPA located at: https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments.aspx.

Appendix 19a lists the freshwater biological monitoring stations and Appendix 19b provides a list of the freshwater probabilistic monitoring[3] stations visited during SFY 2017 and SFY 2018. Benthic monitoring results are not included as a separate appendix in this report because the monitoring is not a direct measure of toxicity. As discussed in Chapter 4, freshwater benthic monitoring that results in impairment listings represent potential but unconfirmed toxics impairments. These require further investigation during the development of the stressor analysis for the TMDL.

Estuarine Benthic Monitoring - Chesapeake Bay and other tidal waters

The Chesapeake Bay Program (CBP) conducts probabilistic monitoring of benthic communities. As a second phase of assessment based on the CBP Benthic Index of Biotic Integrity (B-IBI), a stressor diagnostic tool calculates the probability of contamination as a cause for each impaired benthic sample. Another benthic assessment methodology is used for estuarine probabilistic monitoring, following National Coastal Condition Assessment (NCCA) sampling protocols in minor tidal tributaries to the Bay and in other tidal estuarine waters. It consists of a weight-of-evidence evaluation based on the Sediment Quality Triad (which is comprised of the sediment results discussed in section 3.2.1 above). Estuarine probabilistic monitoring, following the NCCA protocols, provides data on the chemical contamination of sediment, the acute toxicity of sediment, and an evaluation of benthic community wellbeing using three indices of stress[4]. This methodology is described in detail in the current Assessment Guidance Manual for the Integrated Report.

Appendix 19c provides a comprehensive list of the estuarine probabilistic monitoring stations that were included in the program during SFY 2017 and SFY 2018. Weight-of-evidence assessments for sites sampled during the summers of 2015 (SFY16) and 2016 (SFY17) will be included in the 2018 Integrated Report (IR), and those sampled in the summers of 2017 (SFY18) and 2018 (SFY19) will be included in the 2020 IR.

3.2.4 Special Studies Related to Toxics

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, but they may also be initiated to evaluate new monitoring or analytical methods, or to investigate potential problems with new practices, etc. Regional special studies that dealt specifically with toxics during SFY17 and SFY18 are summarized within Appendix 20a. Briefly summarized, they consist of:

Northern RO

- Mountain Run PCB TMDL Study
- Mountain Run benthic stressor analysis special study
- Cub Run benthic stressor analysis special study
- Contrary Creek metal contaminants special study
- Sand Branch turbidity special study

[3] For more information on the Freshwater Probabilistic Monitoring Program, visit the following website: https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/ProbabilisticMonitoring.aspx.

[4] The CBP's B-IBI in tidal Chesapeake Bay waters, the Middle Atlantic Region B-IBI (MAIA B-IBI) for other tidal coastal waters, and EPA's Environmental Monitoring and Assessment Program's Mid-Atlantic Integrated Assessment (EMAP-MAIA) Index of Estuarine Condition discriminant function for the Virginia Biogeographic Province (VA-IEC) as a secondary index in all tidal waters.

- Potomac River Embayments Special Study

Piedmont RO

- Middle and Upper James River PCB Source Investigation
- Total Mercury Monitoring for Future TMDLs in Fish Tissue Impairments in the Pamunkey, Mattaponi, Chickahominy, James, Blackwater Rivers Watersheds

Blue Ridge RO

- Dan River Coal Ash Spill (Appendix 20b)
- New River PCB TMDL
- Upper (and Middle) James River PCB Study

Southwest RO

- Bluestone River PCB Source Investigation
- Upper Clinch River (CPCRI) water quality investigation
- Upper Clinch River watershed of Southwest Virginia in support of the Clinch-Powell Clean Rivers Initiative (CPCRI) by The Nature Conservancy (Appendix 20c).
- New River PCB TMDL

Tidewater RO

- No current toxics-related special studies

Valley RO

- Continuing South River Mercury Studies (Appendix 20d)
- Low level PCB sampling in the middle James River Basin

3.2.5 Other Program Specific Studies

The Chesapeake Bay Program

Toxics Reduction and Prevention Strategy

The 1987 Chesapeake Bay Agreement committed the signatories to develop, adopt, and begin implementation of a basin wide toxics strategy to achieve a reduction of toxics, consistent with the Water Quality Act of 1987, which would ensure protection of human health and living resources. Following the implementation of a multi-jurisdictional effort to define the nature, extent, and magnitude of toxics problems, the initial strategy was further strengthened with the adoption of the 1994 Basin Wide Toxics Reduction and Prevention Strategy.

On June 16, 2014, the *Chesapeake Bay Watershed Agreement* was signed[5]. Signatories include representatives from the entire watershed, committing for the first time the Bay's headwater states to full partnership in the Bay Program. This plan for collaboration across the Bay's political boundaries establishes goals and outcomes for the restoration of the Bay, its tributaries and the lands that surround them. In an indication that toxics continue to be an important topic in the Bay restoration effort, one of the ten goals outlined in the Agreement is the "Toxic Contaminants Goal: Ensure that the Bay and its rivers are free of effects of toxic contaminants on living resources and human health". The agreement is available at the following link: https://www.chesapeakebay.net/what/goals/toxic_contaminants .

A Toxic Contaminants Workgroup (TCW) was established in 2014 after the signing of the Chesapeake Bay Watershed Agreement. This workgroup exists to accomplish the toxic contaminants goals and outcomes outlined in the Agreement. For more information, visit the toxic contaminants research and toxic contaminants policy and prevention management strategy pages located at:

[5] http://www.chesapeakebay.net/presscenter/release/governors_mayor_epa_administrator_and_commission_chair_sign_agreement

http://www.chesapeakebay.net/managementstrategies/strategy/toxic_contaminants_research and http://www.chesapeakebay.net/managementstrategies/strategy/toxic_contaminants_policy_and_prevention.

The Chesapeake Bay Program's Toxic Contaminants Workgroup[6] continues to have monthly meetings and/or conference calls and is in the process of completing a Toxics Policy and Prevention Strategy and a Toxics Research Management Strategy, as well as Work Plans for both endeavors. Details of past meetings as well as a calendar of upcoming events are available on the Workgroup's website.

The current efforts, based primarily on 305(b)/303(d) Water Quality Reports and Impaired Waters Listings and other published studies in member states (Virginia, Maryland, Pennsylvania, West Virginia, and Delaware) also include non-tidal waters of the Bay watershed. Additional information on the concentrations and trends of toxic substances and other water quality parameters, in the Chesapeake Bay and its tributaries, is currently available on the Chesapeake Bay Program Website at: http://www.chesapeakebay.net/issues/issue/chemical_contaminants, or by using the search engine available at: http://www.chesapeakebay.net. Additional information about DEQ's Chesapeake Bay monitoring is available at: http://www.deq.virginia.gov/Programs/Water/ChesapeakeBay/ChesapeakeBayMonitoring.aspx.

The Elizabeth River Program

In 1997, in response to indications of water quality impairment by toxics in the Elizabeth River and its tributaries, DEQ and a group of Elizabeth River Project (ERP) stakeholders collaborated to produce a comprehensive Water Quality Monitoring plan for the water bodies 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. Estuarine probabilistic monitoring and fish tissue sampling were conducted in the Elizabeth River in SFY2017 and 2018 (sections 3.2.2 and 3.2.5, respectively). TMDL development for PCB contamination in fish tissue in the Elizabeth River is projected to be complete by 2020.

A number of groups external to the agency conduct toxics-related monitoring in the Elizabeth River. For example, Dominion Power, Inc. conducts monitoring in association with the closure of the Chesapeake Energy Center (see: https://www.dominionenergy.com/about-us/electric-projects/coal-ash-pond-closure-management/power-stations/chesapeake). Additional information on monitoring activities can be found at the Elizabeth River Project website (http://www.elizabethriver.org/).

The Harmful Algal Bloom Task Force

DEQ serves as a partner agency on the Harmful algae bloom (HAB) task force, along with Old Dominion University, Virginia Institute of Marine Science and the lead partner: the Virginia Department of Health (VDH). The HAB task force responds to public complaints, conducts scientific investigations

[6] http://www.chesapeakebay.net/groups/group/toxic_contaminants_workgroup

on potential HAB events that inform decisions by VDH on the issuance of health advisories, and provides information to the public on HAB events and their associated health risks.

HABs have occurred in both fresh and salt waters in the Commonwealth. HABs produce toxins which may cause skin, eye, and digestive tract irritation, kidney and liver damage and neurotoxic effects. Health effects depend on the exposure route, concentration, and specific toxin encountered. The severity of symptoms ranges from mild irritation to death (though the latter is rare). Exposure of animals and humans to algal toxins can occur from consumption of contaminated water, consumption of contaminated fish or shellfish, dermal contact with contaminated water and (in rare cases) inhalation of airborne toxins. For more information on HABs and the HAB task force, please see: http://www.vdh.virginia.gov/environmental-epidemiology/waterborne-hazards-control/?tab=2.

DEQ currently provides field support to the task force. In response to complaints from the public, which are typically made by way of the online HAB reporting form (http://www.vdh.virginia.gov/environmental-epidemiology/harmful-algal-bloom-online-report-form/), HAB partners such as DEQ mobilize to potential HAB sites, make observations of site conditions that may indicate HABs (*e.g.*, surface scum, elevated dissolved oxygen or pH) and, if necessary, collect water samples to determine cell counts of HAB species and to test directly for toxins. Data on HAB cell counts, toxin concentrations, and observations made on site by field crews are evaluated by the VDH Division of Environmental Epidemiology (DEE). Based on these evaluations, DEE makes recommendations to local health districts that make the final decisions regarding the issuance of health advisories and notifications. In general, notifications are issued due to the detection of low HAB cell counts or toxin concentrations, or visual indicators such as surface scum. Notifications usually include an indication that HAB species are present, and that a low to moderate health risk exists. Health advisories are issued due to high cell counts or high toxin concentrations, which DEE interprets as presenting a moderate to high health risk. Advisories carry an explicit recommendation that use of the water body should be limited (*e.g.*, no swimming). The HAB task force conducts follow-up visits and collects additional samples at sites for which notifications or advisories have been issued. Based on information collected in these follow-up visits, DEE makes recommendations to local health districts, which, in turn, modify, lift, or continue the advisories.

In SF 2017 and 2018, the HAB task force obtained and analyzed 334 samples for cell counts of HAB species, and 111 samples for analysis of HAB toxins (microcystin and cylindrospermopsin). All toxin analyses were conducted from freshwater samples. In general, estuarine and marine HAB investigations do not include toxin analysis unless initial cell counts warrant this analysis in follow-up site visits. Data from these sampling events may be requested from DEE by calling: 804.864.8182 or visiting the division's contact page at http://www.vdh.virginia.gov/environmental-epidemiology/contact-us/.

HAB task force activities in SFY 2017 and 2018 resulted in the issuance of several HAB notifications, as well as official health advisories on 6 Virginia water bodies; Lake Evergreen (Chesterfield County), Chris Greene Lake (Albemarle County), Woodstock Pond (James City County), Sandy River headwaters near Prince Edward Lake (Prince Edward County), Lake James (City of Virginia Beach) and Matthews Lake (Suffolk County). All advisories were issued in fresh waters and included the use limitation that no swimming should occur. In addition to these advisories, a series of advisories and warnings were issued on Lake Anna (Spotsylvania and Louisa Counties) in early SFY 2019. VDH DEE regularly updates the list of existing health advisories associated with HABS on its online HAB map (see: http://www.vdh.virginia.gov/environmental-epidemiology/harmful-algal-blooms-habs/algal-bloom-surveillance-map/).

3.3 The Calendar Year 2017 Water Quality Monitoring Plan

The Annual Monitoring Plan (MonPlan) 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. 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. Virginia's monitoring framework is described in detail in DEQ's 2013 Water Quality Monitoring Strategy located here: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/DEQsWaterQualityMonitoringStrategy.aspx. The Water Quality Monitoring Strategy will be updated in 2019 and posted at the same web location.

The MonPlan for each calendar year is normally completed in December and is implemented on January 1 of the following year. That portion of the new plan that deals with long-term trend stations continues with minimum modification. Other aspects of the Plan, which deal with TMDLs and other special studies or with shorter term rotations such as lake monitoring or citizen requests, also require significant updating for inclusion in each new MonPlan.

Once finalized, the 2019 annual Monitoring Plan will be summarized and linked to the DEQ website at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx.

4.0 Assessment of Toxics in Ambient Waters

4.1 Water quality assessments and impaired waters listings for toxics

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 guidance manual to determine the appropriate assessment category for the associated bodies of water.

The results of Virginia's water quality assessments are summarized each biennium in a comprehensive report called the Water Quality Assessment Integrated Report (IR). EPA approved the 2016 Water Quality Assessment Integrated Report (IR)[7] on March 6, 2018. The assessment window for the 2016 IR extended from January 1, 2009 – December 31, 2014. The 2018 IR is currently under development, and covers data collected between January 1, 2011 through December 31, 2016. The toxics-related data summarized in section 3.2.1 of this report will be assessed as part of the 2020 IR (data window January 1, 2013 – December 31, 2018).

Table 4.1-1 includes a summary of water bodies by size that were listed as impaired in the 2016 IR for at least one toxic-related impairment. The majority of the toxic-related impairments are the result of fish consumption advisories for PCBs or mercury. Both of these contaminants are persistent and bioaccumulative; that is, they are found in much higher concentrations in fish tissues than in the surrounding environment. Other less-frequently occurring toxic impairments are due to metals,

[7] The full 2016 IR and interactive maps are available on the DEQ website at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments.aspx.

pesticides, ammonia, chloride, estuarine bioassessments[8], and polycyclic aromatic hydrocarbons. Freshwater benthic impairments represent another 2,704 impaired river miles in the 2016 IR, but these impairments are not included in the tally of toxic impairments in table 4.1-1. This is because the cause of the benthic impairment has not yet been determined. Therefore, freshwater benthic impairment listings represent potential but unconfirmed toxics impairments, and require further investigation during the development of the stressor analysis for the TMDL.

A list of all toxic-related impairments can be found in Appendix 21a, Segments Impaired by Toxics in the 2016 IR. The total river miles, lake acres and estuarine square miles of toxics impairments summed in table 4.1-1 are not directly comparable to the totals included in Appendix 21a, because many of the impaired segments may have two or more causes (*e.g.*, the same river mile may be listed under PCBs in fish tissue and mercury in fish tissue). Of the listings in Appendix 21a, the vast majority are the result of fish consumption advisories for PCBs or mercury.

Table 4.1-1 Summary of toxics related impairments in the 2016 IR.

Water body type	Total impaired	Impaired for at least one toxic impairment
Rivers	15,282 miles	3,681 miles
Lakes	93,523 acres	86,012 acres
Estuaries	2,132 square miles	2,068 square miles

4.2 Delisted, previously impaired segments

Three segments with toxics-related impairments were approved for delisting in the 2016 IR (see Appendix 21b, Delisted Toxics Impaired Segments in the 2016 IR). All three segments had been previously listed for PCBs in fish tissue. These segments were removed from the impaired waters list to better align with the Virginia Department of Health's fish consumption advisories.

Although listings for benthic macroinvertebrate impairments may not necessarily be related to toxics, they are used as a warning flag to prompt the search for causative stressors. In the 2016 IR, 38 miles of streams (11 segments) were delisted for benthic impairments because more recent evaluations of benthic macroinvertebrate communities scored previously listed sites as now being non-degraded and having met benthic community goals. Follow-up studies continue efforts to identify causes and sources of potential toxic stressors at other impaired benthic sites.

4.3 Virginia Department of Health Fish Consumption and No-Swimming Advisories

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. VDH may also issue no-swimming advisories if harmful algae species or toxins are detected in state waters above VDH-established thresholds. All waters subject to these restrictions and advisories are evaluated as part of DEQ's biennial Water Quality Assessment.

The complete list of VDH fishing consumption advisories currently in effect for any waters in the state can be found summarized and mapped by basin at: http://www.vdh.virginia.gov/environmental-epidemiology/toxic-substances/?tab=1. No new fishing consumption advisories were issued during SFY17 through 2018, because most fish tissue monitoring during these years was carried out in

[8] Estuarine bioassessments include a weight-of-evidence analysis for sediment chemistry, sediment toxicity, and benthics. A water is listed as impaired if two or more parameters do not meet designated thresholds.

segments that are already under fish consumption advisories. Of special note, metals concentrations in fish tissue collected from the Dan River as a result of the Dan River coal ash spill have not exceeded established screening values to date, but longer term monitoring is ongoing.

The VDH algal bloom surveillance map is located at: http://www.vdh.virginia.gov/environmental-epidemiology/harmful-algal-blooms-habs/algal-bloom-surveillance-map/, and includes current information on areas that are being investigated for potential human health issues. The map also indicates areas where human health advisories are in effect. In 2018, VDH issued a human health advisory for portions of Lake Anna due to the presence of algal species that are capable of producing toxins harmful to humans, pets, or fish. The advisory was lifted in late October 2018.

5.0 Remediation of Toxics in Ambient Waters

As discussed above, the Total Maximum Daily Load (TMDL) Program is the primary program for addressing toxics-related impairments in aquatic environments on a watershed scale. TMDLs are prioritized for development based on the national 303(d) Program Vision, which is explained in more detail below. To further facilitate implementation of TMDLs related to toxics-related impairments in aquatic environments, DEQ is currently working on two initiatives; that is, Pollutant Minimization Plan guidance and a comprehensive Salt Management Strategy, both of which are discussed below.

5.1 Total Maximum Daily Load (TMDL) Program

The TMDL Program is an important component of DEQ's toxics remediation in aquatic environments. Completed TMDLs are available via the search form on the "TMDL Development" link on the DEQ website at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment/ApprovedTMDLReports.aspx. EPA approved twelve new TMDLs between 2017 and 2018. While most of the TMDLs approved during this period were related to excessive bacterial contamination and/or sedimentation, the Accotink Creek chloride TMDL was due to an impairment by a toxic contaminant. The Accotink Creek TMDL was the first time the Virginia Department of Environmental Quality (DEQ) identified chloride associated with winter deicing/anti-icing activities as contributing to a water quality impairment. A stakeholder process is currently underway to develop implementation options with a focus on best management practice (BMP) implementation, such as training and certification programs and improved salt application equipment and practices. This "Salt Management Strategy" (SaMS) is described in more detail below.

DEQ currently has TMDL projects underway to address toxics (PCBs) in fish tissue in the New River and lower James River basins.

Future TMDL development will be prioritized by DEQ based on the national 303(d) Vision[9], which calls for the prioritization of impaired waters for TMDL or TMDL alternative development over a six-year window (currently 2016-2022). The list of TMDL priorities is available on the agency website at: https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment/TMDLProgramPriorities.aspx . In addition to the PCB TMDLs currently underway, the prioritization list includes upcoming toxics-related TMDLs for metals in Contrary Creek and PCBs in Mountain Run, the upper/middle James River, and the Bluestone River.

[9] https://www.epa.gov/tmdl/new-vision-cwa-303d-program-updated-framework-implementing-cwa-303d-program-responsibilities

As additional TMDLs are completed and scheduled for implementation, and others are added, follow-up monitoring will be initiated to evaluate their effectiveness in reducing toxics contamination. The effective implementation of these TMDLs should result in measurable reductions of contaminants in the state's waters in the future. The agency's TMDL history, current status, and other development plans are available at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL.aspx.

5.2 Roanoke River PCB TMDL Success Story

In 2009, DEQ completed a TMDL study to address PCB contaminated fish in the Roanoke River basin. During the source investigation portion of the study, high concentrations of PCBs were detected in the industrial effluent of one of the VPDES point source facilities, the former ITG Burlington Industries Plant located in Hurt, VA. Following discussions between DEQ and Burlington personnel about options to address the PCB contamination, the company agreed to treat the wastewater to the maximum extent practical prior to releasing the effluent to the river. It was agreed by both parties that the best solution was to remove as much of the PCBs as possible from the wastewater in order to avoid or minimize releases to the lower Roanoke River. The company voluntarily decided to go beyond the minimum treatment required in order to be as protective of the Roanoke River and the environment as possible.

By successfully identifying and addressing the PCB-contaminated effluent from the Burlington Hurt Plant, implementation of the TMDL has led to a significant reduction of PCBs in the lower Roanoke River. First, the ability to detect low-level PCB concentrations using EPA's Method 1668 (which includes a full analysis of 209 PCB compounds, *i.e.*, congeners) led to the initial discovery of PCBs from this discharge. Second, the implementation of the PCB TMDL led to collaborative reduction efforts by ITG Burlington and DEQ staff, resulting in the successful elimination of an estimated 185,000 mg of PCBs to this waterbody. Lastly, it is safe to conclude the identification and removal of the PCBs would not have occurred without the TMDL study. As such, this effort is considered a significant success. Given the persistent nature of PCBs, it may be years before a response is observed within fish. However, the reduction in measured fish tissue PCB concentrations should be expedited as a significant mass of PCBs was effectively kept out of the lower Roanoke River.

5.3 South River Science Team: Riverbank Remediation and Restoration

The South River Science Team was established in 2001 to work toward understanding how mercury enters the South River and to reduce mercury levels in the South River and South Fork Shenandoah River fish. Following extensive sampling of floodplain sediments in 2008 and 2009, the Science Team found that one source of mercury to the South River was mercury-impacted soil from eroding riverbanks. The soil had become contaminated with mercury from decades of exposure, movement and recycling of river sediment and floodplain particles. In an effort to reduce the amount of mercury-impacted soil transported into the river, the South River Science Team began a phased project to remove and remediate contaminated soils and restore the natural slope and vegetation to the riverbank. Phase one of the riverbank remediation and restoration project was completed in February 2017 at Constitution Park in Waynesboro. The next phase of work will concentrate on riverbanks downstream within the first two miles of the South River. Remediation work is being coupled with water monitoring and modeling to determine if the work is achieving the desired goal.

For more information on the efforts of the South River Science Team, please visit: http://southriverscienceteam.org/.

5.4 Salt Management Strategy (SaMS)

The SaMS is an initiative aimed at proactively addressing an emerging water quality concern in the Northern Virginia Region associated with chloride (salt) products used during winter storm events. The SaMS will also provide a framework for implementing the Accotink Creek chloride TMDL. The effort is expected to provide a clearer understanding of the costs and benefits of improved chloride (salt) application in snow and ice management and also promote improvements in best management practices (BMPs) to more efficiently and effectively apply these products.

The broad goals of the SaMS effort are to: (1) prepare a strategy capable of achieving the target chloride loads identified in the Accotink Creek TMDL and that is relevant to the broader surrounding region, and (2) foster collaboration among all stakeholder groups involved in winter deicing/anti-icing activities to encourage long-term support for improved practices that protect public safety and lessen environmental, infrastructure and public health effects.

To accomplish these goals, the SaMS development process plans to:

1) Develop a suite of salt-related BMPs.
2) Produce a guiding document that outlines all aspects of the issue (environment, infrastructure, health, and cost) and provide resources for addressing those issues.
3) Develop a comprehensive public education and outreach campaign.
4) Explore all possible funding opportunities to assist in implementation of salt-related BMPs.
5) Develop options for effectiveness monitoring.
6) Organize options for reporting and tracking salt usage.

Based on implementation initiatives and experiences in Minnesota and other states such as New Hampshire, this form of BMP implementation holds the promise of improving water quality while saving costs and maintaining public safety. DEQ's SaMS development process began in January 2018 and is planned for completion in early 2020. More information on the SaMS development process is available on the agency's website here: https://www.deq.virginia.gov/SaMS.aspx.

5.5 Pollutant Minimization Plan (PMP) Guidance

Once a TMDL has been reviewed and approved by EPA, implementation for point sources occurs through Virginia Pollutant Discharge Elimination System (VPDES) permits in order to achieve toxicant reductions from point sources to the affected water body. In the specific case of PCBs, this implementation process involves Pollutant Minimization Plans (PMPs) for the permitted point sources. 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. To facilitate the development of PMPs for already completed as well as ongoing PCB TMDLs, DEQ is drafting PMP guidance that can be used by the permitted entity as well as DEQ permit writers. Once finalized, DEQ's PMP guidance will be an important tool to reduce toxics-related impairments in aquatic environments. More information on the PCB PMP guidance is available on the agency's website here: https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/PCBTMDLs/ResourcesforRegulatedStakeholders.aspx .

6.0 References

A cumulative bibliography of general references and publications cited in this and previous Toxics Reports is included in Appendix 22.