2015-2016 Report on Toxics Reduction in State Waters

The complete set of Tables, Folders with Figures, and 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

JANUARY 1, 2017

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All Tables, Folders, Figures and Appendices referred to in the text are available as "Read Only" files on DEQ's website at:

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

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List of Figures: Folders 3.2.1.1 through 3.2.1.5

The numbering of figure-containing **Folders** corresponds to the numbers of the associated **Tables 3 through 5**, which contain the complete results for the ambient monitoring of toxic materials from the past state fiscal year. The Microsoft Excel® workbooks that contain the graphs of historical toxics concentrations also include worksheets with descriptive statistical summaries of historical data arranged as follows:

(1) Historical data arranged by state fiscal year for all toxic parameters in the class;
(2) Historical data arranged by toxic parameter for years 1997 through the present.

Note: Because of restrictions for naming electronic folders and files, the names of some folders and files stored on disk may not appear exactly the same as those listed below.

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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. (https://www.epa.gov/pcbs/learn-about-polychlorinated-biphenyls-pcbs)
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
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 - 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. (http://cfpub.epa.gov/ncea/iris/index.cfm)
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)
OC-Pesticides or OCP	Organo-chlorinated Pesticide(s)

OE	Project Code for Observed Effects monitoring (3C Waters with Observed Effects / Insufficient Data)
OEE	Office of Environmental Education
OP-Pesticides or 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	EPA 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 (short for data 'STOrage and RETrieval' system)
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

Executive Summary

From 1997 through 2015, the Virginia Department of Environmental Quality (DEQ), on behalf of the State Water Control Board, submitted the annual Toxics Reduction in State Waters (TRISW) Report to the Governor and General Assembly of the Commonwealth on January 1st of each year, in accordance with Virginia Code § 62.1 - 44.17:3. That Code section requires the State Water Control Board to conduct ongoing assessments of the amounts of toxics in Virginia's waters, develop and implement a plan for the reduction of toxics in Virginia's waters, and report on those efforts to the General Assembly. In 2015 the General Assembly amended the code such that the Report is now required biennially. This Report is the first under the new reporting schedule.

The primary objective of the TRISW Report is to document the Commonwealth's progress toward reducing toxics in state waters and consequently improving water quality. The Department's efforts to reduce toxics include three principal types of activities: (1) the **prevention** of contamination of the Commonwealth's waters by toxics, (2) the continued **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 Commonwealth's waters.

Prevention

Permitting: Compliance monitoring, the monitoring of in-pipe concentrations of permitted discharges, is one essential element of the prevention of contamination by toxics of the Commonwealth's waters. During State Fiscal Years (SFY) 2015 and 2016, DEQ's Toxics Management Program (TMP) included 284 and 272 facilities, respectively, with 679 and 653 outfalls that had active permit-defined toxics limits in their effluents, as recorded in DEQ's Comprehensive Environmental Data System (CEDS) database. During SFY15, 286 facilities reported their discharge monitoring results. Among 6,611 parameter-specific Discharge Monitoring Reports (DMRs) filed during SFY15, 3,750 contained permit-specified maximum concentration limits, and a total of 98 (2.61%) exceeded those limits. During SFY16 the same attributes were 6,983 parameter-specific DMRs, 2,802 with permit-specified maximum concentration limits, and 75 (2.68%) exceedances. Many of these in each year (approximately 40%) were trivial, short-term violations for metals in the discharge stream at municipal wastewater treatment facilities: total recoverable Copper (~ 50% of short-term violations), and total recoverable Zinc (~ 30%). Various forms of Cadmium, Lead, Mercury and Chromium exceedances averaged from 1% to 2% each year. Only eight violations during the two years were for organic compounds: naphthalene (N = 6, ~ 5%) and ethylbenzene (N = 2, ~ 1%).

Pollution Prevention: The 2016 Pollution Prevention Annual Report is available on the DEQ Website at http://www.deq.virginia.gov/Programs/PollutionPrevention.aspx. Among the highlights of Pollution Prevention (P2) successes affecting reduction of toxics in state waters in the past two years are the following:

- Virginia still provides performance-based permit fee discounts (from 2 to 20%) for "going beyond compliance." In 2015, over $198,000 in fee discounts were distributed among Virginia Environmental Excellence Program (VEEP) facilities that implemented and carried out their Environmental Management System (EMS) plans. Fee discounts in 2016 totaled approximately $138,000.
- Based on the itemized summaries in the annual P2 Reports, environmental benefits from EMS plans include the following:

  2014 (as reported in the 2015 Report) - 44,910 tons of non-hazardous wastes were recycled, and non-hazardous waste disposal was reduced by 1,461,506 tons. The use of hazardous materials decreased by 294 tons, and hazardous waste disposal was reduced by 187,216 tons. The emission of greenhouse gases was reduced by 49,558 tons. Total water use was reduced by 566,083,852 gallons,

and recycled water use increased by 97,741,468 gallons. Reduced total energy usage was 1,291,647 million BTUs. Approximately $41 million in cost savings were realized during this process.

2015 (as reported in the 2016 Report) - increased recycled material usage by 34,543 tons, reduced hazardous material usage by 240 tons, and reduced total water use by 238,156,000 gallons. Use of recycled water increased by 88,732,500 gallons, greenhouse gas emissions were reduced by 111,275 tons, and total energy consumption was reduced by 1,449,690 million BTUs, for a total cost savings of $41 million.

- DEQ's Voluntary Mercury Reduction Initiatives also have been continued successfully. Three hundred two facilities now participate in the "Virginia Switch Out" Project for the recycling of automotive mercury switches. To date (2015) 117,715 switches have been collected, equating to 258.97 pounds of mercury. Totals are not yet available for 2016. Fifty-four facilities have accepted the "Virginia Fluorescent Lamp Recycling Challenge" and pledged to annually recycle over 54,000 energy efficient fluorescent light bulbs, which also contain small quantities of mercury. (Refer to DEQ's Mercury Reduction website at: http://www.deq.virginia.gov/Programs/PollutionPrevention/MercuryReduction.aspx.)

Environmental Education: The Department of Conservation and Recreation's **(**DCR) Office of Environmental Education (OEE) has contributed to toxics reduction with various activities. Educational programs reflect many types of experiences such as workshops, field days, and professional development of teachers and other educators. Events reflect contact time made through activities such as the State Fair, county fairs, and Earth Day special events. Self-guided experiences reflect activities individuals pursue for their own betterment at nature centers via self-guided walks and exploratory experiences. Technical assistance generally represents one-on-one consultations for conservation practices which can take place with homeowners, landowners, farmers, etc. Civic engagement activities can represent stewardship efforts such as trash clean-ups as well as citizen monitoring efforts for water quality. Environmental education includes elements in the prevention, monitoring, and remediation of toxics. Anti-litter and recycling activities reduce the introduction of toxic materials into Virginia's waterways. Adopt-a-stream programs provide insight into recognizing existing and potential sources of pollution and cleanup activities remove toxics from streams. One of the most numerous items encountered in cleanup campaigns is cigarette butts, which are saturated with toxic polycyclic aromatic hydrocarbons (PAHs).

In 2014, the Virginia Office of Environmental Education (DCR) began gathering information about state-wide activities in a more organized and systematic manner, in an effort to efficiently quantify the efforts expended and the audiences reached by the Environmental Education Program. Basic questions that defined this effort were: How are programs delivered across the state? To whom are the programs delivered? And where do they occur? Program activity types were defined as: (1) civic engagement (service learning, citizen science and stewardship) reaching primarily children and youth, (2) educational programs directed at the community, (3) events attracting the general population and often involving institutions of higher education, (4) self-guided learning and site visits often involving professionals in the environmental sciences, and (5) technical assistance, primarily to fellow educators.

By 2015, more than two million individuals annually participated in more than 3,000 environmental educational activities across Virginia. Table 3.1.3-1 illustrates that the total number of confirmed participants essentially doubled between 2014 and 2015 (while the number of reporting organizations grew from 81 to 110). In 2015, approximately 20% of the individual participants were children and youth, while community and professional participation (including teachers, park rangers, master naturalists, etc.) comprised from approximately 37% to 39% each.

Refer to the Table below for numerical summaries. Calendar year 2016 results are not yet available.

Activity Type	Primary Audience	2014	2015
Civic Engagement (service learning, citizen science, stewardship)	**Children and youth**	2,329	421,868
Educational Programs	**Community**	493,979	856,593
Events	**Higher Education and Community**	81,025	112,067
Self guided learning and Site Visits	**Professionals**	542,821	824,449
Technical Assistance	**Individual contact between/ among professionals**	1,555	2,740
Grand Totals	> > > > > > >	1,121,709	2,217,717

Environmental Education Participant Distribution by Activity Type – Calendar Years 2014 & 2015

Project WET (Water Education for Teachers) is a nationally developed organization whose mission is to reach children, parents, teachers and community members of the world with water education. In the past year numerous formal and non-formal educators have been trained in WET through a series of DEQ-sponsored six-hour workshops. These educators have learned about the state of Virginia's waters, have gained a better understanding of Virginia's watersheds, examined the impacts that humans have on the Commonwealth's waters, and studied best management practices. Each of these educators received the Curriculum and Activity Guide 2.0, a full-color 592 page book with 64 multi-disciplinary water related activities, to use as they educate Virginia's children. Additional information about Project WET can be found on DEQ's website at:
http://www.deq.virginia.gov/ConnectWithDEQ/EnvironmentalInformation/ProjectWet.aspx.

The Watershed Educators Institute (WEI), unique to DEQ, was established in 2010 with a three year B-WET grant from the National Oceanic and Atmospheric Administration (NOAA) to train non-formal educators so that they may coordinate with formal educators on Meaningful Watershed Educational Experiences (MWEE) for students. DEQ has received another three year NOAA B-WET grant to continue this objective and build the network between formal and non-formal educators. The WEI consists of a series of ten one- and two-day workshops on a variety of water quality and watershed topics:

- Assessing the Health of a Watershed – Part 1
- Assessing the Health of a Watershed – Part 2
- Designing and Leading a MWEE for School Groups, (held two times since it is a required workshop)
- Introducing Watersheds
- Methods of Teaching Biological Assessment of Stream Health
- Freshwater Wetland Investigation
- Coastal Wetland Investigation

A participant who receives 30 hours of training is formally recognized as a watershed educator leader in Virginia.

Toxics Release Inventory (TRI): Pursuant to the federal Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA), the Commonwealth maintains a Toxics Release Inventory (TRI) that

documents the total quantities of EPA-listed toxic compounds that are released annually to water, 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. The Virginia EPCRA Program is not a federally delegated program; therefore, it is strictly a federal program. The program 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 most recent TRI Reports are available on the DEQ website at: http://www.deq.virginia.gov/Programs/Air/AirQualityPlanningEmissions/SARATitleIII.aspx . The most recent (March 2016) summarizes data from calendar year 2014, during which 436 Virginia facilities filed 1,361 individual reports on the release, transfer, or management of TRI chemicals or chemical categories. Statewide toxic releases to the water totaled approximately 11.16 million pounds or 31.73% of the total onsite releases to all media during 2014. This quantity represents a 5.09% decrease compared to what was released to the water in 2012. In 2014 nitrate compounds (11.84 million pounds) represented 97.12% of all TRI chemicals released to water. Nitrates, however, are of much more concern for their effects as nutrients rather than as toxics. Toxics criteria for dissolved nitrates in drinking water were not exceeded during the period 2007 – 2012, the assessment window for the 2014 Integrated Report.

Monitoring

Water Quality Monitoring (WQM) Programs: Ambient water quality monitoring consists of the measurement of physical and chemical characteristics within the Commonwealth's streams, rivers, lakes, reservoirs and estuaries. Ambient monitoring (and assessment) characterizes ecological stressors and evaluates their potential impact on aquatic organisms and other wildlife, and on human health and recreational use of Virginia's waters.

Summer (June - September) of 2016 was the sixteenth year of DEQ's Estuarine Probabilistic Monitoring (ProbMon) Program and the spring and fall of 2016 comprised the sixteenth year of its Freshwater ProbMon Program. Because of resource limitations, the sampling and analysis for sediment organic contaminants was suspended at freshwater ProbMon sites in SFY07. Sediment chemistry (metals and organics) sampling and analyses and sediment toxicity testing have continued at estuarine ProbMon sites during the 2015 and 2016 field seasons (SFY16 and SFY17) with resources provided by a probabilistic survey-targeted supplement to the federal §106 grant and DEQ general funds.

In the 2016 305(b)/303(d) Water Quality Integrated Assessment Report (2016 Integrated Report or IR), sediment chemistry, sediment toxicity and benthic taxonomic results from DEQ's Estuarine Probabilistic Monitoring Program were used for toxics-related "Weight-of-Evidence" assessments of Aquatic Life Use (ALU) at 273 estuarine sites sampled over the most recent six years (2009 – 2014). These results, primarily from minor tidal tributaries, complement those from the Chesapeake Bay Program's benthic probabilistic monitoring program, which emphasizes the Bay mainstem and extensive mainstem areas of major tidal tributaries. Chapter 4.5 "RESULTS OF ESTUARINE PROBABILISTIC MONITORING 2009-2014" of the 2016 IR summarized the characterizations of all 273 estuarine ProbMon sites sampled during the six-year assessment window. Most of the analytical data from the summer 2015 Estuarine ProbMon Program (SFY16) are included in the tables and folders of this TRISW Report. (Some sediment chemistry results have not yet been released by EPA.) The Weight-of-Evidence assessments from the 2015 and 2016 estuarine surveys (an additional 100 sites) will be incorporated into the next Integrated Report, due in April of 2018.

During 2014 and 2015, DEQ's Fish Tissue and Sediment Monitoring Program collected samples from 55 sites, primarily in the Potomac, James, New and Dan River basins. The sites were selected to gather supplemental analytical chemical data for the development and/or implementation of Total Maximum Daily Loads (TMDLs) for segments of water bodies which had been included in previous 305(b) Reports and 303(d) Impaired Water Listings due to contamination of fish by polychlorinated biphenyls (PCBs), plus follow-up monitoring of the Dan River coal ash spill in February 2014. The results for the 2015 collections were received at the end of September, 2016. The data were evaluated for Quality Control, summarized, and sent to the Virginia Department of Health (VDH) as well as to DEQ's 305(b) assessors and TMDL staff for their use after the results and accompanying Quality Assurance and Quality Control (QA/QC) were confirmed (October/ November, 2016). Results were then posted online at http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/FishTissueMonitoring.aspx.

Thirty-four sites were sampled for fish tissue and sediment during the summer and fall of 2016, in the Rappahannock, James River Basins (PCB TMDLs), and in the Dan/Roanoke River Basin in response to the Duke Energy coal ash spill. Four additional sites were sampled in embayments of the Potomac River, in response to a request from the Department of Game and Inland Fisheries for a snakehead special study. All samples were frozen until the end of the field season and shipped to the Virginia Institute of Marine Science (VIMS) for analysis. Analytical results are anticipated for September 2017, and following QA/QC review should be available for the January 2019 Toxics Report.

Plans have not yet been developed for fish tissue and sediment sampling during the 2017 field season. Regional TMDL Coordinators will request targeted TMDL monitoring with the preparation of the 2017 Monitoring Plan, due by the end of December 2016.

Assessment and Remediation

The 2014 Integrated 305(b)/303(d) Water Quality Report (IR) was submitted to EPA Region 3 in December 2014. The delay in submission was at the request of EPA Region 3, which hoped to resolve unsettled questions from the 2012 IR relative to algal blooms in the Shenandoah River, prior to evaluating the 2014 IR. The 2014 IR was finally approved by EPA Region 3 in May of 2016, and is summarized in this TRISW Report. The 2016 IR has suffered similar delays, and will be summarized in the next TRISW Report, January 2019.

The 2014 IR assessment identified a total of 15,677 miles of impaired rivers (16% of all assessed river miles; EPA Assessment Categories 4 - 7% and 5 - 9%), 94,764 acres of lakes (81% of all assessed significant lakes; EPA Categories 4 – 13% and 5 – 68%), and 2,136 square miles of impaired estuaries (75% of all assessed estuaries; EPA Categories 4 – 3% and 5 – 73%). Of those impaired by toxics, over 99% were listed for fish consumption advisories, primarily for PCBs (26% of impaired river miles, 56% of impaired lake acres, and 98% of impaired estuaries) or mercury (63% of river miles, 42% of lake acres, and less than 1% of estuaries). These figures will be updated with the completion of the next Integrated Report in 2017. Because the number of segments united into each Total Maximum Daily Load (TMDL) varies with the hydrography and the extent of the impairment, the exact number and schedule of toxics-related TMDLs to be developed and implemented is not certain. DEQ's PCB Strategy (2005) established priorities for TMDL development and discusses various options for remediation. Analyses for the 2016 Integrated Report are underway, and any new PCB-impaired segments will be integrated into the Strategy. Changes in

the prevalence and geographic distribution of contaminants included in the 2016 Integrated Report will be discussed in the next (January 2019) Toxics Reduction Report.

Remediation / Reduction: Although no explicitly toxics-related TMDLs were submitted or approved during SFY15 and SFY16, several investigations into stressor analyses for benthic impairments and several PCB TMDL investigations are still under way. A number of draft TMDL Reports have been available for public comment over the past several years (http://www.deq.state.va.us/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment/DraftTMDLReports.aspx), several of which were for benthic impairments and included evaluations of potential toxic stressors. In one case, for the Levisa Fork, Slate Creek, and Garden Creek, PCBs were of concurrent concern and in another, in the North Fork Powell, South Fork Powell and Powell Rivers, significant non-lethal effects of sediment toxicity were observed on juvenile mussels.

A Stressor Analysis Report for the benthic macroinvertebrate impairments in Holmes Run, Fairfax County, Virginia and Tripps Run, Fairfax County, Virginia, and the City of Falls Church, Virginia was completed in September 2014 and concluded that toxics, *per se*, were not indicated as stressors, although total dissolved solids and chlorides are still considered possible stressors. Other, more recent reports on the investigation have concluded that most primary stressors were not toxics related (sedimentation and hydromodification), although chlorides were implicated in one case: Stressor Analysis Report for the Benthic Macro-invertebrate Impairments in the Accotink Creek Watershed, Fairfax County, Virginia – September 2015;

PCB TMDL development:

Elizabeth/tidal James River: A PCB source investigation study has been on-going in these water bodies as part of TMDL development. PCB point source monitoring was requested from those Virginia Pollutant Discharge Elimination System (VPDES) permittees identified as possible contributors to fish impairments. A more accurate accounting of regulated stormwater (MS4 outfalls) is also underway. The available information generated from these studies is to be used in the development of PCB loadings. The TMDL, which is currently scheduled to be completed in 2017, is expected to establish PCB reductions needed to attain the fish consumption use of these impairments.

New River: The New River, beginning at the I-77 Bridge and extending to the West Virginia line, has been the focus of an extensive PCB source investigation study. The study was initiated in 2010 and has included several iterations of ambient river PCB monitoring within the impairment. Large tributaries such as Peak Creek have also been investigated. In addition, PCB monitoring of permitted VPDES facilities has occurred for which data are now available to develop PCB loadings and to set reductions. A PCB TMDL should be completed by mid-2017.

In addition, monitoring for future TMDLs in fish tissue impairments by mercury has continued in the Rappahannock, Pamunkey, Mattaponi, Chickahominy, James, Blackwater, Nottoway and Meherrin River watersheds.

The agency's TMDL history, current status and development plans are available at: http://www.deq.state.va.us/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment/DraftTMDLReports.aspx.

As these TMDLs are completed and scheduled for implementation, and others are added, follow-up monitoring will be initiated to evaluate their effectiveness in reducing toxic contamination. The effective

implementation of these TMDLs should result in measurable reductions of contaminants in a number of the state's watersheds within the next few years.

Two segments with toxics-related impairments (fish consumption and aquatic/wildlife) were approved for delisting in the 2014 IR ("Appendix K.2 – Delisted Toxics Impaired Segments – 2014 IR"). One segment is in the New River (2.3 stream miles), which had been previously listed for mercury in fish. The other segment is in an unnamed tributary of Seacorrie Swamp (1.5 stream miles), which had been previously listed for ammonia. This list will be updated following the submission and approval of the 2016 Integrated Report.

Continued Commitment

DEQ continues its commitment to toxics reduction by the prevention of contamination, continued water quality monitoring to detect contamination by toxics, and the implementation of remedial measures. The Virginia Pollutant Discharge Elimination System, the Pollution Prevention Program, and the Environmental Education Program, in conjunction with other agencies, programs and stakeholders, are working to promote public awareness, as well as to control and reduce toxics releases. The Toxics Release Inventory and various water programs constantly monitor and document the release to, and the presence and movement of toxics in aquatic environments. Close coordination between monitoring and assessment activities will help identify new sources of contamination as they occur and document the effectiveness of load allocations and other remedial measures developed and implemented by the TMDL Program. The agency anticipates significant reductions of toxics in the state's waters as a result of continued TMDL implementation.

Foreword

State Fiscal Years 2015 and 2016 Toxics Reduction in State Waters Report (January 2017)

The Virginia Department of Environmental Quality (DEQ) plans and executes its Ambient Water Quality Monitoring Program on an annual basis. Guidelines for the program include:

- A long-term Water Quality Monitoring and Assessment (WQMA) Strategy was revised and submitted to EPA Region 3 in August of 2013 (a minor revision was accomplished in 2016 and another major revision is scheduled for 2019),
- Formal Quality Assurance Program and Project Plan (QAPP),
- Established Standard Operating Procedures (SOPs), and
- Standardized Sampling Protocols.

The agency's annual monitoring program plan (MonPlan) corresponds with the calendar year. This helps synchronize various monitoring activities and assessment periods with the "ecological" or "water year." The Monitoring activities summarized in this Toxics Report, however, refer to the State Fiscal Year (SFY - July 1 of each year through June 30 of the following year) in order to maximize the availability of analytical results by January 1.

The SFY15 and SFY16 Toxics Reduction in State Waters Report (TRISW- January 2017 – eighteenth in the series) summarizes all toxics monitoring and reduction activities carried out between July 1, 2014 and June 30, 2016. The historical summaries of toxics monitoring results in Folders 3 through 6 are cumulative, with the addition of the corresponding year's results in each new report.

To minimize the size of the report, reduce production time and costs, and facilitate its distribution to interested parties, the data tables, figures and appendices of this report are presented in their complete form on, and may be downloaded from the DEQ website at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx. Electronic copies of the complete report, including tables, figures and appendices, are available on CD upon request.

In the annual tables and historical folders of the Water Quality Monitoring section, data summaries of yearly sets of monitoring results are available in both tabular and graphical forms. Graphical summaries of historical toxics monitoring results (which use statistical interval estimates for median parameter values) will continue to appear with each annual report to assist in the evaluation of:

- Two- to five-year (short-term) changes in water and sediment quality,
- Differences among drainage basins (contemporary, geographic trends) year by year, and
- Differences among years within individual basins (basin-specific, short-term temporal variations).

Eventually, as each year's results are added to the report, historical results in the form of graphed statistical interval-estimates will facilitate the visual evaluation of longer-term trends. Graphed historical summaries (SFY97 – SFY16) for each major drainage basin appear in this year's report, but the relatively short period of record and changes in methodologies and detection limits make the interpretation of trends difficult.

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 (TRISW) 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 TRISW 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.

Each report now provides a summary of the toxics-related prevention, monitoring and remediation activities of the previous two State Fiscal Years (SFY).

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 TRISW 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, eighteenth TRISW Report (January 2017) contains tables of both raw data and statistical summaries of SFY15 and 16 monitoring results, as well as cumulative graphical summaries of results from 1997 through the present.

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 ("a material") within the category of "toxics" (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 was consequently modified during the ensuing years. For example, the EPA's publication of conversion factors in May 1995 lowered the acute and chronic freshwater criteria and the acute saltwater criteria for the dissolved metals arsenic, cadmium, chromium III and VI, copper, lead, mercury, nickel, silver, zinc, and selenium.
- 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

(*e.g.*, see new 2013 Final Aquatic Life Criteria for Ammonia).
Human Health: https://www.epa.gov/wqc/human-health-water-quality-criteria
(*e.g.*, see the updated human health water quality criteria for fifteen chemicals).

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" within state laws and regulations that are protective of the "designated use(s)" assigned to each body of water. The most commonly 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. Changes to toxic pollutant criteria in the Virginia Water Quality Standards occurred during the most recent Triennial Review. The rulemaking regarding Virginia's Triennial Review of the Water Quality Standards regulation concluded with the January 14, 2016 meeting of the State Water Control Board. The following substantive amendments regarding toxics were adopted by the Board:

- The aquatic life water quality criteria concentrations for lead in saltwater were corrected to show the criteria as "dissolved" concentrations by multiplying the old criteria by the saltwater conversion factor of 0.951. The acute saltwater criterion was converted from 240 µg/L to 230 µg/l and the chronic criterion was converted from 9.3 to 8.8 µg/L.
- Acrolein and Carbaryl are new criteria to protect the aquatic life use. Acrolein is a biocide frequently used in recirculating process water systems for slime control and Carbaryl is the active ingredient in the commonly available pesticide Sevin®. Acrolein acute and chronic freshwater criteria for the protection of aquatic life are both 3.0 µg/L. There are no criteria for saltwater. Carbaryl acute and chronic freshwater criteria for the protection of aquatic life are both 2.1 µg/L. The acute saltwater criterion is 1.6 µg/L. There is no chronic criterion for saltwater.
- The proposed updates to eight water quality criteria designed to protect human health (Carbon Tetrachloride, Cyanide (free), Hexachloroethane, Methylene Chloride, Nitrobenzene, Pentachlorophenol, Tetrachloroethylene, Trichloroethylene) were removed from the rulemaking due to EPA publishing nationally recommended updates for all human health criteria at the same time the Notice of Public Comment was published for Virginia's Triennial Review. The timing of EPA's update did not allow for sufficient public input. All human health updates are being addressed in a separate rulemaking.

The amendments will not be effective as State regulation until approved by EPA. It is anticipated the approval package with all amendments and their rationale will be sent to EPA by the end of October 2016.

The most up to date version of Virginia's Water Quality Standards is always available linked to the DEQ website:
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 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, 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."

In the past, the DEQ Office of Environmental Education (OEE) has provided environmental orientation and educational programs for teachers and students through electronic newsletters and other outreach activities (workshops and other training events, meaningful watershed experiences, oyster and fish festivals, etc.) to foster environmental stewardship, including non-competitive litter prevention and recycling grants. On July 1, 2012 various components and/or activities of the OEE were transferred from DEQ to the Department of Conservation and Recreation (DCR), including: Virginia Naturally (website, newsletter, partners map), Environmental Educators Leadership Program, Regional Environmental Education Team coordination, and Annual Environmental Education Conference.

2.2 Monitoring and Assessment

The VPDES Program performs end-of-pipe 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 document compliance with 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 . The major components involved with toxics monitoring normally include the freshwater and estuarine probabilistic monitoring networks, and special studies, including the TMDL Program. Some program-specific monitoring also contributes to the toxics efforts: the Chesapeake Bay Program, the Lakes Monitoring Program, the Biological Monitoring Program, and the Targeted Fish Tissue and Sediment Monitoring Program. Short-term special studies and other activities related to toxics monitoring are included in Annual Water Quality Monitoring Plans for each monitoring year (January 1 to December 31) 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 strictly 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 2013 (March 2015) and 2014 (March 2016), as well as other past reports, are available online at: http://www.deq.virginia.gov/programs/air/airqualityplanningemissions/saratitleiii/sara313toxicsreleaseinventory/va2013toxicsreleaseinventoryreport.aspx.
Future reports will be posted on the same website in March of each year.

2.3 Remediation

Although DEQ participates in several programs that deal with the remediation of toxic contamination (*e.g.*, Brownfields Program, Federal Facilities Program, Superfund Program), the primary agency-driven program involved in remediation of toxics-related impairments in aquatic environments is the Total Maximum Daily Load (TMDL) Program. 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 programmed Pollutant Minimalization Plans (PMPs) with permitted point sources, executing Best Management Plans (BMPs) for non-point sources or, on occasion, the physical removal of contaminated substrate from legacy point sources.

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,
- Toxic metals in the sediment,
- Dissolved organic contaminants,
- Organic contaminants in the sediment, and
- Toxic 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 – SFY15 & 16

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. The reduction of resource consumption and waste, however, also reduces the movement, use, and release of toxic materials. Such reductions occur not only within the consumer population but also among retail outlets and among industries using and/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 December 2015 & 2016 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.

- **Virginia Green Travel** - Virginia Green, the Commonwealth's voluntary initiative to promote pollution prevention within the tourism industry, began its pilot phase in 2006. Prior to September 2015 membership had reached 1,650 participants within the entire travel and tourism sector, the largest number of participants among the 27 states that have green lodging/tourism programs. Virginia, with nearly 570 lodging facility members, is second only to Florida in this category. Participating facilities include lodging, restaurants, attractions, conference facilities, convention centers, campgrounds, events, visitor centers, wineries, golf courses, transportation facilities and supporting organizations.

  Although Virginia Green does not require annual reporting of environmental results, environmental progress is documented through the annual awards program and through ongoing technical assistance and outreach. A highlight of 2015 was OPP's partnership with the Virginia Green Travel Alliance (VGTA) and the city of Richmond's Sustainability Program to promote the 2015 Road World Cycling Championships, which was the first to receive the official UCI recycling eco-label. From the World Championships alone the following waste diversions were achieved:

  25,000 pounds of material recycled
  9,500 pounds of compostables collected
  2,100 pounds of grease collected for production of bio-diesel
  4,000 pounds of pallets recycled
  2,800 pounds of cardboard recycled
  1,000 pounds of food recovered and donated to Churches Around Richmond Involved To Assure Shelter (CARITAS)
  21,300 pounds of signage donated for reuse or recycles

  A total of 65,000 pounds of material recycled or composted.

  In 2016, Virginia Green Travel Alliance (VGTA) inaugurated its Virginia Green Travel Regional Chapters program to leverage the work regional tourism partners carry out in local communities. Inaugural Chapters include Arlington Conventional and Visitors Service, Blacksburg/Christiansburg/ Montgomery County Regional Tourism, Charlottesville Albemarle Convention & Visitors Bureau, Discover Prince William and Manassas, Hampton Conventions & Visitor Bureau, Harrisonburg Tourism & Visitor Services, Newport News Tourism, Richmond Region Tourism, Shenandoah County

Tourism, and Virginia Beach Convention and Visitors Bureau. OPP works with Regional Chapters to insure that regional events and tourist destinations are registered with Virginia Green and develop a standard Virginia Green profile that can be used for events.

- **Virginia Environmental Excellence Program (VEEP) -** There are four types of participation options for interested facilities: (1) E2 (Environmental Enterprise) for facilities that have made significant progress toward the development of an Environmental Management System (EMS), have made a commitment to pollution prevention, and have a record of sustained compliance with environmental regulations, (2) E3 (Exemplary Environmental Enterprise) for facilities that have exceeded the E2 requirements and have a fully-implemented EMS, (3) E4 (Extraordinary Environmental Enterprise) for facilities that have exceeded the E3 requirements, have completed at least one full cycle of an EMS as verified by a third-party auditor, and have demonstrated a commitment to continuous and sustainable environmental progress and community involvement, and (4) SP (Sustainability Partners), the newest VEEP track, which is designed to encourage organizations to make environmental sustainability part of their culture through leadership, innovation, and continual improvement.

  Since its inception in 2000, the program had grown to approximately 425 participating facilities by 2015. Approximately 96 new applications for new and renewing VEEP members were reviewed in 2016, including 14 SP applications.

- Member recognition and success stories are summarized in the 2015 and 2016 reports on the P2 website at: http://www.deq.virginia.gov/Programs/PollutionPrevention.aspx.

- Virginia still provides performance-based permit fee discounts for "going beyond compliance." Potential discounts vary by category: 5-20% for hazardous waste reduction, 10-20% for solid waste reduction, and 2-20% for reduction of water use and release. In 2015, the discounts totaled in excess of $198,000, and in 2016 approximately $138,000 in fee discounts were distributed among VEEP facilities.

- A review of VEEP annual performance reports for calendar year 2014 (reported in 2015) indicated the following results: 44,910 tons of non-hazardous wastes were recycled, and non-hazardous waste disposal was reduced by 1,461,506 tons. The use of hazardous materials decreased by 294 tons, and hazardous waste disposal was reduced by 187,216 tons. The emission of greenhouse gases was reduced by 49,558 tons. Total water use was reduced by 566,083,852 gallons, and recycled water use increased by 97,741,468 gallons. Reduced total energy usage was 1,291,647 million BTUs. Approximately $41 million in cost savings were realized during this process.

  2015 results, as reported in the current 2016 report, revealed increased recycled material usage by 34,543 tons, reduced hazardous material usage by 240 tons, and reduced total water use by 238,156,000 gallons. Use of recycled water increased by 88,732,500 gallons, greenhouse gas emissions were reduced by 111,275 tons, and total energy consumption was reduced by 1,449,690 million BTUs, for a total cost savings of $41 million.

- DEQ's Voluntary Mercury Reduction Initiatives also have been continued successfully. Three hundred two facilities participated in the "Virginia Switch Out" Project in 2015, collecting 117,715 switches and 258.97 lbs. of mercury in 2015. Annual totals for Virginia and other states are available at the End of Life Vehicle Solutions (ELVS) Website at: https://www.usecology.com/Services/Environmental-Services/Recycling/ELVS-Mercury-Switch-Program.aspx. Fifty-four facilities have accepted the "Virginia Fluorescent Lamp Recycling Challenge" and pledged to annually recycle over 54,000 energy

efficient fluorescent light bulbs, which also contain small quantities of mercury: http://www.deq.virginia.gov/Programs/PollutionPrevention/MercuryReduction/Fluorescents/virginiafluorescentlamprecyclingnbsp.aspx.

- Refer to DEQ's Mercury Reduction Webpages for a list of participating facilities, environmental consultants and recycling vendors related to mercury and florescent lamp recycling: http://www.deq.virginia.gov/Programs/PollutionPrevention/MercuryReduction/Fluorescents/VirginiaFluorescentLampRecyclingnbsp;Challenge.aspx.

For additional information concerning the Pollution Prevention (P2) Program, visit the DEQ website at: http://www.deq.virginia.gov/Programs/PollutionPrevention.aspx.

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 from the State Water Control Board. 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.

Appendices B1 and B2 - Facilities & Outfalls with Toxics Parameter Limits SFY15 and SFY16 of this report list facilities that currently have, or have applied for, permits that contain limits on the quantity or concentration of discharged toxics in their effluents. The same spreadsheets include geographic locations, receiving streams, etc. During SFY15, 284 facilities with 679 outfalls had one or more toxics limits in their permits and submitted Discharge Monitoring Reports (DMRs). During SFY16, 272 facilities with 653 outfalls submitted such reports. 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. Fifty-nine new permits or renewals were issued during SFY14 (see Start Date in "Appendix C1"), and began reporting in SFY15. Fifty-two new permits or renewals were issued during SFY15 (see Start Date in "Appendix C2"), and began reporting in SFY16. The current toxics parameters included in each permit, along with their limits and required reporting frequencies, are also listed in "Appendices C1 & C2 – Permits, Parameters, Units & Frequencies SFY15 and SFY16," respectively. The compliance results of each permitted facility's DMRs during SFY15 and SFY16 are reported in "Appendices D1 and D2 – Permitted Toxics Parameters & DMR Results," SFY15 and SFY16, respectively. Some facilities may hold permits requiring only that they report, without a limit-specified value with which they must comply. Since the facility's permit does not have a specified numerical limit, such DMR results cannot be used for compliance determinations.

Of 6,611 parameter-specific DMRs filed in SFY15, 2,902 provided the average concentrations of a toxicant. Of these, 86 reports (2.96%) exceeded their permit limit for average concentration. Parameter-specific maximum concentrations were reported in 3,753 DMRs. Of these, 98 (2.61%) exceeded the limit specified in their permit. Thirty-five (36.08%) of the violations were short-term (one or two consecutive event) occurrences, primarily for total recoverable copper or total recoverable zinc at municipal wastewater treatment plants (WWTP) or Sewage Treatment Plants (STP). Unpredictable, short-term violations are more common at such facilities, since they serve multiple entities with occasional spills or improper disposal of toxic substances, rather than the controlled use or production of toxic substances in an industrial context. Individual single parameter maximum concentration violations consisted of Copper (N = 61, 62.24% of 98 violations), Zinc (N = 28, 28.57%), naphthalene (the only organic compound violation, N = 4, 4.08%), cyanide (N = 2, 2.04%), hexavalent Chromium (N = 1, 1.02%), Lead (N = 1, 1.02%), and Mercury (sludge, N = 1, 1.02%).

Of 6,983 parameter-specific DMRs filed in SFY16, 1,776 provided the average concentrations of a toxicant. Of these, 60 reports (3.38%) exceeded their permit limit for average concentration. Parameter-specific maximum concentrations were reported in 2,802 DMRs. Of these, 75 (2.68%) exceeded the limit specified in their permit. Thirty-four (45.33%) of the violations were short-term (one or two consecutive event) occurrences, primarily for total recoverable copper or total recoverable zinc at municipal wastewater treatment plants (WWTP) or Sewage Treatment Plants (STP). As mentioned above, unpredictable, short-term violations are more common at such facilities rather than in the controlled use or production of toxic substances in an industrial context. Individual single parameter maximum concentration violations consisted of Copper (N = 41, 54.67% of 75 violations), Zinc (N = 25, 33.33%), naphthalene (N = 2, 2.67%), cyanide (N = 3, 4.00%), ethylbenzene (N = 2, 2.67%), Mercury (sludge, N = 1, 1.33%), and Mercury, total recoverable (N = 1, 1.33%).

3.1.3 Reduction of Toxics by Environmental Education

In the past, DEQ's Office of Environmental Education (OEE) has contributed to toxics reduction with various activities. Educational programs reflect many types of experiences such as workshops, field days, and professional development of teachers and other educators. Events reflect contact time made through activities such as the State Fair, county fairs, and Earth Day special events. Self-guided experiences reflect activities individuals pursue for their own betterment at nature centers via self-guided walks and exploratory experiences. Technical assistance generally represents one-on-one consultations for conservation practices which can take place with homeowners, landowners, farmers, etc. Civic engagement activities can represent stewardship efforts such as trash clean-ups as well as citizen monitoring efforts for water quality. Environmental education includes elements in the prevention, monitoring, and remediation of toxics. Anti-litter and recycling activities reduce the introduction of toxic materials into Virginia's waterways. Adopt-a-stream programs provide insight into recognizing existing and potential sources of pollution and cleanup activities remove toxics from our streams. One of the most numerous items encountered in cleanup campaigns is cigarette butts, which are saturated with toxic polycyclic aromatic hydrocarbons (PAHs).

On July 1, 2012 several components of OEE were transferred from DEQ to the Department of Conservation and Recreation (DCR), where they continue to enlighten citizens in relation to environmental quality. During the interim between 2012 and 2016, the OEE at the DCR has managed at least nine state-wide programs: Adopt-a-Stream, Environmental Educators Leadership Program, Project Underground, Regional Environmental Education (EE) Teams, Stewardship Virginia, Virginia Naturally, Virginia Natural Resource Leadership Institute, Virginia Resource Use Education Council, and Your Backyard Classroom.

In 2014, the Virginia Office of Environmental Education (DCR) began gathering information about state-wide activities in a more organized and systematic manner, in an effort to efficiently quantify the efforts expended and the audiences reached by the Environmental Education Program. Basic questions that defined this effort were: How are programs delivered across the state? To whom are the programs delivered? And where do they occur? Program activity types were defined as: (1) civic engagement (service learning, citizen science and stewardship) reaching primarily children and youth, (2) educational programs directed at the community, (3) events attracting the general population and often involving institutions of higher education, (4) self-guided learning and site visits often involving professionals in the environmental sciences, and (5) technical assistance, primarily to fellow educators.

By 2015, more than two million individuals annually participated in more than 3,000 environmental educational activities across Virginia. Table 3.1.3-1 illustrates that the total number of confirmed participants essentially doubled between 2014 and 2015 (while the number of reporting organizations grew from 81 to 110). In 2015, approximately 20% of the individual participants were children and youth, while community and professional participation (including teachers, park rangers, master naturalists, etc.) comprised from approximately 37% to 39% each.

Activity Type	Primary Audience	2014	2015
Civic Engagement (service learning, citizen science, stewardship)	**Children and youth**	2,329	421,868
Educational Programs	**Community**	493,979	856,593
Events	**Higher Education and Community**	81,025	112,067
Self guided learning and Site Visits	**Professionals**	542,821	824,449
Technical Assistance	**Individual contact between/ among professionals**	1,555	2,740
Grand Totals	> > > > > > >	1,121,709	2,217,717

Table 3.1.3-1 Environmental Education Participant Distribution by Activity Type – Calendar Years 2014 & 2015

Project WET (Water Education for Teachers) is an international organization whose mission is to reach children, parents, teachers and community members of the world with water education. In the past year numerous formal and non-formal educators have been trained in WET through a series of six-hour workshops. These educators have learned about the state of Virginia waters, gained a better understanding of Virginia watersheds, examined the impacts that humans have on Virginia's waters, and studied best management practices. Each of these educators received the Curriculum and Activity Guide 2.0, a full-color 592 page book with 64 multi-disciplinary water related activities, to use as they educate Virginia's children. Additional information about Project WET can be found on DEQ's website at: http://www.deq.virginia.gov/ConnectWithDEQ/EnvironmentalInformation/ProjectWet.aspx.

The Watershed Educators Institute (WEI), unique to DEQ, was established in 2010 with a three year B-WET grant from the National Oceanic and Atmospheric Administration (NOAA) to train non-formal educators so that they may coordinate with formal educators on MWEE (Meaningful Watershed Educational Experiences) for students. DEQ also received another three year NOAA B-WET grant to continue this objective and build the network between formal and non-formal educators.

During State Fiscal Year 2015, eight workshops were held between October 2014 and June 2015:

- Assessing the Health of a Watershed – Part 1, October 21, 2014
- Assessing the Health of a Watershed – Part 2, November 12, 2014
- Designing and Leading a MWEE for School Groups, January 25 and February 18, 2015 (held two times since it is a required workshop)
- Methods of Teaching Biological Assessment of Stream Health, March 26, 2015
- Introducing Watersheds, April 30, 2015
- Freshwater Wetlands Investigation, May 14, 2015
- Coastal Wetlands Investigation, June 9 and 10, 2015

During State Fiscal Year 2016, the same eight workshops were held between October 2015 and June 2016:

- Assessing the Health of a Watershed – Part 1, October 15, 2015

- Assessing the Health of a Watershed – Part 2, November 10, 2015
- Designing and Leading a MWEE for School Groups, January 20 and February 18, 2016 (held two times since it is a required workshop)
- Introducing Watersheds, March 9, 2016
- Methods of Teaching Biological Assessment of Stream Health, April 12, 2016
- Freshwater Wetlands Investigation, May 20, 2016
- Coastal Wetlands Investigation, June 6 and 7, 2016

A participant who completes five workshops (30 hours of training), including "Designing and Leading a MWEE for School Groups," which is required, is formally recognized as a watershed educator leader in Virginia.

Planned activities for 2017-2018 include, but are not limited to, (1) again offering the same eight workshops, (2) holding the Virginia Association of Science Teachers (VAST) Professional Development Institute, (3) the Virginia Cooperative Extension participants of the WEI plan to present at their Annual Conferences, (4) additional Project WET workshops are to be held during late winter and early spring, (5) a tentative two–day Project WET facilitator training is planned to train volunteer instructors.

See the WEI Webpages for an up to date list of available activities: http://www.deq.virginia.gov/Portals/0/DEQ/ConnectwithDEQ/EnvironmentalInformation/2015-2016WEIBrochure.pdf.

3.1.4 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 Toxic Release Inventory Reports (SARA Title III TRI, March 2016 for the 2014 calendar [activity] year and March 2015 for the 2013 calendar year: http://www.deq.virginia.gov/Programs/Air/AirQualityPlanningEmissions/SARATitleIII/SARA313ToxicsReleaseInventory/) indicate that 436 and 426 Virginia facilities, respectively, filed 1,361 and 1,372 individual reports on the release, transfer, or management of TRI chemicals or chemical categories. The number of reporting facilities increased by 1.67% from 2012 to 2013, followed by an additional 2.35% increase from 2013 to 2014. During the same period the number of individual reports filed decreased by 4.85% (2012-2013) and 0.80% (2013-2014). Total on-site releases to water declined from 11,763,752 pounds in 2012 to 11,164,687 pounds in 2014, a reduction of 5.09%.These reports included a maximum of 153 of more than 650 chemicals and chemical categories for which TRI reporting is required. Statewide, the tallied toxic releases to the water in 2014 totaled approximately 11.16 million pounds or 31.73% of the total onsite releases to all media.

On-site releases to water include discharges to surface waters, such as rivers, lakes, ponds, and streams. On-site releases to the land (~ 3.64 million lbs. or 10.34% of the total on-site releases in 2014) refer to discharges to landfills, surface impoundments, land treatment, application farming, or any other release of a TRI chemical to land within the boundaries of a facility. Some of these discharges may eventually find

their way into the Commonwealth's surface waters as well. Virginia does not permit under-ground injection as a method of hazardous waste disposal; consequently, no under-ground injection of TRI chemicals was reported in 2013 or 2014. In 2014, an additional 20.39 million pounds (57.94%) was released to the air, either from stacks or as fugitive air. A portion of these releases may also return to the Commonwealth's soil and waterways in the form of aerial deposition.

The top ten TRI chemicals released to water in calendar years 2013and 2014 are summarized below in Table 3.1.4-1. The top ten chemicals and chemical categories in each year accounted for approximately 98.2% of the on-site TRI chemical releases to water during the two years.

TRI Chemical or Class	Annual Release to Water 2013		Annual Release to Water 2014		% Change 2013-2014
	Percent	Weight (lbs x 10^6)	Percent	Weight (lbs x 10^6)	
Nitrate compounds	(1) 93.77%	10.98	(1) 97.121%	10.84	-1.28%
Ammonia	(3) 0.884%	0.104	(2) 1.001%	0.110	5.77%
Barium & Ba compounds	(6) 0.320%	0.037	(3) 0.373%	0.042	13.51%
Zinc (fume or dust) and Zn compounds	(7) 0.276%	0.032	(4) 0.364%	0.041	28.13%
Manganese and Mn compounds	(5) 0.393%	0.046	(5) 0.280%	0.031	-32.61%
Cyclohexanol	(2) 3.416%	0.40	(6) 0.231%	0.026	-93.50%
Dimethylamine	(8) 0.191%	0.022	(7) 0.200%	0.022	0.00%
Lead and Pb compounds	(9) 0.650%	0.007	(8) 0.080%	0.009	28.57%
Nitroglycerin	(4) 0.494%	0.058	(9) 0.076%	0.008	-86.21%
Copper and Cu compounds	---	---	(10) 0.056%	0.006	N/A
Methanol	(10) 0.049%	0.006	---	---	N/A
All other chemicals	0.142%	0.170	0.217%	0.024	-85.88%
Totals	100.00%	11.462	100.00%	11.159	-2.64%

Table 3.1.4-1 Top Ten TRI Chemicals Released to Water On-site in 2013 and 2014. The top ten chemicals were essentially the same in both years, with only Methanol (2013) and Copper and Copper compounds (2014) differing in 10th place. The majority (90%) of the chemicals were the same in both years – only the relative magnitudes of their releases changed. Net change from 2013 to 2014 was a reduction of 2.64% in total releases to water.

Additional information on specific groups of chemicals and the quantities of their chemical releases is available in analyses within the original reports (2013 Virginia Toxics Release Inventory Report - March 2015 and 2014 Virginia Toxics Release Inventory Report - March 2016), both of which are available on the DEQ website at: http://www.deq.virginia.gov/Programs/Air/AirQualityPlanningEmissions/SARATitleIII/SARA313ToxicsReleaseInventory.aspx.

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 2015, will be available in March 2017.

3.2 Monitoring of Toxics in Ambient Waters – SFY15 and SFY16

3.2.1 Surface Waters and Sediments

During the assessment process, concentrations of toxic contaminants found in the water column are compared with the corresponding Virginia Water Quality Standards (Appendix A - DEQ Water Quality Standards January 2011), and concentrations of toxic contaminants found in sediment are compared with the screening values found in "Appendix E - Summary of Sediment Screening Values SFY15-16." "Appendix G – WQM Toxics Monitoring Station Group Code List SFY15&16" lists all monitoring stations where water and/or sediment samples were collected for each DCLS toxics parameter group code during SFY15 and SFY16.

Numerous tables and folders containing raw and summarized monitoring results are described in the following sections of this report. The tables contain all the descriptive information (metadata) relative to each monitoring station, the raw data results for each analyte, and descriptive statistical summaries for the results from each major river basin during SFY15 and SFY16. Corresponding folders contain cumulative historical summaries of the results from each year in which a TRISW Report has been produced, by river basin and analyte. A Microsoft Excel® file titled "Introduction to Tables and Folders" is included in each of the two directories containing the Tables and Folders. This introductory file lists the specific analytes contained in each table and folder, and explains the meaning of the Program Codes associated with the samples.

At the present time, all existing water quality criteria and standards for toxic substances in water are defined in terms of dissolved concentrations. In many cases, the defined standards are extremely low concentrations, near or below the detection limits of common analytical instruments and methodologies. In the past, it was often necessary to collect and concentrate large volumes of water samples to produce meaningful results. Sampling of waters with such low concentrations of toxics also presents severe problems in terms of sample contamination. Consequently, careful planning and specific Standard Operating Procedures (SOPs) are necessary to ensure the quality control of collection, preservation, and transport of the sample, as well as subsequent chemical analyses, to guarantee the accuracy and defensibility of the results. A number of newly developed sampling and analytic technologies are now in use for improving the representativeness, accuracy, and precision of measuring dissolved toxics in the water column. For more detailed descriptions of these procedures, refer to the January 2007 TRISW Report, which is still available on CD (request from donald.smith@deq.virginia.gov).

The analysis of toxic substances in ambient samples is 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, 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). Other resources are directed to the Fish Tissue and Sediment Monitoring Program for follow-up monitoring in toxics-related TMDL development and implementation.

3.2.1.1 Dissolved Metals in Surface Waters

DEQ's dissolved clean[1] metals SOP (DEQ-WQA, 1998) is applied in the collection and analysis of 21 dissolved trace metals in freshwater and of 17 metals in brackish and saltwater samples (Vanadium was added in 2010). "Tables 3.2.1.1 - Dissolved Metals in Surface Waters" (SFY15 and SFY16) present the results of clean, dissolved metals monitoring during SFY15 and SFY16. Individual spreadsheets in the Tables summarize the results from the Freshwater Probabilistic Monitoring Program and associated monthly PA[2] sites, the Shenandoah River Basin Mercury Special Study and several TMDLs and other Special Studies. The newly established Groundwater Monitoring Program has also included dissolved metals in its suite of well water analytes (Groundwater webpage: http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/GroundwaterCharacterization/ReportsPublications.aspx). Also, the follow-up special study to the Duke Power coal ash spill into the Dan River continued to collect dissolved metals data during SFY15 and SFY16. Clean metals sampling (both dissolved and total) was suspended in the Estuarine Probabilistic Monitoring (C2) Program in in SFY13, since five years of sampling (275 random estuarine and near-shore oceanic sites) had not revealed a single exceedance of Water Quality Standards. The resources for the C2 clean metals sampling were transferred to the Fish Tissue and Sediment Program, which had been suspended for several years for lack of resources. Basin-by-basin historical summaries of clean dissolved metals results, including SFY15 and SFY16, can be found in the Excel® workbooks of "Folder 3.2.1.1 – Historical Dissolved Metals in Surface Waters."

3.2.1.2 Total Metals in Surface Waters

Because there are no Water Quality Standards for total metals in the water column, the sampling of total metals has not historically been included in ambient water quality monitoring. In recent years, however, sampling for benthic TMDL studies has revealed that the health of benthic communities in freshwater streams is often more highly correlated with the concentrations of total metals in the water column than with dissolved metals. Consequently, more recently total clean metals have been sampled along with dissolved metals at most freshwater probabilistic monitoring stations. During SFY15 and SFY16, DEQ researchers also collected clean total mercury samples from the Shenandoah River basin for the purpose of monitoring the transport of mercury (Hg) 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 James/Chickahominy, Blackwater, Nottoway, Mattaponi, Pamunkey, and Rappahannock Basins, and for several incident response studies and for industrial compliance monitoring. The resultant data from these samples are included in the spreadsheets of "Table 3.2.1.2a - Total Metals in Surface Waters" - SFY15 and SFY16, and in the workbooks of "Folder 3.2.1.2 – Historical Total Metals in Surface Waters."

3.2.1.3 Total Metals in Sediments

"Tables 3.2.1.3a - Total Metals in Freshwater Sediments All Basins" - SFY15 and SFY16, present tabular results and a statistical data summary of the SFY15 and SFY16 WQM sediment metals data. Most total metals in freshwater sediment analyses were associated with TMDL special studies or with the Dan River special study initiated in response to the Duke Energy coal ash spill into the Dan River in North Carolina.

[1] "Clean" refers to a stringent handling protocol designed to minimize the potential for contaminating the sample.
[2] The PA program code refers to monthly ambient sampling at freshwater probabilistic sites that are normally only sampled in the spring and fall.

"Tables 3.2.1.3b – Total Metals in Sediment Estuarine ProbMon" SFY15 and SFY16 include results from 55 sediment metals analyses from 50 sites annually in the Estuarine Probabilistic Monitoring Program. Samples that were collected during July – September 2014 (SFY15) were analyzed by a DEQ-contracted commercial laboratory (RTI Laboratories Inc., Livonia, Michigan). Samples that were collected during July – September 2015 (SFY16) were analyzed by an EPA-contracted commercial laboratory as part of the 2015 National Coastal Condition Assessment Survey. Results have been received for only a portion of those samples (28 of 50 sites). All estuarine probabilistic sediment chemistry results from SFY15 and SFY16 will be utilized in weight-of-evidence assessment of the 50 annual estuarine sites for the 2018 Integrated Water Quality Report to EPA and the U.S. Congress.

Screening Values for the evaluation of metal and organics concentrations in both freshwater and saltwater sediments can be found in "Appendix E - Summary of Sediment Screening Values SFY15-16."

The Excel® workbooks of "Folder 3.2.1.3 - Historic Metals Sediment All Basins," present historical summaries of sediment metals in both non-tidal freshwaters and tidal estuarine waters.

3.2.1.4 Dissolved Pesticides and Other Organic Contaminants

The concentrations of dissolved organic compounds in the water column are generally extremely low, often at or below the detection limits of generally available analytical methods. For this reason, DEQ has suspended most ambient monitoring of dissolved organics using traditional methods. Semi-Permeable Membrane Devices (SPMDs) have been employed in several special studies on the distribution of polychlorinated biphenyls (PCBs) in the past.

To assist in the generation of PCB data for use in the development of TMDLs, DEQ now utilizes EPA's low-detect Method 1668. Historically, PCBs were not detected in ambient river water or effluents using traditional compliance methods (EPA Method 608 and 8082). These methods have elevated detection levels and are selective toward mixed PCB Aroclor analysis. Recently, EPA 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 upper tidal James River and the Elizabeth River watersheds, and some monitoring was continued during SFY15 and SFY16, primarily in the James, Rappahannock and New River basins. Recent results from the James Basin (James River proper and several MS4 dischargers), the Rappahannock Basin (primarily Mountain Run), and from a number of location in the New River studies are presented in " Appendix J1 – Compiled Sediment & Water PCB data 2015-2016" of this report. Fish tissue and sediment results from these studies are summarized in "Appendix J2 – Compiled Fish Tissue & Sediment PCB data 2014-2015."

The results of samples for PAHs, other volatile and semi-volatile organic compounds and chlorinated pesticides in water are summarized in Tables 3.2.1.4a through 3.2.1.4c. Some samples may be represented in more than one table, since PAHs, other semi-volatile organics, and some pesticides are analyzed under the same Parameter Group Codes (SVW, SVBW).

During SFY15 and SFY16 few water samples were analyzed for semi-volatile organics base, neutral and acid compounds in water, primarily for facility inspections (SFY15, four FI) and for incident responses (SFY15, four IR). Among the eight samples and the 43 analytes included in Parameter Group Code SVBW,

only a single detectible concentration was found for Acenaphthene, one for benzo(ghi)perylene, one for chrysene, one for Di-N-butyl phthalate, two for fluoranthene, one for fluorene, one for ideno(1,2,3-cd) Pyrene, one for Phenanthrene, and one for Pyrene. Almost all results were between the method detection limit and the quantitation limit.

Of five IR samples, 26 well samples, five spring samples, and one FI sample, and from among 17 volatile organic analytes reported under the Parameter Group Code VOCW in SFY15, only a single concentration of 1,1-dichloroethane exceeded its quantitation limit (Table 3.2.1.4b), and it was in the case of an incident response.

3.2.1.5 Pesticides and Other Organics in Sediment

3.2.1.5.1 Chlorinated Pesticides in Sediment

"Tables 3.2.1.5.1a OC Pesticides Sediment Fw All Basins," SFY15 and SFY16, indicate that only a single chlorinated pesticide analysis of freshwater was carried out in SFY15 and SFY16, and the results of all 26 analytes were reported as non-detect. "Table 3.2.1.5.1b – OC Pesticides Sediment Estuarine All Basins", SFY15 and SFY16, summarizes the results of estuarine probabilistic sampling during SFY15 and SFY16. These sediment samples were analyzed by a DEQ-contracted commercial laboratory in SFY15, and by an EPA nationally-contracted laboratory in SFY16. Only partial results (28 of 50 sites) from SFY16 are available at this time.

Among 1,100 SFY15 results from 24 pesticide analytes in 55 samples at 50 sites within seven estuarine basins, 1,086 (98.73%) of the results were negative (non-detect). Of the 14 measureable results, four were DDT or derivatives, four were Hexachlorobenzene, two were Lindane and one was Endrin. All others were from QA duplicate samples and were not included in in the preceding summary. All but two of the results came from three sites: (1) Back River, Northwest Branch, (2) Cherrystone Inlet, and (3) James River behind Jamestown Island. None of the pesticides exceeded any of their sediment screening values.

Among 868 results available from 28 SFY16 sites, 862 (99.31%) were negative (non-detect). Of the six measurable results, four were for 4,4'DDT, one was for 4,4'DDE, and one was for 2,4'DDE, from a total of five sites. One site was from the Elizabeth River, Southern Branch and one from the Chickahominy River (both James River Basin), one was from Aquia Creek, one from the Occoquan River, and one from Potomac Creek (all Potomac River Basin). One additional site with 4,4'DDT was Quantico Creek (Potomac Basin) that was not included in the summary because it was a targeted repeat sample at a site known to be contaminated. Again, none of the results exceeded any sediment screening values.

As can be seen from the Tables and the associated "Folder 3.2.1.5.1 - Historical OC Pesticides Sediment," chlorinated pesticide contamination is very limited in estuarine waters. It should be pointed out here, that the sediment sampling protocol used for estuarine probabilistic monitoring specifies that sediment should only be collected from the top two centimeters of the substrate. Many persistent legacy pesticides may be buried under freshly deposited sediment and would not be included in samples collected under this protocol.

3.2.1.5.2 Phosphorylated Pesticides in Sediment

No analyses of phosphorylated pesticides in sediment were carried out during SFY15 or SFY16. Tables 3.2.1.5.2 (Group 1 & Group 2), SFY15 and SFY16, are included in this Report only as placeholders. The historical phosphorylated pesticides in sediment results are maintained in "Folder 3.2.1.5.2 – Historical OP Pesticides Sediment."

3.2.1.5.3 Herbicides in Freshwater Sediment

A single sediment herbicide sample from the Rappahannock River basin was collected and analyzed during SFY15. It was collected from Sumerduck Run for a TMDL study and the result was negative. The results are listed in "Table 3.2.1.5.3 Herbicides Sediment All Basins - SFY15," "Folder_3.2.1.5.3 – Historical Herbicides Sediment" contains the historical record of sediment herbicide results.

3.2.1.5.4 Polycyclic Aromatic Hydrocarbons (PAHs) in Sediment

"Tables 3.2.1.5.4a - PAHs Freshwater Sediment Grp1&Grp2 All Basins," SFY15 and SFY16, indicate that no PAH sampling or analyses of freshwater sediments were carried out during SFY15 and SFY16. "Tables 3.2.1.5.4b – PAHs & Semi-Volatiles Sediment Estuarine All Basins," SFY15 and SFY16, summarize the PAH results from estuarine probabilistic monitoring during SFY15 and SFY16, which are also included in "Folder 3.2.1.5.4 – Historical PAHs Sediment All Basins." Note that tables (Tables 3.2.1.5.4b – PAHs & Semi-Volatiles Sediment Estuarine All Basins) have also been included in this Report for State Fiscal Years 2007 through 2012. These results were maintained on Excel® spreadsheets rather than in the DEQ CEDS database, and were not readily available for normal data queries. They have been included here to bring the historical records in "Folder 3.2.1.5.4 – Historical PAHs Sediment All Basins" up to date.

3.2.1.5.5.1 Semi-volatile Organics in Freshwater Sediment

"Tables 3.2.1.5.5.1 - Semi-Volatiles Sediment All Basins", SFY15 and SFY16, show that a single sediment semi-volatile organics analysis was performed on a freshwater sediment sample in SFY15. It was part of the same TMDL study (Sumerduck Run) mentioned in Section 3.2.1.5.3 - Herbicides in Freshwater Sediment. The results were negative (non-detect). Two semi-volatiles, biphenyl and dibenzothiophene (synfuel) were analyzed in sediments collected by the Estuarine Probabilistic Monitoring Program. Their results are included in separate tabs of "Tables 3.2.1.5.4b - PAHs & Semi-Volatiles Sediment Estuarine All Basins," SFY15 and SFY16.

3.2.1.5.5.2 Volatile Organics in Freshwater

Dissolved volatile organics were sampled and analyzed at a number of sites by the Groundwater Characterization Monitoring Program during SFY15 and SFY16. The results are summarized in "Tables 3.2.1.5.5.2 – Volatiles Water All Basins," SFY15 and SFY16."

In SFY15 soluble volatile organics samples were collected under two parameter group codes - SVBW and VOCW - from four Facilities Inspection (FI) sites, six Incident Response (IR) sites, and a number of Groundwater Characterization Monitoring (springs and wells) sites. All results were negative (non-detect) except for a single low value for 1,1-dichloroethane leaving a pipe (IR) into an unnamed tributary to Cattail Creek behind Woodson High School in Hopewell.

In SFY16 all results were below method detection limits except for tolune, which was present in low concentrations in four samples from three sites - Diascund Research Station Well SOW 177A, Greenmont Production Well SOW 195 (two samples), and the Log Flume Observation Well – all in the lower James Basin.

3.2.1.5.6 Polychlorinated Biphenyls (PCBs) in Sediment

No ambient freshwater sediment samples were collected or analyzed for PCBs during SFY15 or SFY16. "Tables 3.2.1.5.6a - PCBs Sediment Freshwater All Basins," SFY15 and SFY16 are included in this Report as a placeholder. Sediment PCBs sampled and analyzed in the TMDL Program are summarized in "Appendix J2 – Compiled Fish Tissue & Sediment PCB Data 2014-2015." Fish tissue and sediment results from samples collected during calendar year 2016 (second half of SFY16 and first half of SFY17) will be received in 2017 and will be included in the 2019 Toxics Report.

"Tables 3.2.1.5.6b - PCBs Sediment Estuarine All Basins," SFY15 and SFY16 summarize the results of the analyses of 21 PCB congeners in sediment from 50 estuarine probabilistic sites (plus five QA duplicates) sampled during the summers (July – September) of 2014 and 2015.

In 2014 (SFY15), two samples from a total of 50 sites contained measurable PCBs; 96.00% were non-detect. One was in Lower Machodoc Creek, a Potomac River tributary, and the other was in Cherrystone Inlet, on the Chesapeake eastern shore.

In 2015 (SFY16), five samples from a total of 50 sites contained measureable PCBs; 90.00% were non-detect. Of the five positive samples, two were in Potomac River embayments, one was in the James River Basin (Elizabeth River, Southern Branch), and two were in Chesapeake Bay and a minor western shore tributary to the Bay.

3.2.2 Fish Tissue Contamination

DEQ's Fish Tissue and Sediment Monitoring Program was revived in the summer of 2012 after having been suspended since 2009 because of limited resources. Additional information about the objectives and activities of this program is available at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/FishTissueMonitoring.aspx.

In calendar year 2014 (portions of SFY14 and SFY15), fish tissue collections focused primarily on the New River Basin (New River, Bluestone River, Wolf and Walker Creeks), the Middle James River, the Dan River (Roanoke River Basin), and Potomac River tidal embayments (Occoquan River Bay, Dogue Creek Bay, and Pohick Creek Bay). Fish sampling sites and the species included from each are summarized in the "2014 fish tissue sites" tab of "Appendix F1 – Fish Tissue Sampling Sites SFY15-16." Fish tissue and sediment samples from this program were only analyzed for total Polychlorinated Biphenyls (PCBs) in 2014. The results are listed in the "2014 Fish PCBs" and "2014 Sediment PCBs" tabs of "Appendix J2 – Compiled Fish Tissue & Sediment PCB data 2014-2015."

In calendar year 2015 (portions of SFY15 and SFY16), fish tissue collections focused primarily on the Potomac River Basin (numerous freshwater and tidal tributaries, plus the Occoquan Reservoir) and the Dan River. Fish sampling sites and the species included from each are summarized in the "2015 fish tissue sites" tab of "Appendix F1 – Fish Tissue Sampling Sites SFY15-16." Fish tissue and sediment samples from this program were only analyzed for total Polychlorinated Biphenyls (PCBs) in 2015. The results are listed in the "2015 Fish PCBs" and "2015 Sediment PCBs" tabs of "Appendix J2 – Compiled Fish Tissue & Sediment PCB data 2014-2015."

During calendar year 2016 (portions of SFY16 and SFY17) fish tissue collections focused primarily on the James River Basin (lower tidal James and the Elizabeth River) and the Rappahannock River. Additional

collections were gathered from the Dan River as part of the Dan River Coal Ash Spill response and from Potomac embayments in response to a Department of Game and Inland Fisheries (DGIF) request related to the distribution of the introduced Northern Snakehead fish. Fish sampling sites are summarized in the "2016 fish tissue sites" tab of "Appendix F1 – Fish Tissue Sampling Sites SFY15-16." No analytical results are yet available from the 2016 sampling program.

Prospective sites for Fish Tissue and Sediment monitoring in 2017 have not yet been identified. Regional TMDL Coordinators are to identify and recommend river segments for follow-up monitoring by the end of the 2016 calendar year.

Supplemental fish and sediment sampling related to the Dan River Coal Ash Spill was carried out separately from the normal sampling of this program. Fish samples were collected by the Fish Tissue and Sediment Monitoring Program and sediment samples were collected by field personnel of DEQ's normal Ambient Water Quality Monitoring Program. Samples related to the coal ash spill were only analyzed for metals. Sediment metals were analyzed by the state lab (DCLS, DGS), and the results for Dan River sediment metals are listed among those in "Tables 3.2.1.3a – Total Metals in Freshwater Sediment All Basins," SFY15 and SFY16. Fish tissue metals results from the Dan River fly ash study are summarized in "Appendix J3 - Fish Tissue Metals - Dan River Coal Ash Spill SFY15 & FSY16." These results have been shared among all stake holders participating in the study, but have not yet been posted to the DEQ website related to the study at:
http://www.deq.virginia.gov/connectwithdeq/environmentalinformation/danrivercoalashspill.aspx.

3.2.3 Benthic Monitoring

Benthic Community Evaluation: Field sampling and evaluation of both freshwater and estuarine benthic communities has proven to be an invaluable tool in the assessment of water and sediment quality. Significantly stressed benthic communities may indicate the impact of toxics in the environment, but follow-up evaluation is required to confirm the cause of the observed benthic impairment.

3.2.3.1 Freshwater Benthic Monitoring

DEQ uses the Virginia Stream Condition Index (VSCI) for biological assessment of mountain and piedmont streams, and the Virginia Coastal Plain Macroinvertebrate Index (VCPMI) for coastal plain streams. Assessment rankings, based on a single VSCI or VCPMI bioassessment, are the result of the data evaluation and reduction of numerous measurements and observations conducted during the biomonitoring survey. Bioassessment measures the response of the biological community to all perturbations it has experienced. A single properly conducted VSCI or VCPMI bioassessment is not a "single data-point" analogous to a single dissolved oxygen (DO) measurement or bacteria sample. Non-coastal streams with VSCI scores ≥ 60 or coastal plain streams with VCPMI scores ≥40 will be assessed as "fully supporting for aquatic life use." VSCI scores < 60 and VCPMI scores < 40 will result in streams being listed as "stressed" or "impaired."

Virginia Coastal Plain Macroinvertebrate Index: In the late 1990s, EPA coordinated a six-state monitoring effort to develop a multimetric macro-invertebrate index that included Virginia's coastal plain. That index contained five metrics that when calculated into one number was known as the Coastal Plain Macroinvertebrate Index (CPMI). The index was adopted by DEQ in the early 2000's to make aquatic life use impairment determinations in the coastal plain of Virginia. Virginia biologists more recently recommended validation of the index and initiated a special study to do so.

Over the past decade DEQ compiled a new database of coastal plain macroinvertebrate data, which includes significantly more Virginia reference samples than the original CPMI study. Virginia has created the new Virginia Coastal Plain Macroinvertebrate Index (VCPMI) using a spatially diverse (in terms of ecoregion and stream size) dataset free of pseudoreplication. The VCPMI replaces metrics that did not work well in Virginia's coastal plain and has correctly calibrated each metric's best standard values. The VCPMI study has confirmed that the VCPMI works well to discriminate between sites with acceptable water quality and habitat versus sites with degraded water quality and habitat. The impairment threshold score of 40 was determined from statistical analyses conducted during the VCPMI study. The VCPMI study and the aquatic life use assessment guidance using the VCPMI have been reviewed and approved by EPA. The VCPMI technical report, "The Virginia Coastal Plain Macroinvertebrate Index," can be found at: http://www.deq.virginia.gov/Portals/0/DEQ/Water/WaterQualityMonitoring/ProbabilisticMonitoring/vcpmi.pdf.

"Appendix H1 – Freshwater Biological Stations SFY15 and FSY16" of this report lists the freshwater biological monitoring stations visited during the calendar years 2014 through 2016 (portions of SFY14, SFY15, and SFY16). Some sites visited during the spring of 2016 may not yet have been recorded in the Ecological Data Application System (EDAS) database used for freshwater biological data. Between spring of 2014 and spring of 2016 regional biologists collected a total of at least 1,358 samples at 651 biological monitoring sites; 579 sites in the Piedmont and Appalachian Zones were subsequently evaluated using the Virginia Stream Condition Index (VSCI). Of those 1,212 visits, approximately 16.83% resulted in evaluations of severe stress, possibly related to toxics. An additional 146 samples were collected at 72 sites for evaluation using the Virginia Coastal Plain Macroinvertebrate Index (VCPMI). Approximately 35 (23.97%) of those scores also indicated severe stress. The list in Appendix H1 includes a number of the freshwater probabilistic sites that are also described in Appendix H2.

"Appendix H2 - Freshwater Probabilistic Monitoring Sites SFY14 and SFY15" provides a comprehensive list from CEDS of the freshwater probabilistic monitoring stations that were included in the ambient program during state fiscal years 2015 and 2016. Many of these (the wadeable sites) were also sampled for benthic invertebrate populations and are also included in Appendix H1. Some spring visits in calendar year 2016 may not yet have been entered into the EDAS Biological Monitoring database. The Appendix H2 list summarizes 217 site visits to 155 freshwater probabilistic stations, including spring visits to calendar year 2016 sites, as well as a few (N = 5) follow-up visits for other purposes (*e.g.*, TMDL or other special study projects). These sites were sampled in the spring and fall as normal Freshwater Probabilistic sites (Program "Spg Code" = FP). In many cases (N = 98), only one visit is included in the appendix, because the spring and fall visits occur in different State Fiscal Years. An additional 146 freshwater probabilistic sites were being sampled monthly (a total of 1104 site visits) under the Program "Spg Code" = PA - Monthly Monitoring for physical and chemical parameters. In most cases, the locations of PA sites are not identical to those of the FP sites from which they originated. Because FP sites are chosen in a completely random fashion, access is often difficult and time consuming. PA sites, which are sampled monthly, are consequently established at the nearest (or safest) upstream or downstream bridge to facilitate the monthly ambient sampling.

3.2.3.2 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 (SQT). 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, the CBP's B-IBI plus Diagnostic Tool in tidal Chesapeake Bay waters, the Middle Atlantic Region 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. This methodology is described in detail in the current Assessment Guidance Manual for the 2014 Integrated Report (http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments.aspx).

Weight-of-evidence assessments for sites sampled during 2014 (SFY15) were included in the 2016 Integrated Report (IR). Weight-of-evidence assessments for sites sampled during the summer of 2015 (SFY16) and 2016 (SFY17) will be included in the 2018 Integrated Report (IR). The 2016 IR included a chapter discussing the results of the Estuarine Probabilistic Monitoring Program (ProbMon) during the corresponding six-year assessment window. CHAPTER 4.5 - RESULTS OF ESTUARINE PROBABILISTIC MONITORING 2009-2014 (49 pages) describes the statistical and geographic distributions of various measures of chemical contamination of sediments (metals, selected PAHs, PCBs, and pesticides), the acute toxicity of sediments to marine amphipods, and the health of benthic communities at 273 ProbMon sites sampled during the summers of 2009 – 2014. Table 3.2.3.2, below, summarized the chemical contaminants evaluated by the weight-of-evidence assessments of estuarine probabilistic sites.

Polynuclear Aromatic Hydrocarbons (PAHs)

1-methylnaphthalene
1-methylphenanthrene
2,3,5-trimethylnaphthalene
2,6-dimethylnaphthalene
2-methylnaphthalene
Acenaphthene
Acenaphthylene
Anthracene
Benz(a)anthracene
Benzo(b)fluoranthene
Benzo(a)pyrene
Benzo(e)pyrene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenz(a,h)anthracene
Dibenzothiophene
Fluoranthene
Fluorene
Ideno(1,2,3-c,d)pyrene
Naphthalene
Perylene
Phenanthrene
Pyrene

Semi-volatiles

Biphenyl
Dibenzothiophene

DDT and its metabolites

2,4'-DDD
4,4'-DDD
2,4'-DDE
4,4'-DDE
2,4'-DDT
4,4'-DDT

Organochlorine Pesticides other than DDT

Aldrin
Alpha-BHC
Beta BHC
Delta-BHC
Gamma-BHC (Lindane)
Alpha-Chlordane
Gamma-Chlordane
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin Aldehyde
Endrin Ketone
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Mirex
Oxychlordane
Toxaphene
Cis-Nonachlor
Trans-Nonachlor

21 PCB Congeners:

PCB No.	Compound Name
8	2,4'-dichlorobiphenyl
18	2,2',5-trichlorobiphenyl
28	2,4,4'-trichlorobiphenyl
44	2,2',3,5'-tetrachlorobiphenyl
52	2,2',5,5'-tetrachlorobiphenyl
66	2,3',4,4'-tetrachlorobiphenyl
77	3,3',4,4'-tetrachlorobiphenyl
101	2,2',4,5,5'-pentachlorobiphenyl
105	2,3,3',4,4'-pentachlorobiphenyl
110	2,3,3',4',6-pentachlorobiphenyl
118	2,3,4,4',5-pentachlorobiphenyl
126	3,3,4,4',5-pentachlorobiphenyl
128	2,2',3,3',4,4'-hexachlorobiphenyl
138	2,2',3,4,4',5'-hexachlorobiphenyl
153	2,2',4,4',5,5'-hexachlorobiphenyl
170	2,2',3,3',4,4',5-heptachlorobiphenyl
180	2,2',3,4,4',5,5'-heptachlorobiphenyl
187	2,2',3,4',5,5',6-heptachlorobiphenyl
195	2,2',3,3',4,4',5,6-octachlorobiphenyl
206	2,2',3,3',4,4',5,5',6-nonachlorobiphenyl
209	2,2'3,3',4,4',5,5',6,6'-decachlorobiphenyl

Trace Metals

Aluminum
Antimony
Arsenic
Cadmium
Chromium
Copper
Iron
Lead
Manganese
Mercury
Nickel
Selenium
Silver
Tin
Vanadium
Zinc

Other Measurements

Total organic carbon (sediments)

Table 3.2.3.2 - Chemical sediment contaminants analyzed by the Estuarine Probabilistic Monitoring Program

3.2.4 Special Studies Related to Toxics

3.2.4.1 Regional Special Studies Involving Toxics

Special studies are often initiated independently at the 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 SFY15 and SFY16 are summarized within "Appendix I Special Studies Related to Toxics SFY15 & SFY16." Briefly summarized, they consist of:

Central Office Water Quality Sampling in the Upper Clinch River watershed of Southwest Virginia in support of the Clinch-Powell Clean Rivers Initiative (CPCRI) by

	The Nature Conservancy (see below). Phase 2 of this study has now been initiated, and its QAPP is provided in the form of "Appendix I3 – Quality Assurance Project Plan Clinch River – Final" of this Report.
Northern RO	Mountain Run PCB TMDL Study Jeffries Branch Benthic TMDL (dissolved metals sampling) Sumerduck Run Benthic TMDL (dissolved metals sampling) Quantico Creek (sediment sampling, clean metals water column) Accotink Creek (chlorides)
Piedmont RO	James River PCB Study Low level dissolved PCB sampling at various MS4 outfalls Monthly sampling runs for total mercury in the Chickahominy, Mattaponi, Pamunkey, Rappahannock, Nottoway, Blackwater, and Meherrin River watersheds in preparation for future Hg TMDLs for fish tissue consumption advisories
Blue Ridge RO **- Lynchburg** **- Roanoke**	Dan River coal ash spill (Duke Power in North Carolina) Roanoke River PCB TMDL New River PCB TMDL Dan River coal ash spill (Duke Power in North Carolina)
Southwest RO	Bluestone River PCB TMDL Levisa Fork PCB TMDL New River PCB TMDL
Tidewater RO	Low Level PCB Study in Elizabeth and Lower James Rivers
Valley RO	Continuing South River Mercury Studies Continued coordination with the South River Science Team Continued participation in the Natural Resources Damage Assessment (NRDA) for South River and South Fork Shenandoah DuPont (Corrective Action Permit No. VAD003114832) to conduct investigations and determine if corrective measures are required for the Waynesboro Site (DEQ reviewing plans)

During the summer of 2012, DEQ (Central Office and Southwest RO) began quarterly water quality monitoring (including trace metal sampling) in support of additional research work conducted in the Clinch River. The Nature Conservancy, EPA, the Tennessee Department of Environment & Conservation, the U.S. Geological Survey - Virginia Water Science Center and Tennessee Water Science Center are all participating in the project. Over the past three decades, freshwater mussel populations declined in the reach of the Clinch River from western Russell County to southern Scott County in Virginia. During the same time span, mussel populations in the Tennessee portion of the Clinch River thrived and maintained species richness. No consensus understanding of this biological response pattern exists among biologists or regulatory agencies. Therefore, a group of scientists associated with the Clinch-Powell Clean Rivers Initiative (CPCRI) began a coordinated research project to investigate the issue. The research project includes biological, chemical, and land use analytical components conducted concurrently to determine

most likely stressors related to mussel declines. The water quality sampling and analyses being carried out by DEQ are critical to the success of the overall research effort.

A final report/white paper, summarizing the results of the first (two-year) phase of the study and outlining recommended activities and resource requirements for its continuation was submitted in August 2014. It is included as Appendix I.2 – "Water Monitoring Strategies to Inform Imperiled Species Conservation and Management in the Clinch River, Virginia and Tennessee" of this Toxics Report. Phase 2 of this study has now been initiated, and a copy of its Quality Assurance Project Plan is provided in the form of "Appendix I3 – Quality Assurance Project Plan Clinch River – Final" of this Report.

Interim or final reports from various toxics-related studies are also available on the DEQ website - "Water Reports" page (http://www.deq.virginia.gov/Programs/Water/ReportsPublications.aspx) and "TMDLs in Virginia" page (http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL.aspx).

3.2.4.2 The Dan River Coal Ash Spill

"On February 2, 2014, about 39,000 tons of coal ash and 27 million gallons of ash storage pond water were released into the Dan River from the Duke Energy facility in Eden, NC. Coal ash is the residue generated from burning coal, and is generally stored at power plants or placed in landfills. Coal ash has a large variety of ingredients – mostly silicon oxide, iron oxide and aluminum oxide, with trace amounts of arsenic, selenium, mercury, boron, thallium, cadmium, chlorides, bromine, magnesium, chromium, copper, nickel, and other metals.

"Emergency response and environmental monitoring was conducted over the next 10-12 months by EPA, DEQ, U.S. Fish and Wildlife Service (USFWS), North Carolina Department of Environment and Natural Resources (NCDENR, now reorganized and called the North Carolina Department of Environmental Quality) and Duke Energy. …" [3]

In the November 2016 update of the "Impaired Waters Cleanup Plan" by the Office of the Secretary of Natural Resources, a draft summary of the Dan River coal ash spill and the Commonwealth of Virginia's response, plus excerpts related to the state's coal ash impoundments were provided. Copies of these documents are included here as Appendix I4 - "Dan River Coal Ash Spill and State Response" and Appendix I5 - "Excerpts from SNR's Chesapeake Bay and Virginia Waters Clean-Up Plan Report."

In summary, in addition to the ambient water quality, sediment, and fish tissue monitoring already carried out and reported upon in this and the previous Toxics Report, the Commonwealth intends to continue monitoring the Dan River situation, at least on a short-term basis, for delayed responses to the spill.

Additional Coal Ash considerations: In April 2015, EPA announced final coal ash regulations, which established national minimum criteria for the disposal of coal ash in landfills and ponds. The Waste Management Board adopted the regulations for Virginia in December 2015. Consequently, DEQ has been reviewing coal ash impoundment operations at 13 coal ash impoundments at eight facilities along state waterways. Discharge permits for the removal of water from coal ash ponds have been issued to Dominion Virginia Power for Possum Point (Quantico Creek, Potomac tributary) and for Bremo Bluff and

[3] Taken from the November 2016 update of the "Impaired Waters Cleanup Plan" by the Office of the Secretary of Natural Resources - a draft summary of the Dan River coal ash spill and the Commonwealth of Virginia's response.

Chesterfield - Dutch Gap - facilities (middle and lower James River), and to the Appalachian Power Company for its Clinch River plant.

All of the permitting and weekly sampling results related to the dewatering of coal ash ponds are posted on DEQ's website at: http://www.deq.virginia.gov/Programs/Water/PermittingCompliance/VPDESPermitActions.aspx. Click on Compliance Reports for a characterization of the discharges.

3.2.5 Other Program Specific Studies

3.2.5.1 The Chesapeake Bay Program

3.2.5.1.1 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. The primary goal of the 1994 strategy was to have a:

> *"Bay free of toxics by reducing and eliminating the input of chemical contaminants from all controllable sources to levels that result in no toxic or bioaccumulative impact on living resources that inhabit the Bay or on human health."* [4]

3.2.5.1.2 Toxics 2000 Strategy

Building upon progress achieved through the implementation of the 1994 Strategy, the Chesapeake Bay Program Executive Council adopted a revised strategy in December 2000 known as the "Toxics 2000 Strategy."[5] With the retention of the 1994 goal, new objectives and commitments were developed and incorporated into the document. An important strategy objective was to strive for zero release of chemical contaminants from point and non-point sources through pollution prevention and other voluntary means. For those areas with known chemical contaminant problems and referenced as Regions of Concern, such as the Elizabeth River in southeastern Virginia, the strategy included commitments leading to restoration. Finally, the strategy included commitments that would provide the means to measure progress toward meeting the overall strategy goal. One approach consisted of periodic toxics characterizations, accomplished in 1999 and again in 2008, in which information derived from biological and chemical monitoring were synthesized within the context of toxicological impacts. Those characterizations focused primarily on the Chesapeake Bay mainstem and major tidal tributaries. An additional characterization reached its conclusion in December of 2012. 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 (see below).

[4] "Chesapeake Bay Basinwide Toxics Reduction And Prevention Strategy" - www.chesapeakebay.net/content/publications/cbp_12368.pdf

[5] "Chesapeake 2000" - http://www.chesapeakebay.net/content/publications/cbp_12081.pdf

3.2.5.1.3 Current Toxics-Related Activities

A general organizational restructuring of the Chesapeake Bay Program was carried out in 2008 and activities of the former Toxics Subcommittee were temporarily suspended. The new structure does not expressly include a Toxics Subcommittee, but it does include a "team" with the objective to "Protect and Restore Water Quality." The current partial shift in alignment of CBP monitoring efforts from tidal to non-tidal watershed sources (both point and non-point) of nutrient and sediment input, and emphasis on the Bay-wide TMDL development for these stressors, temporarily resulted in less emphasis on toxics in tidal waters.

In October 2011 the EPA Interstate Chesapeake Bay Program Office (CBPO), Department of the Interior (DOI - USGS, FWS), National Oceanic and Atmospheric Administration (NOAA), and the U.S. Department of Agriculture (USDA), along with various other state and academic stakeholders, held a workshop to initiate compliance with Executive Order 13508 – Chesapeake Bay Protection and Restoration (May 2009). The Chesapeake Bay Workgroup for Toxic Contaminants issued a report in December of 2012, summarizing the extent and seriousness of toxic contaminants in the Bay and its watershed (both estuarine and non-tidal waters): http://executiveorder.chesapeakebay.net/ChesBayToxics_finaldraft_11513b.pdf.

On November 5, 2014 a newly established Chesapeake Bay Program "Toxic Contaminants Workgroup" met to begin addressing the "Toxic Contaminants Outcomes and Management Strategy." A summary of the November 5 meeting was distributed among interested parties. It was established at the meeting that the Policy and Prevention group will be meeting biweekly via conference call, the Research group will be meeting on an ad hoc basis, and the full workgroup will be meeting monthly in person.

The Chesapeake Bay Program's Toxic Contaminants Workgroup (http://www.chesapeakebay.net/groups/group/toxic_contaminants_workgroup) 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 2016-2017 Work Plans for both endeavors.

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.

3.2.5.2 The Virginia Estuarine Probabilistic Monitoring Program

Each summer during July, August, and September the DEQ Estuarine Probabilistic Monitoring Program collects sediment samples from 50 randomly selected estuarine sites within the Commonwealth. Thirty-five (70%) of those samples are collected within the Chesapeake Bay watershed, and the remaining 15 (30%) are collected from coastal Delmarva and the Back Bay/North Landing River region. Sediment subsamples are chemically analyzed for 15 trace metals, 24 polycyclic aromatic hydrocarbons (PAHs), 21 congeners of polychlorinated biphenyls (PCBs), and 28 pesticides and pesticide derivatives. The chemistry results from the SFY15 and SFY16 sampling (July – September 2014 and 2015) are included in the tables of this report. Analytical results from samples collected during the summer of 2016 will be included in the next TRISW Report. Additional sediment subsamples are evaluated for toxicity with ten-day, static, acute toxicity tests

using the marine amphipod *Leptocheirus plumulosus*. Sediment subsamples from tidal freshwater sites are also subjected to a second test employing the freshwater amphipod *Hyalella azteca*. The toxicity test results from these samples are not included here, but are employed in the weight-of-evidence assessments described elsewhere in this Report.

3.2.5.3 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.

While DEQ continues to monitor for conventional pollutants and nutrients, most studies specifically involving toxics and their effects in the Elizabeth River system have been concluded. Because of reduced regional office staff and lack of Elizabeth River funding, toxics-related activities during 2014 through 2016 were restricted to a few stormwater discharge samples related to PCB studies and TMDL model development.

The Elizabeth River and its tributaries have VDH fish consumption advisories for PCBs. Ambient water samples for PCB analyses were collected under both "dry" and "wet" weather conditions from locations throughout the watershed during 2010-2011. More recent results are included in " Appendix J1 – Compiled Sediment & Water PCB data 2015-2016" of this Report and will be used to support model calibration for a PCB TMDL within the watershed. Completion of this TMDL is now scheduled for 2017.

Additional information on the Elizabeth River Project is available at: http://www.elizabethriver.org/.

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 Integrated Report assessment and listing cycle. The synchronization scheme is described in detail in the 2007 and 2013 revisions of DEQ's Water Quality Monitoring Strategy: (http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/DEQsWaterQualityMonitoringStrategy.aspx).

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. Beginning in calendar year 2014 DEQ added monthly monitoring of physical, chemical, and bacterial water column parameters at selected freshwater probabilistic sites that are normally only sampled in the spring and fall. The selection of probabilistic sites for this program (Project Code PA) changes annually.

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. Significant reductions in the resources available for monitoring during the past six years have required a number of alterations to the WQ Monitoring Strategy. Descriptions of program modifications first introduced in the 2013 Monitoring Plan were included in the 2013 revision of DEQ's WQMA Monitoring Strategy.

Once finalized, the 2017 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 The 305(b)/303(d) Water Quality Integrated Assessment Report

The most recently approved Water Quality Integrated Assessment Report (IR) was submitted to EPA in the spring of 2016. The assessment window for that IR extended from January 1, 2007 – December 31, 2012. The approval of the report was delayed because of a protracted discussion between DEQ and EPA over how to best address public complaints regarding excessive algae in the Shenandoah River. The list of impaired segments for delisting submitted to EPA in that Report included several segments that had previously been 303(d)-listed for toxics-related impairments. The complete list of toxics-related delistings from the 2014 IR is contained in "Appendix K.2 – Delisted Toxics-Impaired Segments – 2014 IR."

The release of the draft 2016 IR is being planned for the summer 2017. An updated list of toxics-related listings and delistings will become available upon the submission (and tentative approval) of the 2016 IR at that time and will be included in the next TRISW.

The 2012 IR and the 2014 IR and interactive maps are still available on the DEQ website at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments.aspx. Any more recent changes in assessment methodologies for toxics, such as revised or new water quality standards, are described in the 2016 Assessment Guidance Manual.

4.1.1 The 305(b) Water Quality Assessment

The 2014 IR assessment identified a total of 15,677 miles of impaired rivers (16% of all assessed river miles; EPA Assessment Categories 4 - 7% and 5 - 9%), 94,764 acres of lakes (81% of all assessed significant lakes; EPA Categories 4 – 13% and 5 – 68%), and 2,136 square miles of impaired estuaries (75% of all assessed estuaries; EPA Categories 4 – 3% and 5 – 73%). In 2012, DEQ added 528 stream miles, 361 lake acres and 4 square miles of estuaries to the impaired waters list. Rather than reflecting worsening conditions, the increase in the number of water bodies is due primarily to the monitoring of waters that had not previously been assessed. It should also be noted that DEQ removed 283 stream miles and 291 lake acres from the Impaired Waters List due to improvements in water quality. The extent of current impairments caused by specifically identified toxics are summarized in Text Table 4.1.1 below. The total river miles, lake acres and estuarine square miles of toxics impairments summed at the foot of the table are not directly comparable to the totals cited above, because many of the impaired segments summarized in the table may be included under 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 the table, the vast majority were the result of fish consumption advisories. Fish consumption advisories were primarily 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.

4.1.1.1 The 303(d) Impaired Waters List

The impaired waters list from the 2014 Integrated Report included a total of 6,824 impaired waterbody segments. Of these, 1,271 segments (19%) are directly related to contamination by toxic substances ("Appendix K.1 – Segments Potentially Impaired by Toxics – 2014 303d Report"). The percentages of toxics-impaired stream miles, lake acres, and estuarine square miles represented by each category of toxic contaminant are summarized in Text Table 4.1.1 below. Bioassessment of benthic communities accounted for another 732 impaired segments (11%), but impaired benthic communities are more often the result of excessive sedimentation, eutrophication, hydrological modification, or other forms of habitat disturbance than a result of contamination.

Of the 1,515 (15.8%) impairments associated with specifically identified contaminants, the vast majority (1,456 segments or 96.1%) were for fish consumption. Fish consumption advisories were posted based on fish tissue screening values being exceeded by PCBs (1,087 segments), metals (mercury - 323 segments), pesticides (18 segments), dioxins (20 segments), and PAHs (8 segments).

Aquatic Resource Class ►	Rivers and Streams		Lakes & Reservoirs		Estuaries	
Categories of Toxic Contaminants	Percentage of Toxics-impaired River Miles	River Mies Impaired by Each Category	Percentage of Toxics-impaired Acres	Acres Impaired by Each Category	Percentage of Toxics-impaired Square Miles	Square Mies Impaired by Each Category
PCBs in Fish Tissues	25.99%	1,139.63	55.79%	74,697.17	98.32%	2,336.65
Mercury in Fish Tissues	63.05%	2,764.84	42.04%	56,284.28	0.85%	20.23
PCBs in Water Column	4.94%	216.55	0.92%	1,233.83	0.36%	8.59
Copper	0.41%	17.83	0.86%	1,151.24	0.00%	0.00
PAHs in Fish Tissues	0.52%	22.59	0.21%	274.86	0.03%	0.69
Mirex	3.67%	160.76	0.00%	0.00	0.00%	0.00
DDT & Derivatives	0.28%	12.06	0.10%	128.07	0.00%	0.00
Zinc	0.35%	15.25	0.04%	55.74	0.00%	0.00
Cadmium	0.25%	11.04	0.04%	55.74	0.00%	0.00
Chlorides	0.11%	4.92	0.00%	0.00	0.43%	10.27
Aldrin	0.15%	6.47	0.00%	0.00	0.00%	0.00
Chlordane	0.14%	6.14	0.00%	0.00	0.002%	0.05
Heptachlor Epoxide	0.11%	4.81	0.00%	0.00	0.00%	0.00
Dioxins	0.00%	0.00	0.002%	3.15	0.00%	0.00
Ammonia	0.05%	2.34	0.00%	0.00	0.00%	0.00
Totals		4,385.23		133,884.08		2,376.48

Text Table 4.1.1 Comparative amounts of each aquatic resource class impaired by a specific category of toxic contaminant, and its percentage among all segments impaired by toxics. The number of river mile, lacustrine acres, and square miles of estuary should not be compared with values elsewhere because many segments are double counted if they are contaminated with more than one toxic or are impaired for more than one use. (Extracted directly from Appendix K.1 – Segments Potentially Impaired by Toxics - 2014 303(d) Report.)

Future TMDLs will be developed to address the current listings, but because the size and number of segments united into each TMDL vary with the hydrography and the extent of the impairment, the exact number of TMDLs to be developed and implemented, and the schedule for doing so are not yet certain. DEQ's PCB Strategy (2005) establishes priorities for TMDL development and identifies various options for remediation. Any new PCB-impaired segments identified in the 2014 Integrated Report will be integrated into the strategy.

4.1.1.2 Delisted, previously impaired segments

Two segments with toxics-related impairments (fish consumption and aquatic/wildlife) were approved for delisting in the 2014 IR ("Appendix K.2 – Delisted Toxics Impaired Segments – 2014 IR"). One segment is in the New River (2.3 stream miles), which had been previously listed for mercury in fish. The other segment is in an unnamed tributary of Seacorrie Swamp (1.5 stream miles), which had been previously listed for ammonia.

Although listings for benthic macroinvertebrate impairments are not necessarily related to toxics, they are used as a warning flag to prompt the search for causative stressors. In 2014, 239 miles of streams (51 segments) and 542 square miles of estuaries (3 segments) were delisted for benthic impairments because more recent evaluations of benthic macroinvertebrate communities scored the 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.

4.2 Most Recent Virginia Department of Health Fishing Restrictions and Health Advisories

The Virginia Department of Health (VDH) regularly issues "Fish Consumption Advisories and Restrictions" for Virginia Waterways based upon the results from the DEQ Fish Tissue and Sediment Monitoring Program and other sources. All waters subject to these restrictions and advisories are included in DEQ's biennial 303(d) lists. The VDH website contains the most recently published updates to fishing restrictions and closures due to concerns related to human health and fish consumption. The complete VDH fishing restrictions and health 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/public-health-toxicology/fish-consumption-advisories/. No new or revised fish consumption advisories were issued during SFY15 or SFY16.

Fish Tissue and Sediment sampling in SFY15 and SFY16 was scattered among the New River basin, the middle James River basin, and the Potomac River basin, plus sampling in the Dan River in response to the Duke Energy coal ash spill in North Carolina. Sampling during 2016 was focused on the Rappahannock River basin, the James River watershed, including the Elizabeth River, the Dan River, and a snakehead special study in Potomac embayments.

Results from the analyses of fish tissue and sediment samples collected during 2016 will not be received until the fall of 2017, and following QA/QC reviews will be sent to the Virginia Department of Health and to DEQ assessment staff in the appropriate regional offices.

No new fishing restrictions or health advisories were issued during SFY14 through 2016, and none are expected in 2017 because most fish tissue monitoring in SFY16 was carried out in segments that are already under fish consumption advisories. One doubtful but possible exception would be an advisory for metals in fish tissues resulting from the Dan River coal ash spill. To date, no fish tissue metals concentrations from the Dan have exceeded established screening values, but longer term monitoring is planned.

A general description of DEQ's Fish Tissue and Sediment Monitoring Program, related current and past special studies, and several recent reports as well as analytical results from fish tissue and sediment monitoring by the agency are available on the DEQ website at:

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

5.0 Remediation of Toxics in Ambient Waters

Total Maximum Daily Load (TMDL) Program

The TMDL Program is an important component of DEQ's toxics remediation in aquatic environments. A number of toxics-related TMDLs have been completed and approved in recent years. Completed TMDLs can be identified and viewed by using 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. Queries can be performed based on pollutant, major river basin, political jurisdiction, and water body name or watershed identification. A comprehensive list of all approved TMDLs (currently 305) can be queried out by leaving the search form blank and clicking on the "Search" button. Ten new TMDLs were approved by EPA between 2014 and 2016, but none were directly involved with impairments by toxic contaminants. Most TMDLs approved during this period were related to excessive bacterial contamination and/or sedimentation.

The development of additional toxics-related TMDLs has been on-going. A number of TMDL investigations to identify PCB sources began in SFY09 and the one for the Tidal James River Basin, including the Elizabeth River is scheduled to be completed in 2017. PCB samples have been collected to spatially and temporally augment the existing dataset. PCB source investigation work has also been on-going in the New River Basin (data also presented in Appendices J1 and J2) where TMDL development began in 2014. The impaired New River segments above Claytor Lake, as well as Claytor Lake itself, have been added to that study. To address the Mountain Run PCB impairment, additional PCB water samples were collected at six sites under low and high flow conditions in 2014 and 2015. While a TMDL development schedule has yet to be established for this impaired waterbody, the source investigation study is the first step of the process.

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 within a few years. The agency's TMDL history, current status, and other development plans are available at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL.aspx.

Close coordination between monitoring and assessment activities identifies new sources of contamination as they occur and documents the effectiveness of load allocations and other remedial measures developed and implemented by the TMDL Program. The agency anticipates significant reductions of toxics in the state's waters as a result of continued TMDL implementation.

6.0 References

A cumulative bibliography of general references and publications cited in this and previous TRISW Reports is included in "Appendix L – References."