Toxics Reduction in State Waters

State Fiscal Year 2008

A Report to the Honorable Timothy M. Kaine, Governor and the House Committee on Agriculture, Chesapeake and Natural Resources and the Senate Committee on Agriculture, Conservation and Natural Resources

Virginia Department of Environmental Quality

January 2009

The complete set of tables, figures and appendices associated with this report, as well as the text document itself, are available on the WebPages of the Department of Environmental Quality at http://www.deq.virginia.gov/watermonitoring/

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The numbering of figure-containing electronic Folders corresponds to the numbers of the associated Tables 3 through 6, 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.

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AMD	Acid Mine Drainage
ALU	Aquatic Life Designated Use
B4B	Businesses for the Bay Program
BDE	Bromated diphenyl ether
B-IBI	Benthic Index of Biotic Integrity
CBP	Chesapeake Bay Program
CEDS	Comprehensive Environmental Data System
CIMS	CBP Information Management System
CVs	Consensus-Based Sediment Quality Guidelines – Critical values for contaminants in freshwater sediment (replace previously utilized ER-L and ER-M values for assessment of freshwater sediment; MacDonald et al. 2000). See also PEC, below.
DCLS	Division of Consolidated Laboratory Services
DEQ	Department of Environmental Quality
DMR	Discharge Monitoring Report
EDAS	Ecological Data Application System (database)
EEC	Extreme Effects Concentration – the concentration of a contaminant above which adverse effects to sediment-dwelling organisms frequently or always occur
ELG	Effluent Limitation Guidelines
EMS	Environmental Management System
ER-L	Effects Range-Low
ER-M	Effects Range-Moderate
EPA	Environmental Protection Agency
FY	Fiscal year
IBI	Index of Biological Integrity
ICPRB	Interstate Commission for the Potomac River Basin
IR	"Integrated Report" – abbreviation for the 305(b)/303(d) Integrated Water Quality 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 U.S. Environmental Protection Agency (EPA) and its Office of Research and Development, National Center for Environmental Assessment. (http://cfpub.epa.gov/ncea/iris/index.cfm)
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
MonPlan	Annual Water Quality Monitoring Plan
MY	Monitoring year
NOAA	National Oceanic and Atmospheric Administration
NPEP	National Partnership for Environmental Priorities
NPS	Non-Point Source (pollution)
OCP	Organochlorine Pesticide
OPP or OP2	Office of Pollution Prevention
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated biphenyl
PEC	Consensus-based *Probable Effects Concentrations* for chemical contaminants in freshwater sediments (MacDonald et al. 2000). See also CV, above.
POTW	Publicly Owned Treatment Works
P2 or PP	DEQ's Pollution Prevention Program
ProbMon	Probabilistic Monitoring Program

QAPP	Quality Assurance Program and Project Plan
RBP	Rapid Bioassessment Protocol
SFY	State fiscal year (1 July – 30 June)
SIC	Standard Industrial Classification
SOP	Standard Operating Procedure
SPMD	Semi-Permeable Membrane Device
STORET	EPA's national ecological database (short for data 'STOrage and RETrieval' system)
SV	Screening Value
TBT	Tributyltin
TEC	Threshold Effect Concentration – the concentration of a contaminant below which adverse effects to sediment-dwelling organisms are unlikely to occur
TMDL	Total Maximum Daily Load study
TMP	Toxics Management Program
TMR	Toxics Management Regulation
TOC	Toxics of Concern
TRE	Toxics Reduction Evaluation
TRI	Toxic Release Inventory
TRISWat	Toxics Reduction in State Waters (report)
USGS	United States Geological Survey
VISE	Virginia Information Source for Energy (Website)
VDH	Virginia Department of Health
VEEP	Virginia Environmental Excellence Program
VERC	Virginia Emergency Response Council
VH2E	Virginia Hospitals for a Healthy Environment
VIMS	Virginia Institute of Marine Science
VMN	Virginia Mentoring Network
VPDES	Virginia Pollutant Discharge Elimination System
VPI	Virginia Polytechnic Institute and State University
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)

Executive Summary

This annual Toxics Reduction in State Waters (TRISWat) Report is provided pursuant to Virginia Code § 62.1 - 44.17:3. The primary objective of the TRISWat Report is to document the Commonwealth's progress toward reducing toxics in state waters and improving water quality. This commitment includes 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: During state fiscal year 2008 (SFY08), The Virginia Department of Environmental Quality's (DEQ's) Toxics Management Program (TMP) included 307 reporting facilities with 749 outfalls that had active permit-defined toxics limits in their effluents, as recorded in DEQ's Comprehensive Environmental Data System (CEDS) database. Less than 2% of the 8,484 reported individual parameter measurements exceeded permitted maximum concentrations and almost all of those were incidental elevations of total or dissolved metals in discharges from municipal wastewater treatment plants.

Pollution Prevention: The 2008 Pollution Prevention Annual Report is now available on the DEQ WebPages at http://www.deq.virginia.gov/p2/pdf/report07.pdf. Among the highlights of Pollution Prevention successes affecting reduction of toxics in state waters in the past year are the following:

- At the end of 2008 there were approximately 450 facilities in the Virginia Environmental Excellence Program (VEEP), 24 of which received special recognition during 2008. Virginia is still the only state in the nation to provide performance-based permit fee discounts (from 2 to 20%) for going beyond compliance. In 2008 over $43,000 in fee discounts were distributed among almost 100 VEEP facilities that implemented and carried out their Environmental Management System (EMS) Plans.
  A review of VEEP annual performance for 2008 reported a reduction of 628 tons in the use of hazardous materials and a decrease of 1,733 tons in the disposal of hazardous wastes. The use of recycled materials increased by 125,367 tons, 62,924 tons of which were non-hazardous materials.
- Total water use increased by 585 million gallons during the past year, but the use of reclaimed/recycled water increased by 23 million gallons.
- Releases to the atmosphere were also significantly reduced: toxics emissions were reduced by 19 tons, NOx emissions were reduced by 403 tons, SO_x emissions were reduced by 3,640 tons, emissions of volatile organics were reduced 220 tons and particulate emissions were reduced by 2,400 tons.
- DEQ's voluntary mercury reduction initiatives also have been successful. The "Virginia Switch Out" Project for the recycling of automotive mercury switches pledged the annual removal of 1500 switches, equivalent to five pounds of mercury. Numerous facilities have also pledged to recycle energy efficient fluorescent light bulbs, which also contain small quantities of mercury. (Refer to DEQ's Mercury Reduction WebPages - http://www.deq.virginia.gov/p2/mercury/homepage.html.)
- Virginia's 400+ members of the Businesses for the Bay (B4B) Program have been responsible for more than 750 million pounds of waste reduction and recycling since the program began, at a savings exceeding $12 million. Unfortunately, EPA's Chesapeake Bay Program has suspended its financial support for the B4B Program. DEQ's Office of Pollution Prevention will continue to support the B4B Program and its Virginia participants whenever resources are available.
- This year Virginia National Partnership for Environmental Priorities (NPEP) facilities have pledged to reduce priority chemical use by 6,420 pounds: 200 lbs of mercury, 5,020 lbs of PCBs, and 1,200 lbs of lead.

Monitoring

Toxics Release Inventory (TRI): The March 2008 Toxics Release Inventory (TRI) Report is available on the DEQ Website at: http://www.deq.virginia.gov/sara3. The TRI Report summarizes data from calendar year 2006, during which 467 facilities filed 1786 individual reports. Statewide toxic releases to the water totaled approximately 19.5 million pounds or 29% of the total onsite releases to all media during 2006. Nitrate compounds (19.02 million tons) represented 98.7% of the top ten TRI chemicals released to water. Nitrates, however, are of much more concern for their effect as nutrients than as toxics. Toxics criteria for nitrates in drinking water were not exceeded.

Water Quality Monitoring Programs: Periodic updates and revisions of the agency's Monitoring (WQM) Strategy are necessary as part of the continual planning process within DEQ's WQM and Assessment Program. The monitoring program has now fully implemented two major changes in the 2007 WQM Strategy that affected toxics monitoring and assessment, the adaptation of the monitoring program to the newly delineated sub-watersheds of the National Watershed Boundary Dataset (NWBD) and the realignment of the monitoring year to correspond with the calendar year rather than the state fiscal year.

The summer of 2007 (July – September) was the eighth year of DEQ's estuarine probabilistic monitoring and the spring and summer of 2008 comprised the eighth year of its freshwater probabilistic monitoring (ProbMon). Because of resource limitations, the sampling and analysis for sediment organics was suspended at freshwater ProbMon sites in SFY07. The results of spring freshwater probabilistic sampling of sediment and dissolved metals for Monitoring Year 2008 are included in this report. Sediment chemistry (metals and organics) and toxicity sampling were continued at estuarine ProbMon sites during the 2007 season (SFY08) with resources provided by a probabilistic survey-targeted supplement to the federal §106 grant, complimented with Chesapeake Bay Program support.

In the 2008 Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report sediment chemistry, sediment toxicity and benthic taxonomic results from DEQ's Estuarine Probabilistic Monitoring Program were used for a toxics-related "Weight-of-Evidence" assessment of aquatic life use at 100 estuarine sites. These results, primarily from minor tidal tributaries, complement those from the Chesapeake Bay Program's benthic probabilistic monitoring program, which emphasizes the mainstems of major tidal tributaries and the Bay itself. The corresponding Estuarine ProbMon results from 2006, 2007 and 2008, an additional 150 sites, will be incorporated into the 2010 Integrated Report. An additional line of chemical evidence, based on the solubility of polycyclic aromatic hydrocarbons (PAHs) present in the sediment, has now been added to the weight of evidence assessment procedure.

The 2008 workplan for the Fish Tissue and Sediment Monitoring Program identified 85 tentative sampling sites, from which results will become available next year. Analytical results from the program's 2007 sampling are now available. In all, a total of 842 individual or composite fish tissue samples were collected. To date, 581 results have been returned for tissue metals, 471 for PCBs, and 231 for pesticides. No PAH analyses were carried out in 2007-2008. Although sediment samples were collected in association with each of the sampling sites, they have been archived as frozen reference samples and will only be analyzed if fish tissue results indicate a serious local problem. The most recent data and planning updates on this program are available at http://www.deq.virginia.gov/fishtissue/.

Thirty-five years of monitoring have revealed that the distribution and concentrations of toxics vary greatly among samples, whether they are nearby duplicates collected on the same day or sequential samples collected over various time spans. No definitive long-term trends have been detected to document consistent changes in toxics-related water quality. The probabilistic monitoring of toxics during the past seven years has demonstrated that statewide, concentrations of dissolved trace metals and organics in ambient waters are generally representative of global background levels, except near confirmed or suspected point sources. Periodic reports

on the probabilistic results will provide a baseline for future comparisons. Recent developments of more efficient sampling designs, sampling technologies and analytical methods offer promise of more effective documentation of short-term changes and mid-term trends in the near future.

Assessment and Remediation

Assessment: The 2008 Integrated Report identified 2,448 miles of rivers, 111,384 acres of lakes and reservoirs, and 2,084 square miles of estuaries impaired by specifically identified toxics. Of these, over 99% were listed for fish consumption advisories, primarily for PCBs (41.6% of toxics-impaired rivers, 64.9% of lakes, 99.0% of estuaries) or mercury (54.9% of rivers, 34.6% of lakes, <0.4% of estuaries). Because the number of segments united into each 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) establishes priorities for TMDL development and discusses various options for remediation. Analyses of the 2010 Integrated Report will begin in the spring of 2009, and any new PCB-impaired segments will be integrated into the Strategy.

Remediation / Reduction: The agency's TMDL history, current status and development plans are available on the DEQ WebPages at http://www.deq.virginia.gov/tmdl/. A number of individual toxics-related TMDLs have been developed and approved since 2002 – two in 2002, three in 2004, and 16 in 2007, all for PCBs in the Shenandoah (five) or in other Virginia tributaries to the Potomac (16), and two for benthic impairments with toxic stressors (copper + zinc, and lead + PAHs). The sixteen Potomac tributary PCB TMDLs were incorporated into the interstate Potomac River PCB TMDL developed under the auspices of the Interstate Commission for the Potomac River Basin. This TMDL was submitted in November 2007 and was subsequently approved by the United States Environmental Protection Agency (EPA). Several additional toxics-related TMDLs are in development. Four TMDLs for PCBs in the Roanoke River are scheduled for completion in 2009, and an additional four (also for PCBs) in the New River Basin, will be completed by 2010. In November 2008 EPA requested additional funding (total of $3.7 million) for the cleanup of one former West Virginia industrial site in the Bluestone prior to completing the TMDLs in the New Basin. Seven VDH fish advisory (mercury) TMDLs are scheduled for 2010, three in the Shenandoah and four in the North Fork Holston basins. Benthic TMDLs for 11 PAH-impaired segments in the Tennessee/Big Sandy Basin and a single benthic TMDL in the Roanoke Basin (toxicant unknown) will be developed by 2010.

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

Continued Commitment

DEQ continues its commitment to toxics reduction by the prevention of contamination, continued water quality monitoring, and the implementation of remedial measures. The Virginia Pollutant Discharge Elimination System and the Pollution Prevention Program join with other agencies, programs and stakeholders to control and reduce toxics release. The Toxics Release Inventory (TRI) 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 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 2008

State Fiscal Year 2008 Toxics Reduction in State Waters Report (January 2009)

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

- A long-term Water Quality Monitoring (WQM) Strategy, revised and accepted by EPA Region 3 in April of 2007,
- Formal Quality Assurance Program and Project Plans (QAPPs),
- Established Standard Operating Procedures (SOPs), and
- Standardized Sampling Protocols.

The agency's annual monitoring program plan (MonPlan) now corresponds with the calendar year. This helps synchronize various monitoring activities and assessment periods with the 'ecological' or 'water year'. Monitoring activities summarized in this report, however, still refer to the state fiscal year (SFY - July 1 of each year through June 30 of the following year) in order to provide complete analytical results by January 1.

The SFY08 Toxics Reduction in State Waters Report (TRISWat-09 – twelfth in the series) summarizes all toxics reduction activities carried out between July 1, 2007 and June 30, 2008. The historical summaries of toxics monitoring results in electronic 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 WebPages at http://www.deq.virginia.gov/watermonitoring/tox.html. Electronic copies of the complete report, including tables, figures and appendices, are available on CD upon request from Don Smith at (804) 698-4429 or dhsmith@deq.virginia.gov.

In the Water Quality Monitoring section, data summaries of yearly 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 visual 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 – SFY08) for each major drainage basin appear in this year's report but the short period of record and changes in methodologies and detection limits make the interpretation of trends difficult.

1.0 Introduction

This Toxics Reduction in State Waters (TRISWat) Report is provided pursuant to Chapter 3.1, Title 62.1, § 62.1-44.17:3 of the Code of Virginia**. 1.1 Toxics Reduction in State Waters**

The primary objective of the TRISWat Report is to document the state's commitment to improving water quality. This commitment includes:

1. The prevention of contamination of the Commonwealth's waters by toxics,
2. The continued monitoring of the 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 provides a summary of the toxics-related prevention, monitoring and remediation activities of the previous state fiscal year (SFY – July 1 - June 30).

Although the reduction of toxics in the state's waters is primarily the responsibility of the DEQ, various agencies and organizations, including the Virginia Department of Conservation and Recreation (DCR), the Virginia Department of Health (VDH), the U.S. EPA's Chesapeake Bay Program (CBP), and the U.S. Geological Survey (USGS) participate in the process. 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 TRISWat 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, twelfth TRISWat Report (January 2009) contains tables of both raw data and statistical summaries of SFY08 monitoring results.

The agency retains archived copies of previous TRISWat Reports (January 2001 – January 2008) on the DEQ Water Quality Monitoring WebPages: http://www.deq.virginia.gov/watermonitoring/toxarch.html.

1.2 Functional Definitions, Water Quality Standards and Substrates Monitored

1.2.1 Defining "Toxicity": The Virginia Code (Chapter 3.1, Title 62.1, § 62.1-44.17:2) 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 because 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.

1.2.2 Federal Water Quality Criteria: The Federal Clean Water Act (1983) first described the scope and purpose of water quality standards and defined the authority and responsibility of the U.S. EPA and the various states in relation to the requirements for, submission of, and establishment of such standards. As early as 1990, the Chesapeake Bay Commission published its Toxics of Concern (TOC) and Chemicals of Potential Concern lists, which included 21 chemical substances and/or complexes of substances (forms or isomers of complex organic compounds) that endangered the waters of the Chesapeake Bay and its tributaries. The Chesapeake Bay Commission revised and approved these lists in 1996 with the removal of some chemicals and the addition of others, but views the current "Chemicals of Concern" list more as a watershed management tool than as a list to be widely publicized. (See Appendix A of this report for a summary of both lists). DEQ monitors for all chemicals on the revised list, although several still have no established federal water quality criteria or water quality standards. The proliferation of new chemical products in the market, as well as emerging concerns over the effects of established chemical and pharmaceutical products, makes the use of a static list inadvisable.

The interstate EPA Chesapeake Bay Program's Toxics Subcommittee recently reevaluated its list of toxic substances, updated its database with newly (2007) released monitoring results, and defined new methodologies for toxics evaluation. The production of a new toxics characterization report, which was originally scheduled for December of 2007 and subsequently postponed until June of 2008, has since been suspended. (See Section 4.3, The Chesapeake Bay Program – Toxics Characterization.)

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.

- 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 (Appendix B).
- Subsequent studies have identified additional toxics and/or resulted in the establishment of new criteria for previously defined toxics, and have modified this list considerably 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.
- The EPA provided its most recent complete list of nationally recommended water quality criteria for priority toxic pollutants in November 2002 in the publication of EPA-822-R-02-047, National Recommended Water Quality Criteria, which is available in electronic form from the EPA WebPages at: http://www.epa.gov/waterscience/criteria/wqcriteria.html.
- 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 as a whole. Detailed information on recent updates may be found at:
    - Aquatic Life: http://www.epa.gov/waterscience/criteria/aqlife.html#final
    - Human Health: http://www.epa.gov/waterscience/criteria/humanhealth/15table-fs.htm
    - Mercury in Fish Tissues: http://www.epa.gov/waterscience/criteria/humanhealth/docs/

1.2.3 Virginia Water Quality Standards - WQS: The Commonwealth of Virginia has established and periodically revises its water quality standards, which EPA reviews and must approve prior to their application (*See* 9 VAC 25-260 Virginia Water Quality Standards). These state standards undergo a formal

"Triennial Review" for periodic updating. In reality, the Commonwealth's WQS are almost constantly under review. The most recently adopted Water Quality Standards are briefly summarized in Appendix C and are available in their complete form on the DEQ-WQS WebPages at http://www.deq.virginia.gov/wqs. Virginia's WQS are currently undergoing triennial review, and new developments in this triennial review process and other information related to Water Quality Standards are public-noticed and/or posted on the DEQ Water Quality Standards Website at http://www.deq.virginia.gov/wqs/rule.html as they occur. The State Water Control Board approved all Triennial Review amendments to section 9 VAC 25-260-140 "Criteria for surface water" at its October 17, 2008 meeting. The amendments will become effective upon EPA approval which is expected within the first quarter of 2009.

Approximately 90 parameters in the criteria table in section 9 VAC 25-260-140 (Appendix C) have amendments that were approved by the Board. The majority of the amendments consist of changes to numerical criteria for human health based on updated EPA guidance that is more stringent, due either to a Relative Source Contribution factor or an increase to the estimated amount of fish tissue consumed incorporated into the formula EPA utilizes in the updated criteria calculations. A complete list of Board approved amendments to toxic parameter criteria are in the table of parameters beginning on page 9 of the document:
http://www.deq.virginia.gov/export/sites/default/wqs/documents/TR_WQS08_Triennial_Review_FINAL_LANGUAGE.pdf . Deleted text has strikethroughs and added text is underlined.

Three new criteria based on EPA updates for toxic analytes will be added to the WQS: Diazinon, methylmercury (as a fish tissue concentration criterion), and nonylphenol. Two new footnotes have been added. One regards the number of significant digits to be utilized when assessing for the parameters and the other was added to explain application of the methylmercury criterion to wet weight concentration in edible tissue and its application to commonly eaten species.

1.2.4 Toxic Substances in the Water Column: Water Quality Criteria and the derived Water Quality Standards for toxic substances in the water column are expressed on the basis of dissolved concentrations. DEQ monitors dissolved metals in the water column using specialized "clean sampling" procedures. Because of the low solubility of most toxic organic substances in the water column, traditional methods of sampling have generally resulted in values below the detection limits of the laboratory methods used for their analysis. Consequently, DEQ began using 'Semi-Permeable Membrane Devices' (SPMDs) for the passive sampling of dissolved organic contaminants during the spring of 2003. The use of this methodology has subsequently been limited to more localized special studies because of the relatively high cost of analyses.

Although DEQ monitored the ambient concentrations of total metals in the water column in the past, this practice later became limited to special studies specifically targeting areas of known water quality problems. No criteria or water quality standards exist for total suspended (particulate) contaminants, because they are generally not in a form available for uptake by aquatic organisms. Consequently, no water quality assessment could be performed on the analytical results. The data are, however, useful for locating and identifying the sources of dissolved toxics or to calculate local chemical 'translator' values, for estimating dissolved concentrations from the total amount of metal in the water column. More recently, it was discovered that benthic community degradation is often more highly correlated with concentrations of total metals than with dissolved metals. As a result, monitoring of total metals in the water column is again becoming more frequent.

1.2.5 Toxic Substances in Sediment: At present, neither the EPA nor the Commonwealth of Virginia has established criteria/standards for toxic substances in sediment. In the past, the analytical results of toxics in

freshwater sediments were compared to ecological effects thresholds published in 1991 by the National Oceanic and Atmospheric Administration (NOAA) and in 1992 by the EPA. Thresholds for many metals in estuarine and marine sediments were further refined in 2005. These new screening values are now used for the assessment of estuarine and marine sediments. A summary of the Effects Range - Median (ER-M) values for selected chemicals in sediment appears in Appendix D of this report. The specific ER-M values used for the assessment of sediments in Virginia are updated as new guidelines become available. Beginning with the 2004 Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report, the agency has used more recently (2000) published 'Consensus-Based Sediment Quality Guidelines' (Probable Effects Concentrations or PECs) for the evaluation of toxic sediment contaminants in freshwater environments. A listing of current sediment quality guidelines is provided in Appendix D and in the most recent assessment guidance document for DEQ's Integrated Report: http://www.deq.virginia.gov/wqa/.

Beginning with its 2006 Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report, DEQ has utilized such sediment quality guidelines in weight-of-evidence Aquatic Life Designated Use assessments of estuarine probabilistic sites. The number of ER-M exceedences, the average ER-M Quotient,[1] and Equilibrium Partitioning Sediment Benchmarks[2] (ESBs) for PAH mixtures are integrated with the results of sediment toxicity tests and the evaluation of benthic community structure and function for an overall evaluation of sediment contamination at approximately 50 estuarine sites per year.

1.2.6 Toxic Substances in Fish Tissues: DEQ evaluates levels of toxics in fish tissues by comparing them with human consumption risk screening values calculated from EPA data (USEPA-IRIS). A summary table of the risk-based screening values DEQ uses for fish tissue consumption appears in the agency's biennial assessment guidance documents. These screening values are adjusted as necessary, following monthly updates in the EPA IRIS database (available at http://cfpub.epa.gov/ncea/iris/index.cfm). A current list of the Risk-Based Tissue Screening Values (TSVs) for fish tissue used for the Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report can be found in the most recent assessment guidance manual at http://www.deq.virginia.gov/wqa/. Values for specific compounds can also be found listed in the tables of fish tissue analytical results posted on the DEQ WebPages at http://www.deq.virginia.gov/fishtissue/.

1.3 Federal Reporting Requirements

In addition to the biennial Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment 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.

1.4 DEQ's Ambient Water Quality Monitoring (WQM) Strategy

The revised 2007 edition of DEQ's Water Quality Monitoring Strategy was accepted by EPA Region 3 and is now available on the DEQ Water Quality Monitoring WebPages (http://www.deq.virginia.gov/watermonitoring/monstrat.html). Two major changes that affected toxics monitoring and assessment were the adaptation of the monitoring program to the 1247 newly delineated sub-watersheds of the National Watershed Boundary Dataset (NWBD) and the realignment of the monitoring year to correspond with the

[1] An ER-M Quotient is the ratio of the observed concentration of a contaminant in the sediment to its published ER-M sediment quality guideline. Various studies (e.g., MacDonald, DiPinto et al., 2000; McDonald, Ingersoll et al., 2000; Ingersoll et al., 2001; Field et al., 2002) have reported that the average ER-M Quotient, across numerous metallic and organic contaminants, may be a much more sensitive indicator of possible effects on the benthic community than individual ER-M exceedences.

[2] The summing of ESBs for designated groups of polycyclic aromatic hydrocarbons (PAHs) also may be a much more sensitive indicator of possible effects of low-level dissolved PAHs on the benthic community than individual ER-M exceedences. (US EPA, 2003)

calendar year rather than the state fiscal year. The adaptation of the watershed monitoring program to characterize 1247 individual sub-watersheds, in contrast with the 494 watershed units of the previous delineation, resulted in the redistribution of a number of monitoring sites. The necessary adaptations were initiated in January 2007. Monitoring years and watershed rotations now coincide with the limits of the expanded six-year assessment window initiated for the 2008 Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report. As a result, the assessment in the 2008 Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report included balanced comprehensive statewide monitoring coverage by the rotating watershed network as well as by the freshwater and estuarine probabilistic monitoring networks.

Additional minor revisions to the WQM Strategy are planned for 2010 and will be one subject under discussion at DEQ's biennial statewide monitoring and assessment meeting scheduled for February 2009.

1.5 Sampling Design and Monitoring Methodologies

Implementation of DEQ's 2000 Water Quality Monitoring Strategy focused on the monitoring of toxics in a more systematic effort to assess their potential impact on ambient water quality. At that time inclusion of toxics monitoring within the water column and/or sediment was included in both freshwater and estuarine probabilistic monitoring programs to provide statewide and resource-wide characterizations.

Several recent developments, however, have resulted in more restricted toxics monitoring within the Commonwealth. The very low solubility and consequently low concentrations of dissolved contaminants, both metals and organics, require special sampling and analytical methods. Traditional methods have routinely resulted in no "detectable" analytes present, while specialized methods reveal the presence of low but significant concentrations.

In addition, probabilistic toxics monitoring during the first seven years revealed that the observed concentrations of dissolved toxic metals in the water column of Virginia's rivers seldom exceed characteristic worldwide background levels, except near suspected or previously identified sources. Consequently, since 2004 the monitoring of toxics has shifted focus from ambient waters to major point source discharges and other known or suspected problem areas. Monitoring for dissolved metals continues to occur at major point source discharges and other targeted Standard Industrial Classifications (SICs) based on their permit status, 303(d)[3] listed waters, acid mine drainage (AMD) sites, and the Elizabeth River.

Prior to 2004, the WQM Strategy provided for sampling of trace metals and organic pesticide contaminants in sediments at all watershed stations once every five to six years, and once at each probabilistic monitoring station. The list of organic compounds being monitored has expanded considerably since then to include more current use compounds, and new sampling and analytic methods currently provide significantly lower detection limits for most substances on the list. Table 1 - "DCLS Toxic Parameter Group Codes and Prices - SFY08", which is provided as a separate document to accompany this report, lists the toxic organic compounds monitored as target analytes in sediment. The acceptably low concentrations observed for most contaminants at most locations have allowed the agency to more efficiently distribute available resources among sampling surveys of toxic organics, initially to probabilistic sites under the 2005 Water Quality Monitoring and Assessment Strategy and more recently to more intensive localized special studies carried out within the TMDL Program to define the severity, extent and probable source of contamination

[3] Total Maximum Daily Load Priority List of the biennial 305(b)/303(d) Integrated Water Quality Assessment Report, Virginia Department of Environmental Quality and Department of Conservation and Recreation.

problems that have already been identified. Supplemental federal grants still provide resources for the chemical analysis of sediment samples at estuarine probabilistic sites, but monitoring for toxics at most freshwater probabilistic sites has been temporarily suspended.

2.0 Monitoring for Toxics in State Waters

Toxic chemicals fall into two principal classes of compounds: inorganic trace metals and synthetic organic chemicals. The Commonwealth of Virginia monitors both classes of toxics and their effects in the state's surface waters by both chemical and biological methods in the water column and sediment, and by chemical methods in fish tissues.

C**hemical monitoring** of toxics consists of the direct, quantitative measurement of the concentrations of specific chemical elements and compounds in effluents, in the water column, in the underlying sediments, and/or in animal tissues. Chemical monitoring is considered to be monitoring of the *potential causes* of ecological stress and environmental impairment.

Toxics in the Water Column: DEQ compares the results from water column analyses with water quality criteria and standards based on the acute and chronic toxicity of specific substances dissolved in fresh, brackish, and salt waters. The standards used for these comparisons are listed in the current Assessment Guidance Manual (http://www.deq.virginia.gov/wqa/) for each Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report and in Appendix C of this TRISWat Report, as well as in the Water Quality Standards document itself (http://www.deq.virginia.gov/wqs).

Toxics in Sediment: In most cases, there are as yet no specific standards for toxics present in the sediment. Consequently, ecological risk assessments have generally compared toxics concentrations in sediment to Effects Range - Median (ER-M) concentration screening values (SVs). NOAA (NOAA, 1991), the EPA (U.S. EPA, 1992), and others (e.g., Long et al. 1995) have provided these sediment SVs to evaluate the potential effects of sediment contamination on aquatic life in estuarine and marine waters. Newly published "Consensus-Based" screening values are now used for freshwater sediments. A summary of current ER-M and Consensus screening values can be found in each 305(b)/303(d) Integrated Report Assessment Guidance document (http://www.deq.virginia.gov/wqa/), as well as in Appendix D of this TRISWat Report.

Toxics in Fish Tissues: To assess the human health risk from edible fish tissues, the analytical results from fish tissue analyses are compared to Human Health Screening Values for specific contaminants. The calculation of these SVs uses risk assessment techniques published by the EPA for chronic toxicity and for both carcinogenic and non-carcinogenic effects (U.S. EPA, 1994; also see http://cfpub.epa.gov/ncea/iris/index.cfm). The current Integrated Report Assessment Guidance document (http://www.deq.virginia.gov/wqa/), as well as Appendix E – "EPA Risk-Based Screening Values for Fish Tissues – SFY07" of this Toxics Reduction Report, provide summaries of current fish tissue SVs. More specific details on the sampling and assessment of fish tissues and sediment appear in the 1998 Quality Assurance/Quality Control Project Plan for the Fish Tissue Monitoring Program.

Biological monitoring consists of evaluating the survival, growth and reproduction of living organisms, or of assessing the structure and function of aquatic communities in comparison with those existing under known reference conditions. Such monitoring may be carried out in the field or in the laboratory. When carried out in the field, it is considered monitoring for the *observed effects* of environmental impairment. When impairment of biological communities occurs, however, it does not necessarily indicate toxic effects. Intensive follow-up monitoring is necessary to determine the specific cause(s) of biological impairment. Ecological or biological toxicity tests performed in the laboratory generally expose living organisms,

belonging either to endemic (native) species or to nationally or internationally standardized species, to water and/or sediment samples collected in the field.

Under laboratory conditions, the results of toxicity testing can only be considered the measurement of the *potential effects* of toxicological stress on environmental impairment. DEQ no longer possesses the facilities to perform its own toxicity testing although, when deemed necessary for special studies, DEQ does contract commercial or university laboratories to perform such tests. Each year, estuarine sediment samples collected in the Estuarine Probabilistic Monitoring Program are sent to a contracted commercial laboratory for toxicity testing. Additional toxicity testing, associated with freshwater benthic-related TMDL studies, is often carried out by EPA laboratories.

Many permitted facilities that have Whole Effluent Toxicity (WET) Limits described in their discharge permits must maintain laboratories for the programmed biological testing of toxicity of their own effluents and must report the results to DEQ. DEQ continually reviews these results and periodically collects effluent samples and sends them to independent laboratories to confirm the toxicity levels and the quality assurance/ quality control procedures used by the permitted facilities.

2.1 Chemical Monitoring

2.1.1. Monitoring Activities: DEQ traditionally conducted chemical monitoring of the state's surface waters, fish tissues, and associated sediments for toxics on a regular basis. Because of the high costs of analysis, however, the ambient monitoring of toxic chemicals in sediment and the water column is currently restricted primarily to special studies, most often in association with TMDL development.

DEQ conducts fish tissue and sediment sampling on a rotating basin schedule. In calendar year 2007, DEQ suspended the routine analysis of organics in sediment samples in the fish tissue program, as well as in the freshwater probabilistic program. Beginning in 2008 the frequency and number of fish species sampled was reduced in river basins not associated with TMDLs, Virginia Department of Health (VDH) follow-up study requests, or mercury issues.

Descriptions of additional chemical toxics monitoring activities within specific programs are provided in later sections of this Report.

2.1.2 Matrices and Parameter Classes: Toxic elements and chemical compounds are generally categorized into several primary groups, each of which has specific chemical analysis codes to identify the procedures necessary for its complete analysis by the Division of Consolidated Laboratory Services (DCLS) of the Virginia Department of General Services. The primary groups normally 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 with these categories. Various groups of toxic organic compounds (*e.g.*, PAHs, semi-volatiles, and PCBs) are generally evaluated together with pesticides.

Table 1 – "DCLS Toxic Parameter Group Codes and Prices - SFY08", in a separate file that accompanies this report, summarizes the toxics-related Parameter Group Codes and the specifically associated analytes

in the current DCLS laboratory catalogue within the DEQ CEDS database, including associated reportable limits, costs, and turnaround times. The exact reportable limits may vary from day to day, depending on the stability of the analytical apparatus, the purity of reference materials and blanks, and possible interference from other substances present in the samples collected in the field. It should be understood that various Parameter Group Codes included in this list are seldom utilized within the Water Quality Monitoring (WQM) Program. Some are specific to other matrices, such as fish tissues, soil, etc., or are utilized specifically for industrial facilities. Other group codes have already been updated and replaced with new codes because of concern with new chemical products, the availability of newer analytical methods and/or the availability of lower detection limits for the analytes of interest. Inactive parameter group codes are maintained in the database catalog for referral relative to queries of historical data. Those parameter group codes actually employed by the WQM Program during SFY08 are identified in Table 2 – "Ambient Toxics Samples and Costs - SFY08", which accompanies this report.

Table 2.A summarizes the number of samples, the analytical expenses, and the parameter group codes included in toxics-related analyses performed and billed by the state laboratory (DCLS) during the 2008 state fiscal year. Toxics samples that are associated with the Fish Tissue and Sediment Monitoring Program, collected during various toxics-related special studies, or in the Estuarine Probabilistic Monitoring Program are analyzed elsewhere via contracted services. The costs of contracted analytical services for the major toxics-related programs and special studies are summarized in Table 2.B.

2.2 Biological Monitoring

Benthic Community Evaluation: Field sampling and evaluation of 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. A number of biological sampling and assessment protocols are used within free-flowing mountain and piedmont streams, low gradient coastal plain streams, and estuarine waters, including the Chesapeake Bay. Details of the respective monitoring programs and methods are described in (1) the DEQ WQM Monitoring Strategy and (2) the current Assessment Guidance Manual:

1. (http://www.deq.virginia.gov/watermonitoring/monstrat.html)
2. (http://www.deq.virginia.gov/wqa/homepage.html)

Appendix H1 of this report lists the freshwater biological monitoring stations visited during SFY08. Regional biologists carried out 521 site visits with subsequent site evaluations using the Virginia Stream Condition Index (VSCI). The list in Appendix H1 includes a number of the probabilistic sites that are also described in Appendix H2a.

Appendix H2a, "Freshwater Probabilistic Monitoring Sites Sampled in SFY08," provides a comprehensive list of the freshwater probabilistic monitoring stations that were included in the ambient program during fiscal year 2008. Many of these (the wadeable sites) were also sampled for benthic invertebrate populations and are also included in Appendix H1. This list summarizes 140 site visits to freshwater probabilistic stations, including autumn visits to calendar year 2007 sites and spring visits to calendar year 2008 sites, as well as a number of follow-up visits for other purposes (e.g., TMDL or other special study projects).

Appendix H2b, "Prospective Freshwater Probabilistic Monitoring Sites MY2006-10," provides a comprehensive list of 70 potential probabilistic/biological stations that may be included in the ambient program during the spring and summer of 2009. The final annual lists will become available after regional biologists perform both map and field reconnaissance prior to sampling in the spring of each year.

Chesapeake Bay and other tidal waters: The Chesapeake Bay Program conducts probabilistic monitoring of benthic communities. As a second phase of assessment based on the CBP 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 the National Coastal Assessment (NCA) protocols in the Bay and other tidal coastal waters. It consists of a weight-of-evidence evaluation based on the Sediment Quality Triad (SQT). Estuarine probabilistic monitoring following the NCA protocols provides data on the chemical contamination of sediment, the toxicity of sediment and an evaluation of benthic community wellbeing using three indices of stress, the CBP B-IBI plus Diagnostic Tool in tidal Chesapeake Bay waters, the Middle Atlantic Region B-IBI for other tidal coastal waters, and the EMAP (MAIA) Index of Estuarine Condition discriminant function for the Virginia Biogeographic Region (VA-IEC) as a secondary index in all tidal waters. This methodology is described in detail in the current Assessment Guidance Manual (http://www.deq.virginia.gov/wqa/) for the biennial Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Reports.

Appendix G-2 provides a complete list of the DEQ Coastal 2000 / NCA estuarine probabilistic stations sampled during July - September 2007.

2.3 Toxics Monitoring – Surface Waters and Sediments

Appendix F1 – "Historical Toxics-Monitoring Station List 1970-2001" contains a complete list of all WQM stations where ambient sediment samples had been collected during the period from October 1970 through October 2001. Researchers normally collected sediment metals and pesticide samples simultaneously at the same sites. The list includes 2,359 sites, which were visited a total of 26,783 times (average of 11.4 visits per site). A single visit may include the collection of multiple samples (e.g., sediment metals, sediment pesticides, dissolved and/or total metals in the water column, and dissolved pesticides), so the total number of samples collected during this period probably exceeds 50,000. Samples collected since monitoring year 2001 are summarized in individual Toxics Reduction in State Waters Reports.

Appendix F2 lists the ambient monitoring stations that were sampled for each toxics parameter group code during SFY08. Similar annual summary tables can be found in previous Toxics Reduction in State Waters Reports (Jan 1999 – Jan 2008).

Numerous tables and folders containing raw and summarized monitoring results are described in the following sections of this report. These tables and folders, as well as a number of appendices, are included as separate files external to the text of the report and are available on the DEQ WebPages and on the CD copies of the Report. The tables contain descriptive information 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 SFY08. The available electronic folders contain cumulative historical summaries of the results from each year in which a TRISWat Report has been produced, by river basin and analyte. A Microsoft Excel® file titled "Introduction to Tables and Folders" is included in 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.

2.3.1 Toxics in the Water Column

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 equipment 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 commonly presents severe problems in terms of sample contamination. Consequently, careful planning and specific standards of procedure (SOPs) are necessary to ensure the quality control of sample collection and transport and of the subsequent chemical analyses, and 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 new procedures, refer to the January 2007 TRISWat Report.

2.3.1.1 Clean Dissolved Metals in Surface Waters

DEQ's dissolved clean metals SOP (DEQ-WQA, 1998) is currently being applied in the collection and analysis of 19 dissolved trace metals in freshwater and of 16 metals in brackish and saltwater samples. "Table 3 – Clean Dissolved Metals All Basins SFY08" presents the results of clean, dissolved metals monitoring during SFY08. Additional spreadsheets in Table 3 summarize the results from Shenandoah River Basin mercury and fish kill special studies as well as results from several TMDL studies. Basin-by-basin historical summaries of clean dissolved metals results can be found in the Excel® workbooks of Folder 3 - "TRISWat Jan09 Folder 3 Metals Dissolved Historical."

2.3.1.2 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 normally been included in ambient water quality monitoring. In recent years, however, benthic TMDL studies have 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. As a result, total clean metals were sampled along with dissolved metals at freshwater probabilistic monitoring stations. During SFY08, 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, both for the ongoing mercury studies and the fish kill special study. Additional total metals samples were collected for several incident response studies and for industrial compliance monitoring. The resultant data from these samples are included in the spreadsheets of Table 4 and in the workbooks of Folder 4 - "TRISWat Jan09 Folder 4 Metals Total Water Historical."

2.3.1.3 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 during the past several years. Semi-Permeable Membrane Devices (SPMDs) were employed in several special studies on the distribution of polychlorinated biphenyls (PCBs) in SFY08. Several of the most recent special studies and some preliminary results are briefly described in Appendix I of this report. The tables and historical summaries provided for dissolved organic contaminants reveal that no ambient monitoring was carried out for these analytes during state fiscal year 2008.

2.3.2 Toxics in the Sediment

Beginning in 2001 DEQ restricted its collection of sediment samples primarily to its freshwater and estuarine probabilistic monitoring stations and to the fish tissue program. In 2007 DEQ suspended chemical analyses of sediments at most freshwater sites in order to conserve resources. During SFY 2008 sediment metals samples (but not sediment organics samples) were collected at freshwater probabilistic sites. Federal §106 grant supplements targeted for probabilistic monitoring have permitted DEQ to continue monitoring a reduced suite of contaminant analytes defined by the National Coastal Assessment Program at estuarine probabilistic monitoring sites. These analytes include 11 toxic metals, 22 polycyclic aromatic hydrocarbons (PAHs), 21 polychlorinated biphenyl (PCB) congeners, and approximately 20 pesticides and/or pesticide derivatives. Sediment samples have been collected during studies carried out by the Fish Tissue and Sediment Program in SFY2007 and in SFY2008, but they are frozen and archived. No analyses will be carried out unless fish tissue results indicate a severe toxics problem. Consequently, no sediment results are reported in association with the fish tissue results received in SFY 2008.

2.3.2.2 Sediment Metals

Table 5, "Sediment Metals - All Basins - SFY08" presents tabular results and a statistical data summary of the SFY08 WQM freshwater sediment metals data. Table 5a reports the results of sediment metals analyses from the Estuarine Probabilistic Monitoring Program that were received since the beginning of the 2008 fiscal year. They include results from stations sampled during the summer (July-September) of 2006 (SFY07) and analyzed by EPA nationally-contracted laboratories, as well as from the summer of 2007 (SFY08) that were analyzed at a DEQ-contracted laboratory. The Excel® workbooks of Folder 5 - "TRISWat Jan09 Folder 5 Metals Sediment Historical" present historical summaries. Although there were sediment samples collected during studies carried out by the Fish Tissue and Sediment Program in SFY2007 and in SFY2008, no chemical analyses were performed.

2.3.2.3 Sediment Pesticides and Other Organic Toxics

DEQ also monitors organic toxics deposited in the sediments underlying the Commonwealth's waters. In recent years, DEQ's water quality monitoring program expanded the suite of toxic sediment organics that it monitored from 13 to more than 200 compounds. The resulting analytical costs are high (AMTOX2 Parameter Group Code - $1690 per sample) and the sampling and analysis of organic contaminants in ambient sediment has temporarily been suspended until more resources are available.

Table 6a - "Sediment OC Pesticides - All Basins – SFY08" and the corresponding Folder 6a indicate that no ambient freshwater sediment organochlorine pesticide results are available from the most recent fiscal year.

Tables and Folders 6b (OP Pesticides), 6c (Herbicides), 6d (PAHs) and 6e (Semi-volatiles) follow the same format as Table 6a and Folder 6a. The results for sediment PCBs (6f) are so irregular among congeners that they are summarized only as total PCBs (the sum of 102 congeners) in Table 6f. Consequently, no separate basin-by-basin summary folders have been developed for PCBs. Previously (SFY06), detectable levels of PCBs were identified at 44 (74.6%) of 59 probabilistic sites. Of the 102 congeners (chemicals of the same kind) analyzed, less than half appeared in detectable concentrations at one or more sites and only 16 were detected at more than 10% of the sites statewide. (See "Table 6f-4 PCBs Sediment Grp-4 All Basins MY2006" in the January 2007 Toxics Reduction Report for tabular and graphical summaries.)

The SFY 2007 and SFY 2008 organic sediment contaminant results from the Estuarine Probabilistic Monitoring Program are summarized in Table 6h.

Further information about the statewide Ambient Water Quality Monitoring Program is available from Roger E. Stewart at (804) 698-4449 (restewart@deq.virginia.gov) or from Donald H. Smith at (804) 698-4429 (dhsmith@deq.virginia.gov) at DEQ's Central Office in Richmond.

2.4 SPECIALIZED FISH TISSUE AND SEDIMENT MONITORING

The collection of fish for fish tissue analyses requires specialized sampling techniques, equipment, and training. A field team from DEQ's Central Office Water Quality Monitoring and Assessment Program periodically samples all nine of Virginia's significant river basins (14 sub-basins) on a rotating schedule (formerly 3-year, now 5-year cycles), as well as carrying out other relevant special studies. Sediment samples have traditionally been collected at the same locations and on the same dates as fish samples.

2.4.1 Fish tissue and sediment sampling plan for 2008

A copy of the complete 2008 sampling plan is available at http://www.deq.virginia.gov/fishtissue/ and as Appendix G to this Report. A complete list of the proposed sites scheduled for sampling during summer 2008 can be found on pages 5 - 8 of the sampling plan. (The normal summer sampling season spans parts of two consecutive state fiscal years.) Summer 2008 sampling concentrated on small drainages to the Chesapeake Bay, coastal Delmarva, on the York River basin, selected sites in the lower James River basin, and on Potomac embayments.

2.4.2 Fish tissue results (2007) received in 2008

The results from tissue samples are compared with the screening values listed in Appendices D and E, respectively. Table 7a-1 "Fish Tissue Metals WQS 2007 (Rec'd 2008)," Table 7a-2 "Fish Tissue PCBs WQS 2007 (Rec'd 2008)," Table 7a-3 "Fish Tissue PAHs WQS 2007 (Rec'd 2008)," and Table 7a-4 "Fish Tissue Pesticides WQS 2007 (Rec'd 2008)" summarize the most recent results from fish tissue samples in relation to EPA-IRIS screening values.

None of the sediment samples collected during the summer of 2007 were analyzed for comparisons with the NOAA ER-M and/or consensus-based PEC sediment screening values.

Several reports on fish tissue and sediment monitoring can be found on the DEQ WebPages at http://www.deq.virginia.gov/fishtissue**.** Additional information on the fish-tissue/sediment monitoring program is available from Alex M. Barron, at (804) 698-4119 or ambarron@deq.virginia.gov.

2.5 PERMITTED DISCHARGES AND TOXICS 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) 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. These standards require that the state's waters be free from toxic compounds in toxic amounts. The State Water Control Board adopted a

toxics management regulation (TMR) in 1988 and amended it in 1996 (VAC 250-31-220) to incorporate more recent federal terminology and to simplify the regulatory structure.

DEQ's Toxics Management Program (TMP) assesses all VPDES permit applicants for their potential to discharge specific toxic chemicals that could violate water quality standards. Facilities with the potential to discharge these substances are given *numerical effluent limits* in their permits and are required to monitor and report to DEQ on their compliance with these limits following permit-specified schedules. Based upon evaluations done by the TMP, some permits may include Whole Effluent Toxicity (WET) limits, which require additional biological testing of effluent toxicity. The specific requirements for testing effluent toxicity criteria (both chemical and biological), for compliance self-monitoring, and for toxics reduction evaluation (TRE) are included in the Water Permit Program's guidance documents.

DEQ chemically samples in-pipe concentrations of specified substances on both scheduled and surprise inspections at all permitted facilities. When permits include WET limits, the facilities themselves are also required to perform toxicity tests on their effluents until such time that complete compliance is well established and potential toxic effects of the effluent have been minimized or eliminated. DEQ reviews the results of the self-ministered toxicity monitoring tests for consistency and compliance status and takes the appropriate measures, when necessary, to ensure complete compliance.

"Appendix J - Facilities & Outfalls with Toxics Parameter Limits SFY08" of this report lists facilities that currently have or have applied for permits that contain limits on the quantity or concentration of discharged toxics in their effluents. The same spreadsheet includes their respective addresses, geographic locations, receiving streams, etc. During SFY08, 307 reporting facilities with 749 outfalls had one or more toxics limits in their permits. The effective limits (when specified) and reporting frequencies for toxics may vary, depending upon the chemical parameters involved. In some cases, a permit may have been modified, reissued, or adjusted in terms of the current limits within the past year. The current toxics parameters included in each permit, along with their limits and required reporting frequencies, are listed in "Appendix K – Permits Parameters Units & Frequencies SFY08." The compliance results of each permitted facility's Discharge Monitoring Reports (DMRs) during SFY08 are reported in "Appendix L – Permitted Toxics Parameters & DMR Results SFY08." Some facilities may hold permits requiring only that they report, without a limit-specified value with which they must comply. Because they do not have a numeric value limit, they cannot be used for compliance testing.

Further information on the compliance of specific permitted facilities is available from the corresponding regional Water Compliance Manager. The most current contact information for each regional office is available on the DEQ WebPages at http://www.deq.virginia.gov/regions/.

2.6 SPECIAL STUDIES CONCERNING TOXICS

2.6.1 Regional Special Studies Involving Toxics

Special studies are often initiated independently at the DEQ Regional Office level in response to locally recognized problems. Regional special studies that dealt with toxics during SFY08 are summarized with detailed descriptions in "Appendix I – Special Studies Related to Toxics SFY08." The names and contact information for the responsible individuals at the Regional and/or Central Offices are also provided in the Appendix. Interim or final reports from various toxics-related studies are available on the DEQ Website - "Water Reports" page (http://www.deq.virginia.gov/water/reports.html) and "TMDLs in Virginia" page (http://www.deq.virginia.gov/tmdl/).

2.6.2 Additional Special Studies Involving Toxics

Elizabeth River Project - This project is discussed in more detail elsewhere in this report (Section 5.0).

Benthic and other TMDL Special Studies Involving Toxics - Because toxics must be considered as one possible cause of benthic impairments, water samples are often collected and shipped to the EPA Laboratory in Cincinnati, Ohio, for toxicity testing. The execution schedules and status of benthic and other toxics-related TMDL studies through 2010 can be found linked to DEQ's TMDL Homepage at http://www.deq.virginia.gov/tmdl/homepage.html.

For further information on the results of specific toxics-related TMDLs contact the individuals listed on the TMDL WebPages or, for more general information, contact Mark Richards [(804) 698-4392; marichards@deq.virginia.gov] or Craig Lott [(804) 698-4240; rclott@deq.viginia.gov] at DEQ's Central Office in Richmond.

2.7 THE CALENDAR YEAR 2009 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. The Annual MonPlan was traditionally developed in the first quarter of each calendar year and was usually finalized by early April for a state fiscal / monitoring year (July 1 - June 30). Beginning in 2006, the DEQ Monitoring Year has corresponded with the calendar year, rather than the state fiscal year, in order to synchronize various monitoring program schedules with one another, with the ecological and water year cycles, and with the "assessment window" or monitoring period considered for each Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report assessment and listing cycle. The lake monitoring program, the fish tissue and sediment monitoring program, and the beach monitoring program (Virginia Department of Health), as examples, are based on summer or spring through fall sampling, and have traditionally bridged two monitoring/fiscal year periods. Under the old scheme, watershed and monitoring site rotations were carried out in mid-summer, which fragmented a single season's results into two separate monitoring year data sets. The new synchronization scheme is described in detail in the 2007 revision of DEQ's Water Quality Monitoring and Assessment Strategy (http://www.deq.virginia.gov/watermonitoring/monstrat.html).

The new MonPlan for calendar year 2009 was completed in December 2008 and will be initiated on January 1, 2009. It will initiate the second two-year rotation in the second six-year cycle of DEQ's statewide Watershed Monitoring Network. Once finalized, each annual Monitoring Plan is summarized and posted on the DEQ Website at http://www.deq.virginia.gov/watermonitoring/. Those portions of the new plan that deal with long-term trend stations will continue without significant modification. This two-year rotation of the watershed monitoring network (January 1, 2009 through December 31, 2010) will require the relocation of monitoring sites, and the sampling and analyses of some analytes at those sites have been temporarily suspended to conserve resources. Other aspects of the MonPlan, which deal with TMDLs and other special studies or with shorter term rotations such as lake monitoring or citizen requests, require significant updating for inclusion in each new MonPlan.

2.8 CHALLENGES IN THE EVALUATION OF TRENDS IN TOXICS

The distribution of toxic materials in ambient surface waters, and especially in sediments, is quite variable in both space and time. The problem of extremely low concentrations of dissolved toxics in the water column and the inherent difficulties of sampling, potential contamination, and analysis have already been mentioned. In addition, sampling of the water column has conventionally consisted of temporal "point-samples" in which a water sample is collected at a specific point in time for subsequent analysis. Daily, monthly, and yearly cycles and irregular fluctuations in input rates are generally not well documented, especially at the low frequency at which toxics are normally sampled and analyzed, and the representativeness of the specific point in time that the sample was collected is questionable. The effects of these factors have been noted in recent efforts to evaluate long-term trends in conventional water quality parameters and nutrients that were sampled on a much more frequent basis.

The 30-day integrated sampling of dissolved organic toxics using semi-permeable membrane devices (SPMDs) partially alleviates this problem within the water column. In addition, when united with the confidence estimates provided by probabilistic sampling, chemical characterizations of specific resource classes (stream types, drainage basins, ecoregions, etc.) can be formally compared statistically among themselves and between sampling periods. When resources become available, another probabilistic SPMD special study at some time in the future may permit us to answer the question of whether contamination by specific dissolved organic compounds is decreasing, remaining stable, or increasing.

The concentrations of toxics within a specific unit of sediment may be more stable in terms of temporal variation, but concentrations may vary considerably even on a local spatial scale. Most toxic substances are readily bound chemically to organic material suspended in the water column or precipitated onto the surface of the sediment. This organic matter is generally lighter than the majority of suspended minerals, which may precipitate out of more rapidly moving waters, and the organics precipitate into the underlying sediments of more slowly moving waters, where they and the bound toxics may accumulate in relatively concentrated, localized deposits. However, any significant change in water velocity or flow pattern may spatially redistribute both the organic material and the associated toxics, and the age of contaminants and the date of such depositions are seldom known.

Even when spatially stable under calm waters, sediments tend to be temporally heterogeneous (stratified). The uppermost sediment layer is generally the most recent, the deeper layers often having been deposited days, weeks, months, or even years earlier. In the deeper, relatively undisturbed sediments, toxics may lie for years without reflecting more recent trends in concentrations. Very careful sampling, done by taking sediment cores and isolating the various strata of sediment for separate analyses, may reveal temporal trends in toxics concentrations and deposition rates. Determining the appropriate time scale, however, is very difficult, and the whole process is extremely costly.

In summary, the same factors that generate temporal and spatial variations in toxics distribution also create difficulties in achieving reliable and definitive statistical analyses. Consequently, much of the historical toxics data available in the agency database is not amenable to trend analyses. These factors can never be eliminated, but taking them into consideration can lead to more efficient monitoring designs and sampling methods, and better statistical evaluations that minimize their effects. DEQ's WQM staff is currently evaluating these factors. Continuing wide-scale probabilistic sampling of sediments, water, and biological communities is providing reliable statistical descriptions of regional conditions that can be compared from one sampling cycle to the next. The association of trend monitoring stations with USGS and DEQ gauging stations, to compensate for variations in flow rates and the consequent dilution of toxics in the water

column, will ameliorate some of these problems. Until consistent long-term datasets, collected and analyzed with comparable methods, become available, meaningful trend analyses of toxics will be difficult.

3.0 Assessment and Remediation

3.1 The 305(b)/303(d) Integrated Water Quality Assessment Reports

The complete 2008 Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report, the associated 2008 Assessment Guidance Manual, and interactive maps are available via the DEQ Water Quality Assessment WebPages at:

http://www.deq.virginia.gov/wqa/homepage.html .

Following the comment period for the initial draft and subsequent revision, the final 2008 Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report was submitted in October of 2008 and the associated 303(d) list of impaired waters was subsequently approved by EPA in December.

The Water Quality Assessment Guidance Manual for the 2010 Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report will be developed by spring 2009 and will subsequently become available via the same Internet address. Any recent changes in assessment methodologies for toxics will be described therein. The assessment methodology using the Chesapeake Bay Benthic Index of Biotic Integrity (B-IBI), the associated "Stressor Diagnostic Tool" and the application of the "Weight of Evidence" assessment method for Aquatic Life Designated Use (ALU) in minor tidal tributaries will remained unchanged.

Appendix M - "List of Segments not Fully Supporting Designated Uses because of Toxics (2008 303(d) List)" of this Report presents a comprehensive list and description of all water-body segments that were assessed as impaired because of (or potentially because of) toxics in the 2008 Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report.

The 2008 Integrated Water Quality Assessment Report identified 2448 miles of rivers, 111,384 acres of lakes, and 2,084 square miles of estuaries impaired by specifically identified toxics (see the summary table below). Of these, over 99% were listed for fish consumption advisories, primarily for PCBs (42% of rivers impaired by toxics, 65% of lakes, 99% of estuaries) or mercury (55% of rivers, 35% of lakes, <1% of estuaries). 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 discusses various options for remediation. Any new PCB-impaired segments identified in the 2008 Integrated Water Quality Assessment Report will be integrated into the Strategy.

Extent of Impairments by Toxics in the 2008 Clean Water Act 303(b)/303(d) Integrated Report

Pollutant	Water Body Type (units)	Extent Impaired (whole numbers)	Pollutant	Water Body Type (units)	Extent Impaired (whole numbers)
Aldrin (fish tissue)	**Rivers** (miles)	6	**Lead**	**Rivers** (miles)	13
	Lakes (acres)	0		**Lakes** (acres)	26
	Estuaries (sq. miles)	0		**Estuaries** (sq. miles)	0
Ammonia (Un-ionized)	**Rivers** (miles)	3	**Mercury** (fish tissue)	**Rivers** (miles)	1,344
	Lakes (acres)	0		**Lakes** (acres)	38,493
	Estuaries (sq. miles)	0		**Estuaries** (sq. miles)	8
Benzo(k)fluoranthene (fish tissue)	**Rivers** (miles)	0	**Nitrogen (Nitrate)** Public Water Supply	**Rivers** (miles)	2
	Lakes (acres)	0		**Lakes** (acres)	0
	Estuaries (sq. miles)	1		**Estuaries** (sq. miles)	0
Cadmium	**Rivers** (miles)	5	**PCBs** (fish tissue)	**Rivers** (miles)	1,018
	Lakes (acres)	26		**Lakes** (acres)	72,289
	Estuaries (sq. miles)	0		**Estuaries** (sq. miles)	2,063
Chlordane (fish tissue)	**Rivers** (miles)	2	**PCBs** (SPMD)	**Rivers** (miles)	3
	Lakes (acres)	0		**Lakes** (acres)	0
	Estuaries (sq. miles)	0		**Estuaries** (sq. miles)	0
Copper	**Rivers** (miles)	10	**Sediment Bioassays for Estuarine and Marine Waters**	**Rivers** (miles)	N/A
	Lakes (acres)	524		**Lakes** (acres)	N/A
	Estuaries (sq. miles)	0		**Estuaries** (sq. miles)	1
DDE/DDT (fish tissue)	**Rivers** (miles)	19	**Tributyltin (TBT)**	**Rivers** (miles)	0
	Lakes (acres)	0		**Lakes** (acres)	0
	Estuaries (sq. miles)	0		**Estuaries** (sq. miles)	11
Heptachlor Epoxide (fish tissue)	**Rivers** (miles)	14	**Zinc**	**Rivers** (miles)	9
	Lakes (acres)	0		**Lakes** (acres)	26
	Estuaries (sq. miles)	0		**Estuaries** (sq. miles)	0
Total Toxics Impairments	**Rivers** (miles)	2,448	**Total Fish Consumption Impairments**	**Rivers** (miles)	2,403
	Lakes (acres)	111,384		**Lakes** (acres)	110,782
	Estuaries (sq. miles)	2,084		**Estuaries** (sq. miles)	2,072

Additional information on the Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report is available from Harry Augustine at (804) 698-4037 or hhaugustine@deq.virginia.gov.

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

The Virginia Department of Health 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/epidemiology/DEE/PublicHealthToxicology/Advisories/index.htm.

Additional information from the fish-tissue/sediment monitoring program is available from Alex M. Barron, Office of Water Quality Monitoring and Assessment at (804) 698-4119 or ambarron@deq.virginia.gov. Several reports on fish tissue and sediment monitoring by the Office of Water Quality Monitoring and Assessment can be found on the DEQ WebPages at http://www.deq.virginia.gov/fishtissue.

3.3 Total Maximum Daily Load (TMDL) Program

The Total Maximum Daily Load (TMDL) Program is DEQ's primary means of toxics remediation in aquatic environments. A number of toxics-related TMDLs have been completed and approved in the last seven years; two in 2002, three in 2004, and 16 in 2007, all for PCBs in the Shenandoah (5) or in other Virginia tributaries to the Potomac (16 - Appendix M). Two benthic TMDLs were completed for toxics parameters in 2006, one (copper, zinc) in the New River basin and one (PAHs, lead) in the Shenandoah.

Several toxics-related TMDLs are currently under development. Four PCB TMDLs in the Roanoke River are scheduled for completion in 2009 and an additional four TMDLs for PCBs in the New River Basin will be completed by 2010. Seven VDH fish advisories for mercury are scheduled for 2010, three in the Shenandoah and four in the North Fork Holston. Benthic TMDLs will be completed (PAHs) in the Tennessee/Big Sandy basin for eleven impaired segments while a single benthic TMDL in the Roanoke Basin (unknown toxicant) will be developed, all by 2010.

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 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 development plans are available at http://www.deq.virginia.gov/tmdl/.

Close coordination between monitoring and assessment activities 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.

4.0 The Chesapeake Bay Program

4.1 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 Clean Water 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."*

4.2 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." With the retention of the 1994 goal, new objectives and commitments were developed and

incorporated into the document. An important strategy objective is 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 referenced as Regions of Concern, such as the Elizabeth River in Southeastern Virginia, the strategy includes commitments leading to their restoration. Finally, the strategy includes commitments that will provide the means to measure progress toward meeting the overall strategy goal. One approach consists of periodic toxics characterizations in which information derived from concurrent biological and chemical monitoring are synthesized within the context of toxicological impacts.

4.3 Toxics Characterization

In 1999 the Chesapeake Bay Program's Toxics Subcommittee completed a toxics characterization of the tidal tributaries of the Chesapeake Bay, which included all of Virginia's tidal tributaries to the Bay (see EPA 903-R-99-010 - http://www.chesapeakebay.net/pubs/792.pdf and the associated 1999 map at http://www.chesapeakebay.net/pubs/maps/2002-130.pdf). That characterization served a dual purpose: (1) it was utilized as a guide in the development of the Toxics 2000 Strategy, and (2) it provided the basis from which management actions for chemical reductions could be targeted. The process characterized each pre-defined regional area into one of four categories based on chemical contaminant exposure and biological affects. *Regions of Concern* (e.g., Elizabeth River) were *highly impacted* areas, *Areas of Low Probability for Adverse Effects* were regional areas that were *not impacted* by chemical contaminants, and *Areas of Emphasis* had the *potential for serious chemical contaminant-related impacts*. A fourth category included *Areas of Insufficient or Inconclusive Data*, where the data were not sufficient to place the area into one of the three categories above. One example of a potential management action would be follow-up ambient toxics monitoring in those regional areas characterized as *Areas of Insufficient Data*. In Virginia, complementary monitoring for toxics (The AmbTox Program – Roberts, et al., 2000-2003) subsequently provided data for the Commonwealth's "Areas of Insufficient Data" that had been identified in the original report.

In 2005 the Chesapeake Bay Program (CBP) initiated preparations for a new Bay-wide Toxics Characterization Report. A "Toxics Characterization Workgroup" of the CBP Toxics Subcommittee began a reevaluation of its list of toxic substances, the updating of its database with more recently (2007) released monitoring results, and defining new methodologies for toxics evaluation. In 2007 a draft update of the 1999 map was circulated to the Bay Program stakeholders for comments. The most recent draft of the map, "Chemical Contaminants (2006)," dated March 4, 2008, is provided as Figure 4.3-1, below. (More recent updates, as available, can be found on the CBP WebPages at: http://www.chesapeakebay.net/maps.aspx?menuitem=15230.) The updated map indicates that 60 of the Bay's 89 defined segments (67.4%) contain some level of impairment due to toxics. Extensive areas of Virginia's Bay waters were included because they have been listed as impaired for fish consumption (primarily for PCBs in striped bass), but the origin of tissue contamination in such migratory fish populations is often not known. Many adjacent areas of Maryland's Bay mainstem, utilized by the same migratory fish populations, are not listed because of differing monitoring and assessment procedures utilized there (refer to Figure 4.3-1). The production of a new toxics characterization report, which was originally scheduled for December of 2007 and subsequently postponed until June of 2008, has since been suspended.

A general organizational restructuring of the Chesapeake Bay Program was initiated in the summer of 2008 and approved on September 22, 2008. Activities of the former Toxics Subcommittee have been suspended, at least temporarily, and the new structure does not expressly include a Toxics Subcommittee. It does

however include a “team” labeled “Protect and Restore Water Quality.” Toxics-related goals and activities will be redefined during the transition to the new structure. Greg Allen, CBP Toxics Coordinator and chair of the Toxics Subcommittee will continue to be active in this process.

Additional information on the concentrations and trends of toxic substances and other water quality parameters, in the Chesapeake Bay and it tributaries, is currently available on the Chesapeake Bay Website at http://www.chesapeakebay.net/toxics1.htm, or by using the search engine available at http://www.chesapeakebay.net/search/pubs.htm. For additional information about DEQ’s Chesapeake Bay monitoring contact Rick Hoffman at (804) 698-4334 or fahoffman@deq.virginia.gov.

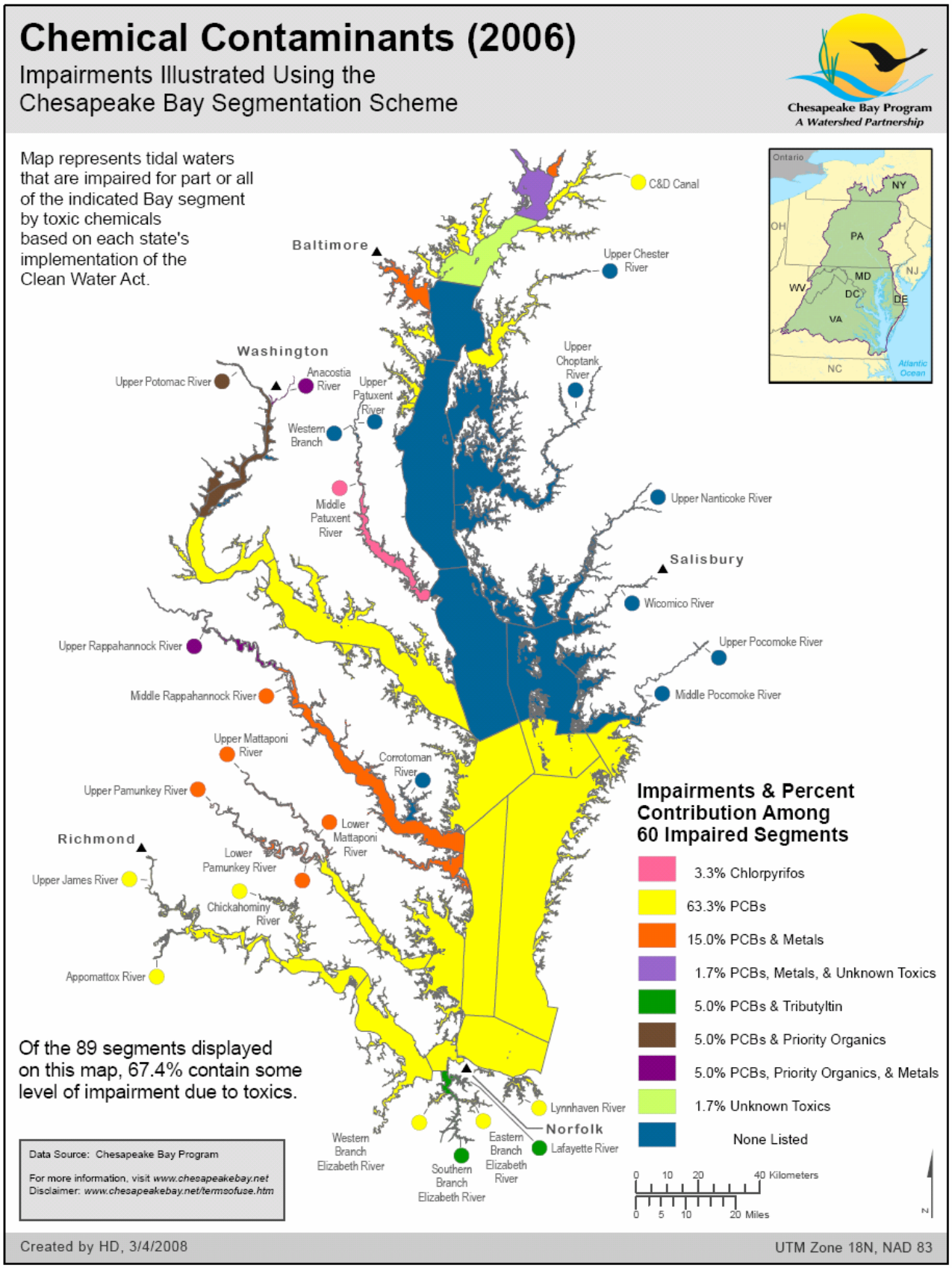

Figure 4.3-1. 2006 Toxics Characterization of the Chesapeake Bay Following the CBP Segmentation Scheme.

5.0 The Elizabeth River Program

In 1997, in response to indications of toxic impairment of water quality in the Elizabeth River and its tributaries, DEQ and a group of Elizabeth River Project 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 (VIMS), Old Dominion University (ODU), and DEQ continue to work with representatives from state, federal, and local authorities and other stakeholders to design and conduct this monitoring effort.

Several activities that have been continued under this initiative are described below.

Conventional Pollutants / Nutrients

DEQ and ODU continue to monitor for these parameters, which include such things as dissolved oxygen, nitrogen, phosphorus, pH, salinity and temperature. This monitoring, while done previously at a limited number of stations, was expanded to 14 stations in 1998 and now includes depth profiles and significantly more detailed nutrient analysis. Although the condition of nutrients and dissolved oxygen are still degraded, monitoring trends show significant improvements at many locations in the river (http://sci.odu.edu/chesapeakebay/reports/trends/index.shtml). Data can be viewed and downloaded from the Chesapeake Bay Information System (CIMS) at http://www.chesapeakebay.net/data_waterquality.aspx

Fish Tissue Histopathology

Recent academic studies indicate that a small, abundant and non-migratory fish, known as a mummichog, is an excellent indicator of adverse health effects attributable to pollutant exposure. An examination of internal organs has shown that numerous types of lesions, including cancer, can be observed and that the prevalence of these lesions may be directly related to the levels of certain pollutants in the environment. Working with Dr. Wolfgang Vogelbein of VIMS, DEQ has incorporated monitoring of this type into the Elizabeth River Monitoring Program at 12 stations in the Elizabeth River. Existing data generated by this DEQ histopathology monitoring show that, for certain types of liver lesions, prevalence can range from a low of 1.7% in fish collected in the Lafayette River and Western Branch to as high as 85% of the fish collected in the Southern Branch (Vogelbein and Unger, 2003). In the most recent study, Vogelbein (Vogelbein et al., 2008) stated, “It is clear that the health of Elizabeth River mummichogs has not changed significantly over the past 10 years.”

A number of relevant research reports can be reviewed on the Internet at
http://www.elizabethriver.org/Publications/ScientificStudies.asp

TBT Monitoring

Dr. Mike Unger, from the Virginia Institute of Marine Science, has collected Tributyltin (TBT) data at 18 stations in the Elizabeth River, Hampton Roads and the lower James River six times a year since August 1999. Only rarely have non-detectable (less than 1 part per trillion) levels of TBT shown up in these data. The highest measured concentrations occurred on September 20, 2001 with several stations near the confluence of the Eastern and Southern Branches of the Elizabeth River exceeding 20 ng/L; the highest measured concentration was greater than 70 ng/L at a station in the Southern Branch. However, no

exceedences of the acute standard (360 pptr) have been observed. A summary of the monitoring results can be viewed at http://www.vims.edu/env/projects/tbt_deq/. A report summarizing the Tributyltin monitoring program can be found at http://www.vims.edu/env/projects/tbt_deq/DEQ%202007%20TBT%20Report.pdf

Benthic Index of Biotic Integrity (B-IBI) monitoring

Dr. Dan Dauer (Old Dominion University) initiated a study of the macrobenthic communities of the Elizabeth River watershed in summer 1999 as a means of characterizing the health of the benthic communities of the Elizabeth River watershed. A probability-based sampling design allows calculation of confidence intervals for estimates of condition of the benthic communities and allows estimates of the geographic extent of degradation of the benthic communities. Results for 1999 to 2007 are summarized in the table below.

Monitoring Year	Percent bottom substrate not meeting restoration goals	B-IBI values
1999	64 ± 10.1	2.7
2000	72 ± 17.6	2.6
2001	52 ± 19.6	2.7
2002	72 ± 17.6	2.4
2003	80 ± 15.7	2.3
2004	88 ± 12.7%	2.2
2005	84 ± 12.7%	2.2
2006	80 ± 15.7%	2.4
2007	72 ± 17.6%	2.5

In general for the Elizabeth River watershed, species diversity and biomass were below reference condition levels, while abundance was above reference condition levels. Community composition was unbalanced, with levels of pollution-indicative species above, and levels of pollution sensitive species below reference conditions.

Copies of relevant Elizabeth River Monitoring Reports by Dr. Dauer are available at the ODU WebPages on the Internet at http://sci.odu.edu/chesapeakebay/reports/elizabeth.shtml

Elizabeth River Monitoring Reports: 2003-2008

Dauer, D.M. 2008. Benthic Biological Monitoring Program of the Elizabeth River Watershed (2007). Old Dominion University, Department of Biological Sciences, July 2008.

Dauer, D.M. 2007. Benthic Biological Monitoring Program of the Elizabeth River Watershed (2006). Old Dominion University, Department of Biological Sciences, July 2007.

Dauer, D.M. 2006. Benthic Biological Monitoring Program of the Elizabeth River Watershed (2005). Old Dominion University, Department of Biological Sciences, August 2006.

Dauer, D.M. 2005. Benthic Biological Monitoring Program of the Elizabeth River Watershed (2004). Old Dominion University, Department of Biological Sciences, August 2005.

Dauer, D.M. 2004. Benthic Biological Monitoring Program of the Elizabeth River Watershed (2003). Old Dominion University, Department of Biological Sciences, October 2004.

Vogelbein, W.K., M. Unger and David Gauthier. 2008. The Elizabeth River Monitoring Program 2006 – 2007: Association between Mummichog Liver Histopathology and Sediment Chemical Contamination. Virginia Institute of Marine Science, February 2008

Vogelbein, W.K. and M. Unger. 2003. The Elizabeth River Monitoring Program 2001 – 2002: Association between Mummichog Liver Histopathology and Sediment Chemical Contamination. Virginia Institute of Marine Science, November 2003

Unger, M. A. 2007. Elizabeth River Tributyltin Monitoring Program: 1999 – 2006. Virginia Institute of Marine Science, May 2007

Additional information on the Elizabeth River Project is available from Roger K. Everton, Environmental Manager, DEQ Tidewater Regional Office, at (757) 518-2150 or via email at rkeverton@deq.virginia.gov.

6.0 Virginia Toxics Release Inventory

(http://www.deq.virginia.gov/sara3/3132006.html)

Under the provisions of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986, also known as SARA Title III, Virginia manufacturing and federal government facilities that release certain chemicals into the air or water or onto the land, or that transfer these chemicals for off-site treatment, disposal, recycling, or energy recovery, are required to submit reports to the 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).

The most recent Virginia Toxic Release Inventory Report (SARA Title III TRI, March 2008 for the 2006 activity year) indicated that 467 Virginia facilities filed 1786 individual reports on the release, transfer, or management of TRI chemicals or chemical categories. This represented a decrease in both the number of facilities (4.3%) and the number of reports (3.9%) from 2005. Statewide, the tallied toxic releases to the water totaled approximately 19.5 million pounds or 29% of the total onsite releases to all media during 2006. This quantity represents an *apparent* doubling from the ~9.7 million pounds released to the water in 2005. This *apparent* increase is almost totally related to nitrogen releases and is a result of the correction of past reporting errors; it does not represent a real increase in the concentrations of nitrogen in the states waters. The Radford Army Ammunition Plant (RFAAP) discovered the error in their reporting for nitric acid. The amount of nitric acid treated onsite, which is the source of most of the nitrate releases, had been incorrectly calculated in the past. Corrected release estimates for calendar years 2001 through 2005 were provided to the EPA shortly after discovery. Established water quality standards for nitrates are being met in the New River at the facility. The increase in reported nitrate releases was a result of a calculation error and does not reflect an actual increase in emissions.

On-site releases to water include discharges to surface waters, such as rivers, lakes, ponds, and streams. On-site releases to the land (~ 4.9 million lbs.) 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 underground injection as a method of hazardous waste disposal, and no underground injection of TRI chemicals was reported in 2006.

Ten chemicals and chemical categories accounted for more than 99.9% of the on-site TRI chemical releases to the water. The top ten TRI chemicals released to water were: nitrate compounds (98.7% of total releases to water = 19.02 million lbs.), manganese and manganese compounds (0.71% = 0.137 million pounds), barium and barium compounds (0.19% = 0.037 million pounds), zinc and zinc compounds (0.19% = 0.036 million pounds), copper and copper compounds (0.07% = 0.013 million pounds), vanadium and vanadium compounds (0.03% = 0.006), nickel and nickel compounds (0.02% = 0.004 million pounds), lead and lead compounds (0.01% = 0.002 million pounds), arsenic and arsenic compounds (0.01% = 0.002 million pounds), and various glycol ethers (0.01% = 0.001 million pounds). All others total 0.01% and 0.002 million pounds. Nitrate compounds are a common byproduct of industrial (and domestic) wastewater treatment processes and have consistently been reported as the major chemical released to the surface water. Nitrates can pose a nutrient problem to water bodies at lower than toxic concentrations.

A considerable amount of additional information on specific groups of chemicals and the quantities of their chemical releases is available in analyses within the original report (2006 VIRGINIA TOXICS RELEASE INVENTORY (TRI) REPORT - March 2008). The March 2008 Virginia TRI Summary Report, summarizing data from CY2006 industry reports, is available on the DEQ Website at: http://www.deq.virginia.gov/sara3/3132006.html.

For further information on the Virginia TRI, contact:

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Additional sources of information on the Toxic Release Inventory: Community Right-to-Know, including the access and use of TRI data and fact sheets for individual states, are available from the EPA's Internet site: http://www.epa.gov/tri/. A CD-ROM, containing all data from the 1987 through 1997 Toxic Release Inventory: Community Right-to-Know is also available from the EPA.

The next Virginia TRI report, summarizing toxic releases for calendar year 2007, should be available in March 2009.

7.0 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. Although the P2 Program focuses primarily on the reduction of solid wastes, the reduction of waste 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, perhaps most important of all, among industries using and/or producing toxic materials.

OPP's activities for each fiscal year are summarized in the Pollution Prevention Annual Report, submitted to the Governor and the General Assembly in December of each year. The 2008 report summarizes the

pollution prevention strategies developed and implemented by the Virginia Pollution Prevention Program, which is coordinated with other DEQ activities as well as with those of the Department of Conservation and Recreation. The current annual report summarizes activities carried out by the major components of the Pollution Prevention Program during 2008, several of which are briefly summarized here:

- At the end of 2008 there were approximately 450 facilities in the Virginia Environmental Excellence Program (VEEP), almost 100 more than last year. This Program recognizes three levels of performance for participating 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, and (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. At present, almost 60% of the 450 facilities are at the E2 level, about a third of them are at the E3 level, and the remaining 5% are at the E4 level. Twenty-four of these facilities were honored with special recognition during 2008. Virginia still provides performance-based permit fee discounts (from 2 to 20%) for "going beyond compliance." In 2008 over $43,000 in fee discounts were distributed among more than 100 VEEP facilities that implemented and performed their Environmental Management Plans.
- A review of VEEP annual performance for 2008 reported a reduction of 628 tons in the use of hazardous materials, and an increase of 125,367 tons in the use of recycled materials. Total water use increased by 585 million gallons, but the use of recycled water increased by 23 million gallons. The disposal of hazardous waste decreased by 1,733 tons in 2008 and the recycling of non-hazardous waste increased by 62,924 tons. The emission of toxic gases (NO_x, SO_x), volatile organic compounds and particulate matter to the air decreased by more than 643 tons. Over $10 million in cost savings were realized during this process.
- DEQ's voluntary mercury reduction initiatives have also been successful. Members of the "Virginia Switch Out" Project for the recycling of automotive mercury switches have pledged the removal of 1500 switches, equivalent to five pounds of mercury, annually. Nearly 40 facilities have pledged to recycle almost 53,000 energy efficient fluorescent light bulbs per year, which contain small quantities of mercury. (Refer to DEQ's Mercury Reduction WebPages - http://www.deq.virginia.gov/p2/mercury/homepage.html.)
- DEQ's Pollution Prevention in Healthcare Program (Hospitals for a Healthy Environment – VH2E) continued to promote the reduction of regulated medical wastes, to reduce toxic materials by encouraging environmentally preferable purchasing practices, and to eliminate mercury from health care purchases. The national H2E Program transitioned into a privately run partnership during 2008; it is now fee-based and is no longer directly supported by EPA. OPP continues to actively support regional hazardous waste compliance staffs and assists with outreach visits to healthcare facilities.
- Over the years, more than 400 Virginia participants in the Businesses for the Bay (B4B) Program had accounted for more than 750 million pounds of reduced pollutants and saved more than $12 million dollars as a result of their pollution prevention efforts, receiving more than half of the awards given for outstanding performance. Unfortunately, however, in 2008, the EPA's Chesapeake Bay Program ended its financial support of the Businesses for the Bay (B4B) Program. OPP will continue to support Virginia participants with whatever resources are available.
- DEQ's OPP also administers the Commonwealth's National Partnership for Environmental Priorities (NPEP) program, which encourages public and private organizations to form voluntary partnerships (with states and the EPA) that reduce the use or release of substances that have been designated "Priority Chemicals" – i.e., substances that are persistent, bioaccumulative and toxic. In 2008 Virginia

NEEP facilities pledged to reduce the use of priority chemicals by 6420 lbs: 200 lbs of mercury, 5020 lbs of polychlorinated biphenyls (PCBs), and 1,200 lbs of lead. Seven Virginia facilities received special recognition at EPA's "Waste Wise and NPEP Annual Conference" in 2008.

For additional information concerning the Pollution Prevention (P2) Program, visit the DEQ WebPages at http://www.deq.virginia.gov/p2/ , or contact:

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8.0 Summary and Conclusions

DEQ's commitment to toxics reduction includes (1) the prevention of contamination of the state's waters by toxics, (2) the continued monitoring of those waters for the presence of toxics, and (3) the development of TMDLs and the implementation of remedial measures to reduce and/or eliminate toxics found in the state's waters. The following summary is organized in relation to the interacting, cyclic relationship among these three activities and incorporates all eight specific items of information identified in the original legislation (Chapter 3.1, Title 62.1, § 62.1-44.17:3 of the Code of Virginia) requiring this report.

8.1 Pollution Prevention

Virginia Pollutant Discharge Elimination System (VPDES)

During SFY08, DEQ's Toxics Management Program included 307 reporting facilities with 749 outfalls that had toxics limits in their VPDES permits (Appendix J). All of the associated permits had start dates prior to July of 2007. Of the 8,484 parameter-specific results reported, 161 values (1.9%) had measured values that exceeded their permitted maximum concentration limits (Appendix L). In most cases, they resulted from minor isolated variations that occasionally exceeded the limit, almost always for total, or occasionally dissolved metals at municipal wastewater treatment plants. (Copper and zinc were the most common.) On 19 occasions parameter-specific exceedences persisted during multiple reporting dates during the period.

Office of Pollution Prevention

The 2008 Pollution Prevention Annual Report is available on the DEQ WebPages at http://www.deq.virginia.gov/p2/homepage.html . At the end of 2008 the Virginia Environmental Excellence Program (VEEP) included approximately 450 facilities, 24 of which received special recognition during 2008. Virginia awarded over $43,000 in fee discounts to more than 100 VEEP facilities for the performance of their Environmental Management Plans. VEEP reported a 628 ton decrease in the use of hazardous materials, and an increase of 125,367 tons in the use of recycled materials. This was accompanied by a 1,733 ton reduction in the disposal of hazardous wastes and an increase of 62,924 tons of non-hazardous waste recycled. Releases to the atmosphere were also significantly reduced: toxics emissions were reduced by 19 tons, NOx emissions were reduced by 403 tons, SO_x emissions were reduced

by 3,640 tons, emissions of volatile organics were reduced 220 tons and particulate emissions were reduced by 2,400 tons.

Virginia's 400+ members of the Businesses for the Bay (B4B) Program have been responsible for more than 750 million pounds of waste reduction and recycling since the program began, at a savings exceeding $12 million. Unfortunately, however, EPA's Chesapeake Bay Program has suspended its financial support for the B4B Program.

In 2008, Virginia facilities in the National Partnership for Environmental Priorities (NPEP) Program pledged to reduce priority chemical use by 6,420 pounds - 200 lbs of mercury, 5020 pounds of PCBs, and 1,200 lbs of lead.

8.2 Monitoring

Toxics Release Inventory

The March 2008 Toxics Release Inventory (TRI) Report is available on the DEQ Website at: http://www.deq.virginia.gov/sara3/ . The TRI Report summarizes data from 2006, during which 467 Virginia facilities filed 1786 individual reports. Statewide toxic releases to the water totaled approximately 19.5 million pounds or 29% of the total onsite releases to all media during 2006. Of the top ten TRI chemicals released to water, nitrate compounds represented 98.7% of the total (19.02 million lbs.). Nitrates are of much more concern for their effect as nutrients rather than as toxics.

Water Quality Monitoring Programs

Statewide, DEQ's Water Quality Monitoring Programs collected and analyzed 624 toxics-related samples at freshwater sites during SFY08, 153 from sediments and 471 from water. Most freshwater sampling was in association with mercury special studies in the Shenandoah and South Fork Shenandoah special studies and the Freshwater Probabilistic Monitoring Program represented most of the remaining. TMDL and other toxics-related special studies accounted for another 20%. The Estuarine Probabilistic Monitoring Program collected sediment samples from an additional 50 sites; these were analyzed for chemical contamination and toxicity, as well as benthic community health. Specific monitoring results from WQM programs are available by means of the Water Quality Monitoring Data Retrieval Application at http://gisweb.deq.virginia.gov/monapp/mon_data_retrieval_app.html and scheduled activities from the current Water Quality Monitoring Plan are available at http://www.deq.virginia.gov/watermonitoring/.

The 2008 workplan for the Fish Tissue and Sediment Monitoring Program identified 85 tentative sampling sites, from which results will become available next year. Analytical results from the Program's 2007 sampling are still arriving. In all, a total of 842 individual or composite fish tissue samples were collected. To date, 581 results have been returned for tissue metals, 471 for PCBs, and 231 for pesticides. No PAH analyses were carried out in 2007-2008. Although sediment samples were collected in association with each of the sampling sites, they have been archived as frozen reference samples and will only be analyzed if fish tissue results indicate a serious local problem. The most recent data and planning updates on this program are available at http://www.deq.virginia.gov/fishtissue/.

8.3 Assessment, Remediation, and the Continued Reduction of Toxics

Assessed Impairments – The 2008 Clean Water Act 305(b)/303(d) Integrated Water Quality Assessment Report

The 2008 Integrated Water Quality Assessment Report identified 2,448 miles of rivers, 111,384 acres of lakes, and 2,084 square miles of estuaries impaired by specifically identified toxics. Of these, over 99% were listed for fish consumption advisories, primarily for PCBs (41.6% of toxics impaired rivers, 64.9% of lakes, 99.0% of estuaries) or mercury (54.9% of rivers, 34.6% of lakes, <0.4% of estuaries). Because the number of segments united into each TMDL varies with the hydrography and the extent of the impairment, the exact number and schedule of TMDLs to be developed and implemented is not yet certain. DEQ's PCB Strategy (2005) establishes priorities for TMDL development and discusses various options for remediation. Analyses for the 2010 Integrated Report will begin in the spring of 2009, and any additional PCB-impaired segments will be integrated into the Strategy.

Remediation / Reduction

A number of toxics-related TMDLs have been completed and approved since 2002; two in 2002, three in 2004, and 16 in 2007, all for PCBs in the Shenandoah (5) or in other Virginia tributaries to the Potomac (16 - Appendix M). The Potomac tributary PCB TMDLs were incorporated into the interstate Potomac River PCB TMDL developed under the auspices of the Interstate Commission for the Potomac River Basin. This TMDL was submitted in November 2007and was subsequently approved by EPA. Two benthic TMDLs were completed for toxics parameters in 2006, one (copper and zinc) in the New River basin and one (PAHs and lead) in the Shenandoah.

Several additional toxics-related TMDLs are in development. Four TMDLs for PCBs in the Roanoke River are now scheduled for completion in 2009, and an additional four (also for PCBs) in the New River Basin will be completed by 2010. In November 2008, EPA requested additional funding (total of $3.7 million) for the cleanup of one former West Virginia industrial site in the Bluestone prior to completing the TMDLs in the New Basin. Seven VDH fish advisory (mercury) TMDLs are scheduled for 2010, three in the Shenandoah and four in the North Fork Holston. Benthic TMDLs for 11 PAH-impaired segments in the Tennessee/Big Sandy Basin and a single benthic TMDL in the Roanoke Basin (toxicant unknown) will be developed by 2010. The agency's TMDL history, current status and development plans are available at http://www.deq.virginia.gov/tmdl/.

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

Continued Commitment

DEQ continues its commitment to toxics reduction by the prevention of contamination, continued water quality monitoring, and the implementation of remedial measures. The Virginia Pollutant Discharge Elimination System and the Pollution Prevention Program join with other programs and stakeholders 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 continue to 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.

9.0 References

A cumulative bibliography of general references and publications cited in this and previous TRISWat Reports is included in Appendix N – References.