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January 2, 2008

MEMORANDUM:

TO: The Honorable Timothy M. Kaine

The Honorable Patricia S. Ticer, Chair
Senate Agriculture, Conservation and Natural Resources Committee

The Honorable Harvey B. Morgan, Chair
House Agriculture, Chesapeake and Natural Resources Committee

FROM: David K. Paylor

SUBJECT: The Toxics Reduction in State Waters Report 2007

In accordance with § 62.1-44.17:3 of the *Code of Virginia*, the Department of Environmental Quality has completed its annual report on the status of the State Water Control Board's efforts to reduce the level of toxic substances in state waters.

The Department of Environmental Quality is committed to preventing the contamination of the Commonwealth's waters by toxics, monitoring State waters for the presence of toxics and implementing remedial measures to reduce and/or eliminate toxics found in State waters. The primary objective of this report is to document the Commonwealth's commitment.

The full report is being made available at www.deq.virginia.gov/regulations/reports.html. If you need further information or would like a hard copy of this report, please contact me or Rick Linker at 804-698-4195.

**The Virginia**

**DEPARTMENT OF ENVIRONMENTAL QUALITY**

# Toxics Reduction in State Waters

# State Fiscal Year 2007

**A REPORT TO**

## THE GENERAL ASSEMBLY OF VIRGINIA

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/.

**COMMONWEALTH OF VIRGINIA**
**RICHMOND**
**JANUARY 1, 2008**

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(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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# Table of Acronyms and Abbreviations

| | |
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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://www.epa.gov/iris/) |
| 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

The Virginia Department of Environmental Quality (DEQ) submits the annual Toxics Reduction in State Waters (TRISWat) Report to the Governor and General Assembly of the Commonwealth on January 1st of each year, in accordance with Virginia Code § 62.1 - 44.17:3.

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 2007 (SFY07), DEQ's Toxics Management Program (TMP) included 301 reporting facilities with 747 outfalls that had active permit-defined toxics limits in their effluents, as recorded in DEQ's Comprehensive Environmental Data System (CEDS) database.

**Pollution Prevention:** The 2007 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 2007 there were approximately 360 facilities in the Virginia Environmental Excellence Program (VEEP); approximately 250 (70%) at the Environmental Enterprise (E2) level, approximately 100 (28%) at the Exemplary Environmental Enterprise (E3) level and approximately 12 (3%) at the Extraordinary Environmental Enterprise (E4) level. Twenty-seven of these facilities were honored with special recognition during 2007. 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 2007 over $57,500 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 2007 reported a reduction of 48.9 tons in the use of hazardous materials, a decrease of 150 tons in the disposal of hazardous wastes, and over 65 tons of hazardous wastes recycled. Over 3,900 tons of recycled materials were used and 9.4 million tons of non-hazardous materials were recycled. Greenhouse gas emissions were reduced by more than 8,700 tons, $NO_x$ emissions were reduced by 724 tons, and water use was reduced by almost 927 million gallons, while realizing total cost reductions of more than $1.5 million.
- DEQ's Voluntary Mercury Reduction Initiatives also have been successful. The "Virginia Switch Out" Project for the recycling of automotive mercury switches pledged the 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.)
- 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 Program and its participants received a number of awards and recognition from the national program. Participants reported the reduction of over 500 lbs of mercury as well as 185 tons of solid waste, and a cost savings of more than $335,000.
- Of the 960 members (735 participants and 125 mentors) of the Businesses for the Bay (B4B) Program, 398 (41%) are in Virginia. In 2007 they reported approximately 102 million pounds of waste reduction

and recycling, at a cost savings of over $2.6 million due to pollution prevention efforts. Virginia's participants earned eight B4B Excellence Awards in 2007, more than half of the total awarded.

- Virginia NEEP facilities have pledged to reduce priority chemical use by 592,682 pounds: 145 lbs of mercury, 225 lbs of methyl ethyl ketone, and 592,312 lbs of lead. An additional commitment is to reduce the use of lead by another 10,000 lbs by the end of 2008.

## Monitoring

**Toxics Release Inventory (TRI):** The March 2007 Toxics Release Inventory (TRI) Report is available on the DEQ Website at: http://www.deq.virginia.gov/sara3/3132005.html. It summarizes data from calendar year 2005, during which 488 facilities filed 1859 individual reports. Statewide toxic releases to the water totaled approximately 9.7 million pounds or 17% of the total onsite releases to all media during 2005. This represented an approximate 6.5% increase from the 9.15 million pounds released in 2004. Nitrate compounds, of much more concern for their effect as nutrients rather than as toxics, represented 97.3% of the total released.

**Water Quality Monitoring Programs:** As a result of the continual planning process within DEQ's Water Quality Monitoring (WQM) and Assessment Program, periodic updates and revisions of the agency's WQM Strategy are necessary. Two major changes in the 2007 WQM Strategy that affect toxics monitoring and assessment are 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.

Summer 2006 was the seventh year of DEQ's estuarine probabilistic monitoring and the spring and summer of 2007 comprised the seventh 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 2007 are included in this report. Sediment chemistry (metals and organics) and toxicity sampling were continued at estuarine ProbMon sites during the summer of 2006 with resources provided by a grant from the federal National Coastal Assessment Program, complimented with Chesapeake Bay Program support. Resources provided by a federal §106 grant supplement and by DEQ's Chesapeake Bay Program allowed the continuation of this sampling during the summer of 2007.

Beginning with the 2006 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 in estuarine waters. 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 2005 are being incorporated into the 2008 Integrated Report.

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 six 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. Reports on the probabilistic results are currently in preparation and 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 2006 Integrated Report identified 1,423 miles of rivers, 76,013 acres of lakes, and 2,145 square miles of estuaries impaired by specifically identified toxics. Of these, over 99% were listed for fish consumption advisories, primarily for PCBs (68% of toxics-impaired rivers, 95% of lakes, 98% of estuaries) or mercury (26% of rivers, 5% of lakes, <1% 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 yet certain. DEQ's PCB Strategy (2005) establishes priorities for TMDL development and discusses various options for remediation. The 2008 Integrated Report is in preparation, 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/. Twenty-three individual toxics-related TMDLs have been developed and approved since 2002 - 23 for PCBs, and two for benthic impairments with toxic stressors (copper + zinc, and lead + PAHs). Sixteen Potomac tributary PCB TMDLs have since been 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 has also been approved by the Environmental Protection Agency. Four additional TMDLs for PCBs in the Roanoke River are scheduled for completion in 2008. Another seven for VDH fish advisories (mercury) are scheduled for 2010, three in the Shenandoah and four in the North Fork Holston basins. Three additional TMDLs, for tributyltin in the Elizabeth River, are also scheduled for completion in 2010.

As these 24 completed and 21 scheduled TMDLs are implemented, 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 release. 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 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 2007

**State Fiscal Year 2007 Toxics Reduction in State Waters Report (**January 2008)

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

- A long-term Water Quality Monitoring (WQM) Strategy, revised and again 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 - 1 July of each year through 30 June of the following year) in order to provide complete analytical results by 1 January.

The SFY07 Toxics Reduction in State Waters Report (TRISWat-08 - eleventh in the series) summarizes all toxics reduction activities carried out between July 1, 2006 and June 30, 2007. The historical summaries of toxics monitoring results in Folders 3 through 6 are cumulative, with the addition of the corresponding year's results in each new report.

To minimize the size of the report, reduce production time and costs, and facilitate its distribution to interested parties, the data tables, figures and appendices of this report are presented in their complete form on, and may be downloaded from the DEQ 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 Patricia Carpin at (804) 698-4575 or pmcarpin@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 – SFY07) 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

The Virginia DEQ submits the Toxics Reduction in State Waters (TRISWat) Report to the Governor and the General Assembly of the Commonwealth by January 1st of each year, in accordance with **Chapter 3.1, Title 62.1, § 62.1-44.17:3 of the Code of Virginia**. The specific text from the Code that is related to the report is included below.

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**Article 3.1**
***Toxics Discharge Reduction***

**…**

**§ 62.1-44.17:3. Toxics reduction in state waters; report required.**

A. The Board shall (i) conduct ongoing assessments of the amounts of toxics in Virginia's waters and (ii) develop and implement a plan for the reduction of toxics in Virginia's waters.
B. The status of the Board's efforts to reduce the level of toxic substances in state waters shall be reported annually, no later than January 1, to the House Committees on Conservation and Natural Resources and Chesapeake and Its Tributaries, and the Senate Committee on Agriculture, Conservation and Natural Resources. The initial report shall be submitted no later than January 1, 1998, and shall include data from the previous five years on the trends of the reduction and monitoring of toxics in state waters. The initial report and each subsequent annual report shall include, but not be limited to, the following information:
1. Compliance data on permits that have limits for toxics
2. The number of new permits or reissued permits that have toxic limits and the location of each permitted facility;
3. The location and number of monitoring stations and the period of time that monitoring has occurred at each location;
4. A summary of pollution prevention and pollution control activities for the reduction of toxics in state waters;
5. The sampling results from the monitoring stations for the previous year;
6. The Board's plan for continued reduction of the discharge of toxics which shall include, but not be limited to, additional monitoring activities, a work plan for the pollution prevention program, and any pilot projects established for the use of innovative technologies to reduce the discharge of toxics;
7. The identification of any segments for which the Board or the Director of the Department of Environmental Quality has made a decision to conduct additional evaluation or monitoring. Information regarding these segments shall include, at a minimum, the geographic location of the stream segment within a named county or city; and
8. The identification of any segments that are designated as toxic impaired waters as defined in § 62.1-44.19:4 and any plans to address the impairment.

…

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## 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 – 1 July - 30 June).

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, eleventh TRISWat Report (January 2008) contains tables of both raw data and statistical summaries of SFY07 monitoring results.

The agency retains archived copies of previous TRISWat Reports (January 2001 – January 2007) 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 to those substances that are directly and "chemically" detrimental to living organisms when they are "in excess". Direct chemical effects would exclude the physical effects of excess sedimentation or the indirect effects of nutrient enrichment, for example, both of which would also be detrimental to aquatic life. Furthermore, the concept of "other adverse environmental effects" must be defined in biological terms, since toxicity can only be observed, described, and quantified in relation to living organisms. The classification of chemical substances ("a material") within the category of "toxics" (those that cause toxicity) is always based on the observed effects of their presence on specific living organisms. In fact, the concept of "excess" itself is defined in terms of the concentrations at or above which living organisms experience detrimental effects.

**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 is currently in the process of reevaluating its list of toxic substances, updating its database with recently (2007) released monitoring results, and defining new methodologies for toxics evaluation. Publication of a new report on "toxics characterization" of the Bay watershed, which was originally scheduled for publication in December of 2007, has been postponed until June of 2008.

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 U.S. 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/ost/pc/revcom.pdf. More recent updates are provided as a link from that address or 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 (9 VAC 25-260 Virginia Water Quality Standards. Statutory Authority: § 62.1-44.15 3a of the Code of Virginia - WITH AMENDMENTS EFFECTIVE JANUARY 12, 2006). 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.

**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 has in the past monitored the ambient concentrations of total metals in the water column, this practice has now been 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 can 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.

**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 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/.

**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://www.epa.gov/iris). A current list of the Risk-Based Tissue Screening Values (TSVs) for fish tissue used for the 305(b)/303(d) Integrated Report can be found at http://www.deq.virginia.gov/waterguidance/ pdf/042006.pdf. 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 305(b)/303(d) Integrated Report, federal law requires reporting procedures for the production, movement, storage, use, and release of many of these toxic substances. These procedures, as well as Virginia's annual Toxics Release Inventory (TRI) Report, are discussed more fully below.

## 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 affect toxics monitoring and assessment are 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 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, will result in the redistribution of a number of monitoring sites. The necessary adaptations were initiated in January 2007. The monitoring years and watershed rotations will now coincide with the limits of the expanded six-year assessment window being initiated for the 2008 305(b)/303(d) Integrated Report. Consequently, assessment in the 2008 Integrated Report will include balanced comprehensive statewide monitoring coverage by the rotating watershed network as well as by the freshwater and estuarine probabilistic monitoring networks.

## 1.5 Sampling Design and Monitoring Methodologies

Implementation of DEQ's Water Quality Monitoring Strategy has focused on the monitoring of toxics in a more systematic effort to assess their potential impact on ambient water quality. 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 consequent 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 past seven years has 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, with the exception of sampling at all probabilistic sites, since 2004 the monitoring of toxics has shifted focus from ambient waters to major point source discharges and other known or suspected problem areas. Major point source discharges and other targeted Standard Industrial Classifications (SICs) based on their permit status, 303(d)[1] listed waters, acid mine drainage (AMD) sites, and the Elizabeth River are prime areas where monitoring for dissolved metals continues to occur.

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 - SFY07", 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

[1] 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.

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 to define the severity, extent and probable source of contamination problems that have already been identified.

## 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 of the receiving water body, 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 current standards used for these comparisons are listed in the current Assessment Guidance Manual (http://www.deq.state.va.us/wqa/) for each 305(b)/303(d) Integrated Report and in Appendix C of this Toxics Reduction 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 Toxics Reduction 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://www.epa.gov/iris/). 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 the desired tests. 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 the permitted facilities are using.

## 2.1 Chemical Monitoring

**2.1.1. Monitoring Activities:** DEQ has 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 will be reduced in river basins not associated with TMDLs, 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 of 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 their 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 Ambient Water Quality Monitoring (AWQM) 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 AWQM Program during SFY07 are identified in Table 2.

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 2007 state fiscal year. Toxics samples, analytical costs, etc., 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 and 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 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 SFY07. This list includes a number of the probabilistic sites that are also described in Appendix H2a.

Appendix H2a, “Freshwater Probabilistic Monitoring Sites Sampled in SFY07”, provides a comprehensive list of the freshwater probabilistic monitoring stations that were included in the ambient program during fiscal year 2007. Many of these (the wadeable sites) were also sampled for benthic invertebrate populations and are also included in Appendix H1.

Appendix H2b, “Prospective Freshwater Probabilistic Monitoring Sites MY2006-10”, provides a comprehensive list of the potential probabilistic/biological stations that may be included in the ambient program during the five-year period. The final annual lists will become available after regional biologists perform both map and field reconnaissance prior to their 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 (MAIA) IBI for other tidal coastal waters, and the EMAP discriminant function as a secondary index in all tidal waters. This methodology is described in detail in the Assessment Guidance Manual (http://www.deq.virginia.gov/wqa/) for the biennial 305(b)/303(d) Integrated Reports.

Appendix G-2 provides a complete list of the DEQ Coastal 2000 / NCA estuarine probabilistic stations sampled during July - September 2006.

## 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 SFY07. Similar annual summary tables can be found in previous Toxics Reduction Reports (Jan 1999 – Jan 2007).

Numerous tables and folders containing raw and summarized monitoring results are described in the following sections of this report. The tables contain all the descriptive information 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 SFY07. 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 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 SFY07" presents the results of clean, dissolved metals monitoring during SFY07. Additional spreadsheets in Table 3 summarize the results from Shenandoah River Basin mercury and fish kill special studies. Basin-by-basin historical summaries of clean dissolved metals results can be found in the Excel® workbooks of Folder 3 - "TRISWat Jan08 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 is not normally included in ambient water quality monitoring. During SFY07, DEQ researchers did collect clean total mercury samples from the Shenandoah River basin and in Dragon Run (Piankatank River drainage) for the purpose of monitoring the transport of mercury (Hg) at many of the same sites where clean dissolved mercury samples were collected. Additional total metals samples were collected for special TMDL studies in Accotink Creek, Long Branch, and Difficult Run within the lower Potomac River Basin. The resultant data from these samples are included in the spreadsheets of Table 4 and in the workbooks of Folder 4 - "TRISWat Jan08 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 pesticides 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 SFY07. Several of the most recent special studies and some preliminary results are briefly described in Appendix I of this report. No tables or historical summaries are provided for dissolved organic contaminants.

### 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.

#### 2.3.2.1 Virginia Sediment Characterization Relative to other States

The status of Virginia's sediments was well characterized in comparison with the rest of the nation in a national survey published in 2004. A brief summary of Virginia's results in comparison with other states in the report is provided in Appendix G1 - National Sediment Quality Survey. The results confirm that sediment characterization of the Commonwealth's waters is as intense, if not more intense than that of any

other state and that, within EPA Region 3, Virginia had a lower percentage of significantly contaminated sediment sites, on average, than any other state in the region.

#### 2.3.2.2 Sediment Metals

Table 5, "Sediment Metals - All Basins - SFY07" presents tabular results and a statistical data summary of the SFY07 WQM sediment metals data. The Excel® workbooks of Folder 5 - "TRISWat Jan08 Folder 5 Metals Sediment Historical" present historical summaries. The sediment results from studies carried out by the Fish Tissue and Sediment Program are summarized elsewhere, in a separate section.

#### 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 ambient monitoring program expanded the suite of toxic sediment organics that it monitored from 13 to more than 200 compounds.

Table 6a - "Sediment OC Pesticides - All Basins – SFY07" and the corresponding Folder 6a summarize the ambient freshwater sediment organochlorine pesticide data from the most recent fiscal year.

Tables and Folders 6b, 6c, 6d and 6e are in the same format as Table 6a and Folder 6a. The results for sediment PCBs (6f) are so irregular among congeners that they were 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 last year's Toxics Reduction Report for tabular and graphical summaries.)

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 Standards 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 2007

A copy of the complete 2007 sampling plan is available at http://www.deq.state.va.us/fishtissue/ and as Appendix G to this Report. A complete list of the proposed sites scheduled for sampling during summer 2007 can be found on pages 5 - 16 of the sampling plan. (The normal summer sampling season spans parts of two consecutive state fiscal years.)

### 2.4.2 Fish tissue and sediment results (2006) received in 2007

The results from tissue and sediment samples are compared with the screening values listed in Appendices D and E, respectively. "Table 7a-1 Fish Tissue Metals WQS 2006 (Rec'd 2007)", Table 7a-2 Fish Tissue PCBs WQS 2006 (Rec'd 2007)", "Table 7a-3 Fish Tissue PAHs WQS 2006 (Rec'd 2007)" and "Table 7a-4 Fish Tissue Pesticides WQS 2006 (Rec'd 2007)" summarize the most recent results from fish tissue samples in relation to EPA-IRIS screening values.

"Table 7b Sediment Results WQS 2006 (Rec'd 2007)" summarizes the results of sediment samples collected during the summer of 2006, in relation to the NOAA ER-M and/or consensus-based PEC 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 water 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 SFY07" 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 SFY07, 301 reporting facilities with 747 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 SFY07. The compliance results of each permitted facility's Discharge Monitoring Reports (DMRs) during SFY07 are reported in "Appendix L – Permitted Toxics Parameters & DMR Results SFY07." Some facilities may hold permits requiring only that they report, without a limit-specified value with which they must comply. Since 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 Regional Office level in response to locally recognized problems. Regional special studies that dealt with toxics during SFY07 are summarized in detailed descriptions within "Appendix I – Special Studies Related to Toxics SFY07." 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 also 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 (Refer to the section on the Elizabeth River Program – pp 33-34).

**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; marchirds@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 2008 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 (1 July - 30 June). Beginning in 2006, the DEQ Monitoring Year has corresponded to the calendar year, rather than the state fiscal year, in order to synchronize various ambient monitoring program

schedules with one another, with the ecological and water year cycles, and with the "assessment window" or monitoring period considered for each 305(b)/303(d) Integrated 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 2008 was completed in mid-December 2007 and will be initiated on January 1, 2008. 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 and two-year rotations of the watershed monitoring network (1 January 2007 until 31 December 2008) will continue without significant modification. Other aspects of the Plan, which deal with TMDLs and other special studies or with shorter term rotations such as lake monitoring or citizen requests, will be updated for inclusion in the 2008 Plan.

## 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 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 SPMDs may partially alleviate 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 deposition 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 will provide reliable statistical descriptions of regional conditions that can be compared from one sampling cycle to the next. Among the additional strategies being developed is 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. 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 2006 305(b)/303(d) Integrated Report, the associated 2006 Assessment Guidance Manual, and interactive maps are available via the DEQ Water Quality Assessment WebPages at:

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

The 2006 Integrated Report was submitted in September of 2006 and the associated 303(d) list of impaired waters was subsequently approved by EPA.

The Water Quality Assessment Guidance Manual for the 2008 305(b)/303(d) Integrated Water Quality Assessment Report is now available via the same Internet address. Any recent changes in assessment methodologies for toxics are 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 have remained unchanged from 2006.

Appendix M - "List of Segments not Fully Supporting Designated Uses because of Toxics (2006 303(d) List)" of the current Toxics 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 2006 305(b)/303(d) Integrated Report. It has remained unchanged since the last Toxics Reduction in State Waters Report. An updated list will be available in 2008, following completion of the next 305(b)/303(d) Integrated Report.

The 2006 Integrated Report identified 1,423 miles of rivers, 76,013 acres of lakes, and 2,145 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 (68% of rivers impaired by toxics, 95% of lakes, 98% of estuaries) or mercury (26% of rivers, 5% 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 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. The 2008 Integrated Report is in preparation, and any new PCB-impaired segments will be integrated into the Strategy.

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

**Extent of Impairments by Toxics Identified in the 2006 305(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) | **7** | **Mercury** | **Rivers** (miles) | **0** |
| | **Lakes** (acres) | **0** | | **Lakes** (acres) | **28** |
| | **Estuaries** (sq. miles) | **0** | | **Estuaries** (sq. miles) | **0** |
| **Arsenic** (fish tissue) | **Rivers** (miles) | **3** | **Mercury** (fish tissue) | **Rivers** (miles) | **374** |
| | **Lakes** (acres) | **0** | | **Lakes** (acres) | **3,401** |
| | **Estuaries** (sq. miles) | **0** | | **Estuaries** (sq. miles) | **8** |
| **Benzo(k)fluoranthene** (fish tissue) | **Rivers** (miles) | **35** | **PCBs** (fish tissue) | **Rivers** (miles) | **973** |
| | **Lakes** (acres) | **0** | | **Lakes** (acres) | **72,008** |
| | **Estuaries** (sq. miles) | **0** | | **Estuaries** (sq. miles) | **2,110** |
| **Chlordane in fish tissue** (fish tissue) | **Rivers** (miles) | **2** | **PCBs** | **Rivers** (miles) | **0** |
| | **Lakes** (acres) | **0** | | **Lakes** (acres) | **28** |
| | **Estuaries** (sq. miles) | **0** | | **Estuaries** (sq. miles) | **0** |
| **Copper** | **Rivers** (miles) | **6** | **Estuarine Sediment** (toxicity tests) | **Rivers** (miles) | **N/A** |
| | **Lakes** (acres) | **548** | | **Lakes** (acres) | **N/A** |
| | **Estuaries** (sq. miles) | **0** | | **Estuaries** (sq. miles) | **2** |
| **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) | **0** | **Zinc** | **Rivers** (miles) | **4** |
| | **Lakes** (acres) | **0** | | **Lakes** (acres) | **0** |
| | **Estuaries** (sq. miles) | **14** | | **Estuaries** (sq. miles) | **0** |
| **Total Toxics Impairments** | **Rivers** (miles) | **1,423** | **Total Fish Consumption Impairments** | **Rivers** (miles) | **1,413** |
| | **Lakes** (acres) | **76,013** | | **Lakes** (acres) | **75,409** |
| | **Estuaries** (sq. miles) | **2,145** | | **Estuaries** (sq. miles) | **2,132** |

## 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 always 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.state.va.us/epidemiology/publichealthtoxicology/Advisories/index.htm.

Additional information from the fish-tissue/sediment monitoring program is available from Alex M. Barron, Office of Water Quality Standards at (804) 698-4119 or ambarron@deq.virginia.gov. Several reports on fish tissue and sediment monitoring by the Office of WQS 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 five 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). The Potomac tributary PCB TMDLs have since been 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 and has also been approved by EPA. 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.

Four additional TMDLs for PCBs in the Roanoke River are scheduled for completion in 2008. An additional seven for VDH fish advisories (mercury) are scheduled for 2010, three in the Shenandoah and four in the North Fork Holston. Three additional TMDLs, for tributyltin in the Elizabeth River, are also scheduled for completion in 2010.

As these 24 completed and 21 scheduled TMDLs are implemented, 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). The 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) are *highly impacted* areas, *Areas of Low Probability for Adverse Effects* are regional areas that are *not impacted* by chemical contaminants, and *Areas of Emphasis* have 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 could include additional ambient toxics monitoring in those regional areas characterized as *Areas of Insufficient Data.*

The Chesapeake Bay Program has a commitment to produce a new Bay-wide Toxics Characterization Report. A "Toxics Characterization Workgroup" of the Toxics Subcommittee is currently in the process of reevaluating its list of toxic substances, updating its database with recently (2007) released monitoring results, and defining new methodologies for toxics evaluation. Complementary monitoring for toxics that has been carried out since 1999 has now provided data for Virginia's "Areas of Insufficient Data" that were identified in the original report. (Refer to the 1999 map at http://www.chesapeakebay.net/pubs/maps/2002-130.pdf ) A draft 2007 update of the 1999 map has already been circulated to the Bay Program stakeholders for comments. Publication of the new toxics characterization report, which was originally scheduled for publication in December of 2007, has been postponed until June of 2008.

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.

# 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 the Department of Environmental Quality (DEQ) are working 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.

## 5.1 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/wquality.htm

## 5.2 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 lesion, 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). An additional report on mummichog liver histopathology and sediment PAHs is scheduled for completion by early 2008.

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

## 5.3 Tributyltin (TBT) Monitoring

Dr. Mike Unger, from VIMS, 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 (380 ng/L) have been observed. A description of this monitoring program and a series of reports summarizing the results from 1999-2006 can be viewed at http://www.vims.edu/env/projects/tbt_deq/. .

### 5.4 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 the summer of 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 2006 are summarized in the table below.

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.

| 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 |

### 5.5 Elizabeth River Monitoring Reports: 2003-2007


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. 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 at (757) 518-2150 or rkeverton@deq.virginia.gov.

## 6.0 Virginia Toxics Release Inventory

(http://www.deq.virginia.gov/sara3/3132005.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 2007) indicated that 488 Virginia facilities filed 1859 individual reports on the release, transfer, or management of TRI chemicals or chemical categories for the 2005 activity year. Statewide toxic releases to the water totaled approximately 9.7 million pounds or 17% of the total onsite releases to all media during 2005. This quantity represents an approximate 6.5% increase from the ~9.15 million pounds released in 2004.

On-site releases to water include discharges to surface waters, such as rivers, lakes, ponds, and streams. On-site releases to the land (~5.9 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 under-ground injection as a method of hazardous waste disposal, and no under-ground injection of TRI chemicals was reported in 2005.

Ten chemicals and chemical categories accounted for more than 99.8% of the on-site TRI chemical releases to the water. The top ten TRI chemicals released to water were: nitrate compounds (97.3% of total releases to water = 9.60 million lbs.), ammonia (0.76% = 0.075 million pounds), manganese and manganese compounds (0.72% = 0.071 million pounds), barium and barium compounds (0.31% = 0.031 million pounds), zinc and zinc compounds (0.22% = 0.021 million pounds), sodium nitrite (0.18% = 0.018 million pounds), chlorine (0.12% = 0.011 million pounds), copper and copper compounds (0.11% = 0.010 million pounds), N-methyl-2-pyrrolidone (0.077% = 0.008 million pounds), and dimethylamine (0.075% = 0.007 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. (To date, only one 2.2 mile stream segment statewide has been assessed as impaired for toxic levels of nitrates, and a TMDL has been completed and approved.)

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 (2005 VIRGINIA TOXICS RELEASE INVENTORY (TRI) REPORT - March 2007). The March 2007 Virginia TRI Summary Report, summarizing data from CY2005 industry reports, is available on the DEQ Website at: http://www.deq.virginia.gov/sara3/3132005.html.

For further information on the Virginia TRI, contact:

Primary Contact: Nichelle D. McDaniel
Program Coordinator, SARA Title III
(804) 698-4159
ndmcdaniel@deq.virginia.gov

Alternate Contact: Sanjay Thirunagari
Environmental Program Manager, SARA Title III
(804) 698-4193.
skthirunagari @deq.virginia.gov

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 2006, should be available by March 2008.

## 7.0 Reduction of Toxics by Pollution Prevention

The Office of Pollution Prevention (OPP) of DEQ contributes to the reduction of toxics in the state's waters through its multimedia (i.e., air, water, and waste) non-regulatory pollution prevention 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 2007 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 annual report presents summaries of activities carried out by the major components of the Pollution Prevention Program during 2007, several of which are briefly summarized here.

- At the end of 2007 there were approximately 360 facilities in the Virginia Environmental Excellence Program (VEEP). 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, there are approximately 250 facilities (~ 70%) at the E2 level, ~ 100 (28%) at the E3 level and ~ 12 (3%) at the E4 level. Twenty-seven of these facilities were honored with special recognition during 2007. 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 2007 over $57,500 in fee discounts were distributed among almost 100 VEEP facilities that implemented and performed their Environmental Management Plans.

- A review of VEEP annual performance for 2007 reported a reduction of 48.9 tons in the use of hazardous materials, a decrease of 150 tons in the disposal of hazardous wastes, over 65 tons of hazardous wastes recycled. Over 3,900 tons of recycled materials were used and 9.4 million tons of non-hazardous materials were recycled. Greenhouse gas emissions were reduced by more than 8,700 tons, $NO_x$ emissions were reduced by 724 tons, and water use was reduced by almost 927 million gallons, while realizing total cost reductions of more than $1.5 million.
- DEQ's Voluntary Mercury Reduction Initiatives have been successful. The "Virginia Switch Out" Project for the recycling of automotive mercury switches pledged the 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.)
- 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 Program and its participants receive a number of awards and recognition from the national program. Participants reported the reduction of over 500 lbs of mercury as well as 185 tons of solid waste, and a cost savings of more than $335,000.
- Of the 960 members (735 participants and 125 mentors) of the Businesses for the Bay (B4B) Program, 398 (41%) are in Virginia. In 2007 they reported approximately 102 million pounds of waste reduction and recycling, at a cost savings of over $2.6 million due to pollution prevention efforts. Virginia's participants earned eight B4B Excellence Awards in 2007, more than half of the total awarded.
- DEQ administers Virginia's National Partnership for Environmental Priorities (NPEP) program, previously called the National Waste Minimization Program, which was renamed and re-energized in 2004. The NPEP program encourages public and private organizations to form voluntary partnerships, with states and the EPA, that reduce the use or release of any of the thirty-one substances that have been designated "Priority Chemicals". Virginia NEEP facilities have pledged to reduce priority chemical use by 592,682 pounds: 145 lbs of mercury, 225 lbs of methyl ethyl ketone, and 592,312 lbs of lead. An additional commitment is to further reduce the use of lead by 10,000 lbs by the end of 2008.

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

Sharon Baxter
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629 E. Main Street
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## 8.0 Summary and Conclusions

DEQ's commitments to toxics reduction include (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 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.

## 8.1 Pollution Prevention

### Virginia Pollutant Discharge Elimination System (VPDES)

During SFY07, DEQ's Toxics Management Program included 304 reporting facilities with 747 outfalls that had toxics limits in their VPDES permits (Appendix J). Of these, 68 permits were new or reissued during the period. Of the 8,562 parameter-specific results reported, 155 values (1.8%) 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. On 14 occasions parameter-specific exceedences persisted during multiple reporting dates during the period.

### Office of Pollution Prevention

The 2007 Pollution Prevention Annual Report is available on the DEQ WebPages at http://www.deq.virginia.gov/p2/pdf/report07.pdf. At the end of 2007 the Virginia Environmental Excellence Program (VEEP) included approximately 360 facilities, 27 of which received special awards during 2007. Virginia awarded over $57,000 in fee discounts to almost 100 VEEP facilities for the performance of their Environmental Management Plans. VEEP reported a 150 ton decrease in the disposal of hazardous wastes and 65 tons of hazardous waste recycled. Over 3,900 tons of recycled materials were used and 9.4 million tons of non-hazardous materials were recycled. Greenhouse gas emissions were reduced by >8,700 tons and $NO_x$ emissions were reduced by 724 tons.

Total mercury reductions resulted in the removal of more than 500 lbs of mercury, and many facilities have also pledged to recycle energy efficient fluorescent light bulbs, which also contain small quantities of mercury. A reduction of 185 tons of solid waste and a significant reduction in regulated medical wastes were reported by the health care industry. Virginia's 398 members of the Businesses for the Bay (B4B) Program reported approximately 102 million pounds of waste reduction and recycling. Virginia facilities in the National Partnership for Environmental Priorities (NPEP) Program pledged to reduce priority chemical use by 592,682 pounds - 145 lbs of mercury, 225 lbs of methyl ethyl ketone, and 592,312 lbs of lead. A commitment was made to reduce the use of lead by an additional 10,000 lbs by the end of 2008.

## 8.2 Monitoring

### Toxics Release Inventory

The March 2007 Toxics Release Inventory (TRI) Report is available on the DEQ Website at: http://www.deq.virginia.gov/sara3/3132005.html. It summarizes data from 2005, during which 488 facilities filed 1859 individual reports. Statewide toxic releases to the water totaled approximately 9.7 million pounds or 17% of the total onsite releases to all media during 2005. This represented an approximate 6.5% increase from the ~9.15 million pounds released in 2004. Of the top ten TRI chemicals released to water, nitrate compounds represented 97.3% of the total (9.6 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 515 toxics-related samples at 150 freshwater sites during SFY07, 72 from sediments and 443 from water. An additional 347 samples collected within other programs included toxic analytes. Most freshwater sampling (47%) was in association with mercury special studies in the Shenandoah, South Fork Shenandoah or Dragon Run special

studies. The Freshwater Probabilistic Monitoring Program represented 26% of the total, and TMDL and other toxics-related special studies accounted for another 18%. 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 at http://www.deq.virginia.gov/watermonitoring/.

The 2007 workplan for the Fish Tissue and Sediment Monitoring Program identified 107 tentative sampling sites, from which results will become available next year. Analytical results from the program's 2006 sampling are still arriving. In all, a total of 735 fish tissue samples were submitted for metals analyses, 510 for PCBs, and 25 for other organics (PAHs and pesticides). Ninety-seven sediment samples were submitted for metals analyses, 73 for PCBs, and 27 for other organics. 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 2006 305(b)/303(d) Integrated Water Quality Assessment Report

The 2006 Integrated Report identified 1,423 miles of rivers, 76,013 acres of lakes, and 2,145 square miles of estuaries impaired by specifically identified toxics. Of these, over 99% were listed for fish consumption advisories, primarily for PCBs (68% of toxics impaired rivers, 95% of lakes, 98% of estuaries) or mercury (26% of rivers, 5% of lakes, <1% 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. The 2008 Integrated Report is in preparation, and any new 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 have since been 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 and has also been approved by EPA. 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.

Four additional TMDLs for PCBs in the Roanoke River are scheduled for completion in 2008. An additional seven for VDH fish advisories (mercury) are scheduled for 2010, three in the Shenandoah and four in the North Fork Holston. Three additional TMDLs, for tributyltin in the Elizabeth River, are also scheduled for completion in 2010. The agency's TMDL history, current status and development plans are available at http://www.deq.virginia.gov/tmdl/.

As these 24 completed and 21 scheduled TMDLs are implemented, 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 release. 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 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**.