COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER QUALITY PROGRAMS
ELLEN GILINSKY, Ph.D., DIRECTOR

P.O.BOX 1105 **Richmond, VA 23218**

Subject: Guidance Memo No. 07-2010
2008 Water Quality Assessment Guidance Manual

To: Regional Directors

From: Ellen Gilinsky, Ph.D., Director

Date: **June 25, 2007**

Copies: Alan Pollock, Regional Water Quality Planning Managers and staff, Office of Water Quality Programs Managers, WQMA Staff

Summary:

EPA's 2006 Integrated Report Guidance and subsequent 2008 clarification guidance recommended that states submit an "Integrated Report" that will satisfy Clean Water Act (CWA) requirements for both Sections 305(b) water quality reports and 303(d) impaired waters lists. This Integrated Report will include the following information:

- delineation of water quality assessment units (AUs) based on National Hydrography Dataset (NHD);
- status of and progress toward achieving comprehensive assessments of all waters;
- Water Quality Standard attainment determination for every AU;
- additional monitoring that may be needed to determine Water Quality Standard attainment status and, if necessary, to support development of TMDLs for each pollutant/AU combination;
- schedules for additional monitoring planned for AUs;
- pollutant/AU combinations still requiring TMDLs;
- TMDL development schedules reflecting the priority ranking of each pollutant/AU Combination; and
- Water Quality "Effluent Limited" Waters.

DEQ has incorporated the EPA Integrated Reporting guidance into the 2008 DEQ assessment guidance. It is essentially the same overall guidance used in 2006 with the addition of an EPA subcategory (5M) for atmospheric mercury impairments and is designed to integrate or combine the 305(b) overall assessment of Virginia's waters and separate out those waters impaired and needing a TMDL as per 303(d). The EPA 2008 Integrated Report Guidance and Assessment Database (ADB V2.2.0) has 5 different categories with some having subcategories, in which every segment or "assessment unit" (AU) will be placed. The US EPA Integrated Report Guidance allows the states to subdivide the federal Categories in order to address state programmatic needs. Virginia has subdivided the categories for enhanced tracking and data management purposes.

Below are the US EPA defined Categories followed by associated Virginia defined subcategories**:**

FULLY SUPPORTING - Waters are supporting one or more designated uses.

- **EPA Category 1 -** Attaining all associated designated uses and no designated use is threatened

  Va. Category 1A - waters are attaining all uses and a TMDL has been developed for one or more uses.

- **EPA Category 2 –** Available data and/or other information indicate that some, but not all of the designated uses are supported.

  Va. Category 2A - waters are supporting all of the uses for which they are monitored.

  Va. Category 2B - waters are of concern to the state but no Water Quality Standard exists for a specific pollutant, or the water exceeds a state screening value or toxicity test.

  Va. Category 2C - waters are now attaining the use(s) for which they were originally 303(d) listed and the TMDL is EPA approved but other applicable use(s) were not monitored and assessed.

INDETERMINATE - Waters needing additional information.

EPA Category 3 - Insufficient data and/or information to determine whether any designated uses are met

Va. Category 3A - no data are available within the data window of the current assessment to determine if any designated use is attained and the water was not previously listed as impaired.

Va. Category 3B - some data exists but are insufficient to determine support of any designated uses. Such waters will be prioritized for follow up monitoring.

Va. Category 3C- data collected by a citizen monitoring or other organization indicating water quality problems may exist but the methodology and/or data quality has not been approved for a determination of support of designated use(s). These waters are considered as having insufficient data with observed effects. Such waters will be prioritized by DEQ for follow up monitoring.

Va. Category 3D - data collected by a citizen monitoring or other organization indicating designated use(s) are being attained but the methodology and/or data quality has not been approved for such a determination.

IMPAIRED - Waters are impaired or threatened but a TMDL is not required.

- **EPA Category 4A -** water is impaired or threatened for one or more designated uses but does not require a TMDL because the TMDL for specific pollutant(s) is complete and US EPA approved.
- **EPA Category 4B -** water is impaired or threatened for one or more designated uses but does not require the development of a TMDL because other pollution control requirements (such as VPDES limits under a compliance schedule) are reasonably expected to result in attainment of the Water Quality Standard by the next reporting period or permit cycle.
- **EPA Category 4C -** water is impaired or threatened for one or more designated uses but does not require a TMDL because the impairment is not caused by a pollutant and/or is determined to be caused by natural conditions.

IMPAIRED - Waters are impaired or threatened and require a TMDL

- **EPA Category 5 - Waters are impaired or threatened and a TMDL is needed.**

Va. Category 5A - a Water Quality Standard is not attained. The water is impaired or threatened for one or more designated uses by a pollutant(s) and requires a TMDL (303d list).

Va. Category 5B - the Water Quality Standard for shellfish use is not attained. One or more pollutants causing impairment require TMDL development.

Va. Category 5C - the Water Quality Standard is not attained due to "suspected" natural conditions. The water is impaired for one or more designated uses by a pollutant(s) and may require a TMDL (303d list). WQ Standards for these waters may be re-evaluated due to the presence of natural conditions.

Va. Category 5D - the Water Quality Standard is not attained where TMDLs for a pollutant(s) have been developed but one or more pollutants are still causing impairment requiring additional TMDL development.

Va. Category 5E - effluent limited facilities are not expected to meet compliance schedules by next permit cycle or reporting period.

Va. Category 5F - the WQ Standard is attained for a pollutant(s) with a TMDL and 303(d) delisting approved but the water remains impaired for additional pollutant(s) requiring TMDL development.

- **EPA Category 5M** – the WQ Standard is not attained for mercury primarily due to atmospheric deposition.

Electronic Copy:

An electronic copy of this guidance in PDF format is available for staff internally on DEQNET, and for the general public on DEQ's website at: http://www.deq.virginia.gov/water.

Contact information:

If you have any questions regarding the guidance manual, you can contact Harry Augustine, Department of Environmental Quality, P.O. Box 1105, Richmond, Virginia 23218. Telephone (804) 698-4037, FAX (804) 698-4116, or via e-mail hhaugustine@deq.virginia.gov.

Disclaimer:

This document is provided as guidance and, as such, sets forth standard operating procedures for the agency. However, it does not mandate any particular method nor does it prohibit any particular method for the analysis of data, establishment of a wasteload allocation, or establishment of a permit limit. If alternative proposals are made, such proposals should be reviewed and accepted or denied based on their technical adequacy and compliance with appropriate laws and regulations.

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

WATER QUALITY ASSESSMENT GUIDANCE MANUAL for

Y2008

305(b)/303(d) Integrated Water Quality Report

June, 2007

Table of Contents

i **PREFACE** P. 7

ii **PURPOSE** P. 7

iii **BACKGROUND** P. 8

PART I **305(b)/303(d) ASSESSMENT PROCESS** P. 11

PART II **WATER QUALITY MONITORING, INFORMATION and RESTORATION ACT** P. 13

PART III **RULES FOR 2006 WATER QUALITY ASSESSMENT (WQA) PROCESS** P. 14

PART IV **DESIGNATED USES OF VIRGINIA'S WATERS** P. 17

PART V **CRITERIA TO DETERMINE DEGREE of USE SUPPORT** P. 19

PART VI **ASSESSMENT EVALUATION METHODOLOGY**

Section 6.1 Conventional Parameter Evaluation Methodology P. 25
- 6.1.1 Fixed Rate (Percent Method)

Section 6.2 Monitoring Station Strategy P. 25
- 6.2.1 Monitoring Station Delineation

Section 6.3 Non DEQ Data Evaluation Methodology P. 26
- 6.3.1 Citizen Monitoring
- 6.3.2 Other State and Federal Water Quality Data
- 6.3.3 Nonpoint Source Evaluation

Section 6.4 Designated Use Evaluation Methodology P. 32
- 6.4.1 Wildlife Use
- 6.4.2 Aquatic Life Use
  - 6.4.2.1 Chesapeake Bay Subcategories of Aquatic Life Use
  - 6.4.2.2 Free-Flowing Waters
  - 6.4.2.3 Estuarine Waters
- 6.4.3 Fish Consumption Use
- 6.4.4 Shellfish Consumption Use
- 6.4.5 Swimming Use
- 6.4.6 Public Water Supply Use

Section 6.5 Additional Parameter Evaluation Methodology P. 41
- 6.5.1 Fish Tissue and Sediment Evaluation
- 6.5.2 Additional Toxics Evaluation
- 6.5.3 Natural Low DO and pH Evaluation for Swamp Waters

Section 6.6 Lake and Reservoir Evaluation Methodology P. 54
- 6.6.1 Interpretation/Assessment Issues Unique to Lakes and Reservoirs
- 6.6.2 Nutrient Evaluation
- 6.6.3 Dissolved Oxygen Evaluation

Section 6.7 Coastal Assessment P. 59

Section 6.8 Wetlands Assessment Methodology P. 59

Section 6.9 Freshwater Probabilistic Assessment P. 64

PART VII **303 (d) LISTING/DELISTING and TMDL PRIORITY RANKING EVALUATION**

Section 7.1 Effluent Limited and Alternative Control Waters (Category 4B/5E) P. 64

Section 7.2 Impaired Waters (Category 5) P. 67

PART VIII **APPENDICES**

APPENDIX A - Clean Water Act References P. 70

APPENDIX B - Regional Biologist Assessment Checklist P. 72

APPENDIX C - Classification of Virginia's Shellfish Growing Areas P. 73

APPENDIX D - Incorporating the *Proactive Approach* for Impaired Waters Delisting P. 76

APPENDIX E-1 - Fish Tissue Values (TVs) P. 78

APPENDIX E-2 - Fish Tissue Screening Values (TSVs) P. 80

APPENDIX F - Consensus-Based and ER-M Sediment Screening Values P. 81

APPENDIX G - Significant Lakes by DEQ Regional Offices P. 84

List of Tables

Table 1	Designated Use Matrix	P. 18
Table 2	Designated Use Assessment Criteria	P. 24
Table 3	Fixed Rate Assessment Guidelines	P. 25
Table 4	Possible SQT Conclusions and Listing Decisions for Estuarine Toxics Evaluation	P. 45
Table 5	B-IBI Ranges and Benthic Community Condition	P. 46
Table 6	Wetland Monitoring and Assessment Program Elements	P. 62
Table 7	Long-term wetlands field assessment strategy for Virginia	P. 63

List of Figures

Figure 1	Flow Diagram Used to Establish Weighting for Sediment Quality Triad Data	P. 48
Figure 2	Wetlands Multi-tiered Sampling Design	P. 61
Figure 3	Wetlands data viewer development	P. 64
Figure 4	EPA Shellfish Listing/Delisting Flowchart	P. 75

Guidance Disclaimer
This guidance document has been developed based on current and proposed Water Quality Standards and Virginia's interpretation of those Standards. Since many WQ Standards are currently being reviewed and crafted under triennial review, there may be some adjustments needed within this guidance document to correspond with the final WQ Standards as adopted by the State Water Control Board and approved by EPA.

Preface

Each State must develop a program to monitor the quality of its surface and ground waters and prepare a report every 2 years describing the status of its water quality. DEQ will identify waters of concern as having observed effects and will schedule additional monitoring if appropriate, to determine if designated uses are being met. The EPA issues guidelines for States to use during the reporting cycle. States are encouraged to use these guidelines to prepare these reports for EPA. EPA compiles the data from the State reports, summarizes them, and transmits the summaries to Congress, including an analysis of the water quality nationwide. This new 305(b)/303(d) integrated process is the principal means by which the EPA, Congress, and the public evaluate current water quality, the progress made maintaining and restoring water quality and the extent of remaining work to be done. Many States, including Virginia, rely on the 305(b)/303(d) process for information needed to conduct water quality planning. The 305(b)/303(d) process is an integral part of Virginia's water quality management program, requirements for which are set forth in 40 CFR 130.

Production of this guidance manual is to assist the public in its understanding and DEQ regional and central office staff in the development and reporting of the 2008 Integrated Report (305(b) Water Quality Assessment /303(d) Impaired Waters). The data window used in the development of the Integrated Report is January 1, 2001 through December 31, 2006. The manual uses excerpts from the "EPA 2006 Integrated Report Guidance and 2008 EPA Integrated Report Clarification Guidance", "EPA 1997 Guidelines for the Preparation of the 1998 State Water Quality Assessment 305(b) Reports", and "Assessment Data Base (ADB) Systems User's Manual" published by EPA, along with other State and Federal documents.

The Water Quality Monitoring, Information, and Restoration Act (WQMIRA) directs DEQ to develop and publish a procedure governing the process for defining and determining impaired waters. Additionally, DEQ shall provide for public comment on this procedure. Public comment was solicited through May 04, 2007 on a draft of this guidance. The processes for defining and determining impaired waters are contained in this guidance document and these was public noticed in the Virginia Register on April 2, 2007. Additionally, this guidance document can be found on the DEQ website at ***http://www.deq.virginia.gov/wqa/***

The Water Quality Monitoring, Information, and Restoration Act (WQMIRA) requires the former 303(d) and 305(b) reports, now combined into the Integrated Report, be developed in consultation with scientists from State universities prior to the submission of these documents to the U.S. Environmental Protection Agency (EPA). In order to meet this directive, DEQ has updated this guidance containing procedures used to assist scientists in the review of previous Integrated Reports.

Purpose

Section 305(b) of the Clean Water Act requires each State to submit a biennial report to EPA describing the quality of its navigable waters. The 305(b) report provides DEQ's best overall assessment of water quality conditions and trends in the Commonwealth. The report is intended to be used as a tool in planning and management (40 CFR 130, page 4) of waters in Virginia. The report also directs continuous planning and implementation activities in coordination with the State Water Quality Management Plan and the Continuous Planning Process (CPP).

Primary objectives of the Integrated Report are:

1. To educate and inform citizens and public officials about Virginia's overall water quality.

2. To analyze water quality data in order to determine the extent to which Virginia's waters are supporting the designated uses for all state waters and to compare the results to WQ Standards and other appropriate criteria and guidelines.

3. To determine the causes for the "failure to support" the designated uses of the State's waters.

4. To determine the nature and recognizable extent of point and nonpoint source impacts in accordance with state and federal guidelines.

Section 303(d) of the Clean Water Act and the Environmental Protection Agency's regulation 40 CFR Section 130.7 (d) promulgated in July 1992, require each state to submit a Total Maximum Daily Load (TMDL) Priority List to EPA on April 1 of even numbered years. Category (5) is a summary of those waters that are impaired and need a TMDL.

Category 4 includes waters that are "water quality effluent limited" and other waters not needing a TMDL. Water Quality Limited waters are those waters where WQ Standards are not expected to be met with the application of technology based effluent control technology of secondary treatment and best practicable treatment. Waters receiving effluent from facilities with water quality based effluent limits in their Virginia Pollution Discharge Elimination System (VPDES) permits with schedules of compliance to meet these limits within the next reporting cycle or within the current permit cycle (5 years) are considered Subcategory 4B (impaired but not needing a TMDL) due to the control requirements and compliance schedules associated with the VPDES permit or other alternative control requirements. Waters, where compliance schedules extend past the current permit cycle or into the next assessment cycle, are considered part of the 303(d) impaired waters list (Subcategory 5E) that need additional compliance review and tracking until the compliance schedule falls within the next reporting or permitting cycle. See the Background section for additional Integrated Report Category descriptions.

Background

As in 2006, EPA's 2008 Integrated Report Guidance recommends that states submit an "Integrated Report" that will satisfy Clean Water Act (CWA) requirements for Sections 305(b) overall water quality report, 303(d) impaired waters list and Section 314 assessment of publicly owned lakes. This Integrated Report will show the following information:

- delineation of water quality assessment units (AUs) based on National Hydrography Dataset (NHD);
- status of and progress toward achieving comprehensive assessments of all waters;
- Water Quality Standard attainment status for every AU assessed;
- additional monitoring that may be needed to determine Water Quality Standard attainment status and, if necessary, to support development of TMDLs for each pollutant/AU combination;
- schedules for additional monitoring planned for AUs;
- pollutant/AU combinations still requiring TMDLs; and
- TMDL development schedules reflecting the priority ranking of each pollutant/AU combination.
- Water Quality "Effluent Limited" Waters.

DEQ has incorporated the Integrated Reporting guidance EPA initially developed in 2004 with supplemental EPA guidance and clarification included in the 2006 and 2008 assessment guidance. The Integrated Report is similar to the 2004 guidance in most areas and is designed to integrate or combine the 305(b) overall assessment of Virginia's waters and separate out those waters impaired and needing a TMDL as per 303(d). The 2008 EPA Integrated Report Guidance and Assessment Database (ADB V2.2.0) has five (5) federal categories with category 4 having 3 subcategories in which every "assessment unit" (AU) will be placed based on designated use attainment. Additionally, Virginia has incorporated several subcategories to supplement the federal categories and provide a more precise water quality tracking and reporting mechanism.

Below are the US EPA defined Categories followed by associated Virginia defined subcategories**:**

<u>FULLY SUPPORTING</u> - Waters are supporting one or more designated uses

- **EPA Category 1 -** Attaining all associated designated uses and no designated use is threatened

  Va. Category 1A - waters are attaining all uses and a TMDL has been developed for one or more uses.

- **EPA Category 2 –** Available data and/or other information indicate that some, but not all of the designated uses are supported.

  Va. Category 2A - waters are supporting all of the uses for which they are monitored.

  Va. Category 2B - waters are of concern to the state but no Water Quality Standard exists for a specific pollutant, or the water exceeds a state screening value or toxicity test.

  Va. Category 2C - waters are now attaining the use(s) for which they were originally 303(d) listed and the TMDL is EPA approved but other applicable use(s) were not monitored and assessed.

<u>INDETERMINATE</u> - Waters needing additional information

- **EPA Category 3 -** Insufficient data and/or information to determine whether any designated uses are met

  Va. Category 3A - no data are available within the data window of the current assessment to determine if any designated use is attained and the water was not previously listed as impaired.

  Va. Category 3B - some data exists but are insufficient to determine support of any designated uses. Such waters will be a prioritized for follow up monitoring.

  Va. Category 3C- data collected by a citizen monitoring or other organization indicating water quality problems may exist but the methodology and/or data quality has not been approved for a determination of support of designated use(s). These waters are considered as having insufficient data with observed effects. Such waters will be prioritized by DEQ for follow up monitoring.

  Va. Category 3D - data collected by a citizen monitoring or other organization indicating designated use(s) are being attained but the methodology and/or data quality has not been approved for such a determination.

<u>IMPAIRED</u> - Waters are impaired or threatened but a TMDL is not required.

- **EPA Category 4A -** water is impaired or threatened for one or more designated uses but does not require a TMDL because the TMDL for specific pollutant(s) is complete and US EPA approved.

- **EPA Category 4B -** water is impaired or threatened for one or more designated uses but does not require the development of a TMDL because other pollution control requirements (such as VPDES limits under a compliance schedule) are reasonably expected to result in attainment of the Water Quality Standard by the next reporting period or permit cycle.

- **EPA Category 4C -** water is impaired or threatened for one or more designated uses but does not require a TMDL because the impairment is not caused by a pollutant and/or is determined to be caused by natural conditions.

<u>IMPAIRED</u> - Waters are impaired or threatened and require a TMDL

- **EPA Category 5 - Waters are impaired or threatened and a TMDL is needed.**

  Va. Category 5A - a Water Quality Standard is not attained. The water is impaired or threatened for one or more designated uses by a pollutant(s) and requires a TMDL (303d list).

  Va. Category 5B - the Water Quality Standard for shellfish use is not attained. One or more pollutants causing impairment require TMDL development.

  Va. Category 5C - the Water Quality Standard is not attained due to "suspected" natural conditions. The water is impaired for one or more designated uses by a pollutant(s) and may require a TMDL (303d list). WQ Standards for these waters may be re-evaluated due to the presence of natural conditions.

  Va. Category 5D - the Water Quality Standard is not attained where TMDLs for a pollutant(s) have been developed but one or more pollutants are still causing impairment requiring additional TMDL development.

  Va. Category 5E - effluent limited facilities are not expected to meet compliance schedules by next permit cycle or reporting period.

  Va. Category 5F - the WQ Standard is attained for a pollutant(s) with a TMDL and 303(d) delisting approved but the water remains impaired for additional pollutant(s) requiring TMDL development.

- **EPA Category 5M** – the WQ Standard is not attained for mercury primarily due to atmospheric deposition.

PART I 305(b)/303(d) ASSESSMENT PROCESS

Virginia's biennial water quality assessment is conducted by the Department of Environmental Quality (DEQ), with the assistance of the Department of Conservation and Recreation (DCR), to determine the water quality conditions in the Commonwealth. The results of this water quality analysis are reported to the EPA in the Integrated Report due on April 1 of even numbered years. The Integrated Report describes the aggregated water quality conditions of the State. Additionally, the Integrated Report contains the individual listing of those waters identified as "impaired" for one or more designated uses and needing a Total Maximum Daily Load (TMDL). As per EPA guidance, the former 305(b) Water Quality Assessment Report and the 303(d) Impaired Waters List are now combined into a single Integrated Report. EPA compiles the data from all State reports into a national water quality status report that is presented to Congress.

Impaired waters needing a TMDL are those waters that do not meet WQ Standards due to a pollutant(s). *A pollutant, as defined in 40 CFR 122.2, means any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.)), heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water.*

The assessment begins by analyzing all QA/QC approved data from DEQ ambient water quality monitoring stations, biological, sediment and fish tissue monitoring, other special studies and/or other non-DEQ water quality data for the 6-year assessment period. For 2008, DEQ has incorporated a 6-year assessment window to correspond with the current 2-year ambient rotating watershed monitoring program. It is anticipated that a trend analysis will be conducted at the end of each 6-year rotating watershed cycle or every six years. The results of these comprehensive data analyses are compared to both numeric and narrative criteria related to the designated uses contained in the WQ Standards. The WQ Standards are provisions of State and/or Federal regulations that contain numeric and/or narrative criteria for protecting the designated uses of all waters in the Commonwealth.

There are two basic types of water quality data used in the assessment process. The first type of data is QA/QC approved "monitored" data. This data comes from the collection and analysis of chemical, biological, and/or physical samples taken by DEQ and/or any other DEQ approved data submitted during the reporting period. These data are considered the highest quality data. Normally, the 303(d) Impaired Waters list is comprised of only QA/QC approved monitored data due to the assessment confidence associated with the QA/QC monitoring requirements. Monitored data is obtained using EPA accepted methods and DEQ approved protocols. All non-DEQ monitoring submittals, except USGS chemical data submittals, must provide a sampling and analysis protocol and all field data for review. If data discrepancies or other suspect information is generated, a field verification audit will be conducted by DEQ monitoring staff. Partially approved monitoring data can be used to signify waters as "insufficient but having observed effects" where DEQ assessment methodologies, had they been used, would show degradation (Category 3C). These waters should be prioritized for follow up monitoring. Partially approved monitoring data, where DEQ assessment methodologies would show fully supporting results, are considered insufficient data with low priority for follow up monitoring (Category 3D). These data could include results from water quality test kits or other alternate biological methodologies that do not provide the quality assured accuracy needed to confirm WQ Standards exceedences but can provide an accurate indication of good water quality or other observed effects.

The second type of data used in the assessment is considered "evaluated" data. These physical, chemical and/or biological data are primarily obtained from sources where there is not an EPA accepted sampling protocol and/or DEQ non-approved sampling and analysis protocols. An example of evaluated data would be data generated by water quality indicator test kits. These data are considered to be of lower quality with less confidence in their results and normally are not used directly for listing waters as fully supporting or impaired but on a case by case basis, as having observed effects. Assessment Units, where lower quality data indicate chronic and recurring water quality degradation, may be designated as insufficient but having observed effects for associated designated uses on a case by case basis. Additional DEQ monitoring shall be targeted for these waters as resources allow. Additionally, waters

that were fully supporting or on previous 303(d) lists, with no additional monitoring data for the 2008 reporting cycle, will retain previous assessment results for associated designated uses. Additional information concerning assessment and use of Citizen Monitoring and other non-DEQ data can be found in Part VI, Sections 6.3.1 and 6.3.2.

The following approval process will be used for non-DEQ "monitored" data protocol and QA/QC procedure review:

All ancillary data that have been received and reviewed by DEQ and found acceptable shall be used for the Integrated Report. The data are from two categories, state/federal agencies (other than DEQ) and the Citizen Monitoring Program. The approval process for data from the Citizen Monitoring Program is addressed in Part VI, Section 6.3.1. The following addresses the approval process for data from non-agency providers.

All "monitored" chemical and biological data must be supported by EPA accepted monitoring protocols. QA/QC procedures must also be reviewed and approved by DEQ. As regional assessment staff becomes aware of data sources, those parties generating data for DEQ assessment consideration should be requested by the regional assessment staff or Water Quality Data Liaison to submit QA/QC plans, standard operating procedures (SOPs), and monitoring procedures to the DEQ Water Quality Data Liaison. The Liaison will provide copies of supporting documentation for chemical data to QA/QC review staff in the Water Quality Monitoring and Assessment (WQMA) program and provide copies of all supporting documentation for biological monitoring of freshwater benthic macroinvertebrates to the WQ Standards Biological Monitoring Coordinator.

Benthic information from non-DEQ sources that meet 'Level III' classification according to Guidance Memo No. 06-2010: Guidelines for DEQ Review and Approval of Biological Monitoring QAPPs Submitted by Non-DEQ Sources shall be assessed by regional biologists. In addition, benthic information that does not meet Level III classification may be independently assessed by regional biologists according to non-agency benthic assessment guidance to determine their acceptability for assessment purposes on an individual basis. Copies of the supporting documentation for freshwater benthic data should be provided to the regional offices where the surveyed sites are located for review by the regional biologists. The regional biologists are most familiar with the various eco-regions in the state and are knowledgeable about location of appropriate reference sites, conditions or benthic metrics that are acceptable for assessing streams in these eco-regions. The regional biologists, in consultation with the biological coordinator, shall review the sampling and analysis methodology and if practical, the available data, to determine the acceptability of the benthic data. The regional biologists will provide any comments or requests for additional information directly to the data generators and will copy such communications to the DEQ Biological Coordinator. Copies of the review results shall be distributed to the regional assessment staff and the DEQ 305(b) Coordinator. If the protocols involve estuarine toxics data and/or biological assessments in tidal environments, supporting documents should be provided to and reviewed by the Chesapeake Bay Program staff.

All comments concerning toxics data, chemical (SOPs) and/or QA/QC plans will be coordinated through the Water Quality Monitoring and Assessment (WQMA) QA/QC Coordinator. The WQMA QA/QC Coordinator is responsible for providing comments to data generators and the DEQ 305(b) Coordinator concerning the acceptability of SOPs and QA/QC documentation for chemical data.

If a chemical, biological or tidal waters data package cannot be used in the assessment process, the appropriate DEQ staff will provide the data generator an explanation for the data not being useable. A list of all data providers and the status of the QA/QC review will be included in Appendix D of the 2008 Integrated Report.

PART II WATER QUALITY MONITORING, INFORMATION AND RESTORATION ACT (WQMIRA)

In 1997, the General Assembly enacted the Water Quality Monitoring, Information and Restoration Act (WQMIRA) §62.1- 44.19:4 through §62.1- 44.19:8. This legislation supplements the CWA 305(b)/303(d) federal requirements. The requirements of this legislation for State assessment procedures or processes are briefly outlined as follows:

1. The Act requires the 303(d) portion of the Integrated Report to identify geographically defined water segments as impaired if monitoring or other evidence shows:

    a. violations of ambient WQ Standards for aquatic life or human health;
    b. fishing restrictions or advisories;
    c. shellfish consumption restrictions due to contamination;
    d. nutrient over-enrichment;
    e. significant declines in aquatic life biodiversity or populations; and/or
    f. contamination of sediment at levels which violate WQ Standards or threaten aquatic life or human health.

2. Waters identified as "naturally impaired", "fully supporting but threatened" or "evaluated" (without monitoring) as impaired shall be set out in the 303(d) portion of the Integrated Report in the same format as those listed as "impaired".

3. The 303(d) portion of the Integrated Report shall include an assessment, conducted in conjunction with other appropriate state agencies, for the attribution of impairment to point and nonpoint sources. The absence of point source permit violations on or near the impaired water shall not conclusively support a determination that impairment is due to nonpoint sources. In determining the cause for impairment, the Board shall consider the cumulative impact of 1.) multiple point source discharges, 2.) individual discharges over time, and 3.) nonpoint sources.

4. The Board shall develop and publish a procedure governing its process for defining and determining impaired water segments and shall provide for public comment on the procedure.

5. The Integrated Report, inclusive of CWA sections 305(b) and 303(d) shall be produced in accordance with the schedule required by federal law and shall incorporate at least the preceding five years of data, where appropriate. Data older than five years shall be incorporated when scientifically appropriate for trend analysis or other longer term considerations.

6. The Integrated Report, inclusive of CWA sections 305(b) and 303(d), shall be developed in consultation with scientists from state universities prior to submission by the Board to EPA.

7. The Integrated Report, inclusive of CWA sections 305(b) and 303(d), shall indicate water quality trends for specific, easily identifiable, geographically defined water segments and provide summaries of the trends using available data and evaluations. This will allow the citizens of the Commonwealth to easily interpret and understand the conditions of the geographically defined water segments.

8. Based on the information in the Integrated Report, inclusive of CWA sections 303(d) and 305(b), the Board shall request the Department of Game and Inland Fisheries (DGIF) or the Virginia Marine Resources Commission (VMRC) to post notices at public access points for all "toxic" impaired waters. The notice, prepared by the Board, shall contain the basis for the impaired designation and a statement of potential health risks. The Board shall coordinate with the DGIF and VMRC to assure that adequate notice of posted waters is provided to those purchasing hunting and fishing licenses.

PART III RULES FOR THE 2008 WATER QUALITY ASSESSMENT

Rule 1

Impaired waters are defined as those with chronic, recurring or human health related WQ Standard exceedences using QA/QC approved ambient monitoring data, special study data and/or other programmatic in-stream data collections. Predictive data generally refers to computer generated modeling data and may be used for assessment purposes on a case by case basis. Impaired waters are generally based on exceedences of the numeric WQ Standards criteria using the guidelines described in Part V and VI of this guidance and/or exceeding the narrative WQ Standards.

Rule 1 applies to the conventional parameters dissolved oxygen, pH, bacteria, and temperature (except temperature in tidal waters). Previous EPA guidance recommended States use a violation rate of > 10.5% of the total samples analyzed for classifying waters impaired due to potential monitoring equipment malfunctions and data analysis errors. However, a single sample will not be assessed and will be placed in federal Category 3 (Insufficient Data). A single exceedence of the WQ Standards results in an assessment of insufficient data for small datasets (2-9 samples) of conventional parameters. At least two exceedences and > 10.5% of the total samples is required before a water is listed as impaired. This includes small datasets. Temperature in tidal waters up to the fall line will not be assessed due to the lack of a maximum WQ Standard for temperature in these waters.

Rule 2

Waters classified as impaired based on biological data or restrictions placed on the designated uses (shellfishing and fish consumption advisories, limiting consumption) by the Virginia Department of Health (VDH), are in violation of the narrative Designated Use Standard (9 VAC 25–260–10 A.) unless the designated use has been administratively removed due to the presence of a permitted discharge outfall and any associated VDH safety zone or a consumption advisory that does not limit the designated use.

Rule 3

For recreational designated use, E.coli (freshwater) and enterococci (saltwater and transition zone) data will be assessed. Fecal coliform will not be assessed for 2008. Any previous listings for fecal coliform will remain as impaired until appropriate bacteria data is available and assessed.

The E coli/enterococci instantaneous standard of 235 per 100 ml (E. coli in fresh water) and 104 per 100 ml (enterococci in saltwater and transition zone) applies when 2 or more samples per month are not available to calculate a geometric mean. Where data are not sufficient to calculate a geometric mean, at least two exceedences and >10.5% of the total single samples taken during the assessment period exceeding the instantaneous maximum bacteria Standard for primary contact recreation is impaired.

When appropriate, the geometric mean standard of 126 per 100 ml (E. coli) for freshwater and 35 per 100 ml (enterococci) for saltwater and transition zone applies where 2 or more samples are collected during any calendar month. See 9 VAC 25-260-140-C for fresh water, saltwater and transition zone delineation. Two or more geometric mean exceedences results in an impairment.

Rule 4

Conventional parameter data, generated by probabilistic monitoring (Probmon) networks, will be used as a "general overview" of those waters and shall be used to direct additional targeted monitoring into those areas that indicate potential water quality degradation. This is due to the fact that, for most stations, only one data

point will be available from probabilistic monitoring and an assessment for the associated parameters will not be made on one data point unless that data point exceeds a human health standard. A single "grab sample" exceedence of human health or aquatic life toxic criteria is assessed as fully supporting with an observed effect and follow-up monitoring should be conducted within a 3-year period to determine if the water is impaired. A single chronic or acute exceedence of a 30-day SPMD sample for a toxic parameter associated with aquatic life and wildlife use is considered fully supporting with an observed effect. A single fish tissue, 30 day SPMD sample and/or sediment sample with no exceedence is considered fully supporting the associated use because these types of samples are generally associated with longer-term water quality conditions. For probabilistic stations with 2 conventional data points, assessment will be the same as any station with 2 or more data points. Benthic data will be compared to the new Virginia Stream Condition Index (VSCI) and assessed accordingly.

Rule 5

When assessing multiple sample data or continuous sampling data, as with a hydrolab multi-probe, the 24 hour "daily average" will be used, as appropriate, for the daily Standard. Hourly data will be used to assess against hourly or instantaneous criteria as described in the WQ Standards. The 24 hour daily average period will begin at the time of the instrument deployment and will end 24 hours hence. Hourly data will be considered valid for an hourly average if > 30 minutes of the hour is sampled. Where appropriate, this rule does not apply to depth profile sampling where each depth sample should be assessed as an independent sample. Where information indicates a pycnocline (density gradient in estuarine waters) or thermocline (temperature gradient in reservoirs) exist, surface and bottom waters will be vertically segmented, as appropriate according to WQ Standards, by the estimated pycnocline/thermocline or in the case of the Chesapeake Bay and its tidal tributaries, according to the associated Chesapeake Bay designated uses and corresponding criteria.

Rule 6

When data analysis reveals fully supporting with observed effects or insufficient data but having observed effects, additional monitoring relating to the designated use associated with the observed effect should be considered. Observed effects are water quality observations where WQ Standards have not been exceeded due to the lack of a Standard or criteria and/or lower quality and less reliable data indicates potential adverse water quality associated with a particular designated use. This rule applies to conventional and/or toxic parameters (water column, sediment, nutrient and/or fish tissue) as well as biological monitoring.

Rule 7

Waters that are assessed as impaired and suspected to be naturally occurring, non-anthropogenic (not human related) conditions (such as low DO and/or pH in slow-flowing swamp waters or high temperature from thermal springs) will be included in Category 5C (possibly needing a TMDL) of the Integrated Report. If natural conditions are shown to be responsible for the impairment, the water will be listed in Category 4C (impaired but not needing a TMDL). For waters in Category 5C or 4C, the WQ Standards will be reviewed and possibly updated during next triennial review to reflect variations caused by natural conditions for these waters. Once appropriate WQ Standards are in place, data will be reviewed again to determine whether these waters meet or exceed designated uses. It may be necessary to conduct a TMDL study or Use Attainability Analysis (UAA) prior to WQ Standards modification in order to determine and/or verify the appropriate criteria based on natural pollutant loadings.

Rule 8

Waters that were fully supporting or on previous 303(d) lists, with no additional monitoring data for the reporting period, will continue to be tracked in the Integrated Assessment Database (ADB) and monitoring station list. These waters will retain the results of the previous assessment for all designated uses. For those waters on a previous 303(d) list, they will continue to be tracked until a TMDL is developed or additional monitoring data and assessment reveals the waters are no longer impaired and needing a TMDL for the designated use(s) for which it was originally listed and approved for delisting by EPA. As previously stated, this rule applies to those waters that were originally found to be fully supporting designated use(s) and no additional monitoring data has been collected to generate a new assessment. However, due to the ambient monitoring watershed rotating approach, fully supporting waters can only be carried forward as fully supporting for two additional reporting cycles with no new data. After two reporting cycles, if no additional data has been collected the water will be listed as insufficient information and will remain in that category until new data is collected.

Rule 9

For effluent limited waters, if the VPDES permit has been issued with a scheduled compliance date that extends beyond the next 303(d) listing or permit cycle, the water would be listed as Category 5E. If the compliance date falls within the next listing cycle or within the current permit cycle whichever is longer, the water would be listed in Category 4B. See Section 7.1 for additional information.

Rule 10

Duplicate and/or split samples collected for QA/QC purposes will not be used in the assessment. The primary sample (S1) will be assessed against the appropriate Standard and the duplicate/split sample (S2) will be used only to document lab analysis quality control.

Rule 11

In assessing water quality trends, a segment will be classified as threatened if the trend predicts a WQ Standard criteria exceedence by the next assessment reporting period.

Rule 12

Sampling stations that happen to be located within a permitted mixing zone, primarily via probabilistic monitoring, will not be individually assessed for aquatic life use. They will be included with the overall probabilistic assessment. Any other stations that inadvertently were located in mixing zones will not be assessed individually for aquatic life use as the use is exempt in mixing zones.

Rule 13

A review of stockable and some natural trout waters currently listed as impaired has revealed that most if not all of these impairments are due to either erroneous segment boundaries or natural conditions. Both issues will be addressed as part of Virginia's next triennial review. For the 2008 assessment, these waters will be categorized as category 4C (impaired due to natural conditions and not needing a TMDL) as long as supporting documentation is provided by the Virginia Department of Game and Inland Fisheries (VDGIF). This will prevent and/or correct the misclassification of these segments, pending the triennial review process.

Rule 14

Multi-probe meters are accurate to single digits (tenths) and data associated with these monitoring devices are truncated to single digits.

PART IV DESIGNATED USES of VIRGINIA'S WATERS

The 305(b) process assesses a total of six primary designated uses, as appropriate for a particular waterbody, based on the WQ Standards. Assessed designated uses may include wildlife use, aquatic life use, swimming use, fish consumption use, shellfish consumption use and drinking water use. Swimming use is assessed to represent the primary and secondary water contact recreational use. Drinking water use, where applicable, is based on attainment of public water supply criteria. The new Chesapeake Bay criteria, adopted in 2005, have sub-divided the aquatic life use into several distinct sub-uses. See Section 6.4.2.1 for additional information relative to the new Chesapeake Bay criteria. Following are details relating to the assessment of the six designated uses of Virginia's waters.

1. Wildlife Use:

Wildlife use includes the propagation, growth, and protection of a balanced, indigenous population of wildlife.

Support of wildlife use is determined by assessing Water Quality Toxic Standards for aquatic life found in 9 VAC-25-260-140 B. These criteria were developed to protect aquatic life as well as wildlife.

2. Aquatic Life Use:

Aquatic life use includes the propagation, growth, and protection of a balanced indigenous population of aquatic life (including game and marketable fish) which may be expected to inhabit the waters.

Support of aquatic life use can be determined by the assessment of conventional parameters (dissolved oxygen, pH and temperature), toxic pollutants in the water column (relative to the acute WQ Standards), toxic pollutant analysis of sediments, toxicity testing, nutrient analysis and/or the biological assessment of benthic communities. All available data, relative to aquatic life use, shall be considered to determine if the aquatic life use is being supported. This assessment includes the sub-categories of aquatic life use associated with the new Chesapeake Bay criteria. The maximum temperature will not be assessed for aquatic life in tidal waters as no maximum temperature Standard is applicable.

3. Fish Consumption Use:

Fish consumption use includes the propagation, growth and protection of a balanced population of aquatic life including game and marketable fish. Human health is also a primary consideration with regard to fish consumption use.

Support of this use is determined using three separate criteria. First, support or lack thereof, is based on human health related advisories and/or restrictions issued by the Virginia Department of Health (VDH). Impairment for fish consumption results when the public is advised by VDH that fish consumption is prohibited for the general population or there is an advisory that certain fish species should not be consumed by the general population or sub-populations at greater risk, such as children and/or pregnant women.

Second, the assessment methodology used for fish consumption use is a comparison of fish tissue data to WQ Standards criterion based tissue values (TVs) and tissue screening values (TSVs) for toxic pollutants. Any single observation above the TV or TSV results in the water being assessed as fully supporting but having an observed effect. Two or more exceedences within or across species sampled of a particular TV listed in Appendix E-1 results in an impaired assessment of the water for the fish consumption designated use.

Third, support of the fish consumption use is determined by comparison to the human health criteria in public water supplies and other surface waters, as listed in the WQ Standards.

4. Shellfish Consumption Use:

Shellfish consumption use includes the propagation, growth and protection of a balanced population of aquatic life including marketable shellfish.

Support of this use is determined using the following criteria. The Division of Shellfish Sanitation (DSS) of the VDH bases support or lack thereof on a classification system designed for the harvesting and marketing of shellfish resources in accordance with Food and Drug Administration (FDA) guidelines. Four classifications are used to describe shellfish waters. They are approved, conditionally approved, restricted, and prohibited. ***Approved*** areas are waters from which shellfish may be taken for direct marketing at all times. ***Conditionally approved*** (seasonal condemnation) areas are waters where the quality may be affected by a seasonal population increase or sporadic use of a dock or harbor facility. ***Restricted*** (condemnations) areas are waters where a sanitary survey indicates a limited degree of pollution which makes it unsafe to market shellfish for immediate consumption. Shellfish harvested in these areas must be moved to an approved area for a certain length of time to allow for depuration before marketing. ***Prohibited*** (condemnations) areas are waters where the DSS sanitary survey indicates dangerous numbers of pathogenic microorganisms or other contaminants that impact the area. Shellfish cannot be harvested or relayed for purification in prohibited areas.

Shellfish waters where restrictions or prohibitions are due solely to a discharge outfall and associated buffer zone and not due to water quality exceedences will not be included in the 303(d) list. In these cases, monitoring should not be conducted as the shellfish designated use has been administratively removed through the issuance of a discharge permit. Additional information relative to shellfish use assessment can be found in Appendix C of this guidance.

5. Recreation/Swimming Use:

Recreation use assessment includes swimming and other primary and secondary water contact recreation uses such as water skiing and pleasure boating.

Normally, support or lack thereof of this use is based on a comparison of E. coli and enterococci bacteria data to the instantaneous standard using the > 10.5% percent assessment method. However, if a special study designed to collect two or more bacteria data points within a one-month period is conducted, such as in the BEACH (Beaches Environmental and Coastal Health) program, then these results should be compared to the geometric mean criterion described in 9 VAC-25-260-170. Also, any VDH beach closures/swimming advisories should be assessed according to Part V.

6. Public Water Supply Use:

Waters that are used for public drinking water supply are identified in the WQ Standards and are protected by additional health related standards that are applicable to these waters. Support or lack thereof of this use is based on VDH closures or advisories due to excessive pollutant(s) and/or a comparison of water column data to applicable public water supply criteria. Table 1 is a summary of the designated uses and the criteria used to assess the individual uses.

Table 1 DESIGNATED USE MATRIX

NO.	DESIGNATED USE	SUPPORT OF USE ASSESSMENT CRITERIA
1.	Wildlife Use	Aquatic life toxics criteria in water column
2.	Aquatic Life Use	Conventional parameters (DO, pH, Temp.); Aquatic life toxics criteria in water column (relative to the acute WQ Standards); toxicity testing; biological evaluation. Waters exceeding nutrient and/or sediment screening values (SVs) are considered to have "observed effects"
3.	Fish Consumption Use	Advisories, limiting consumption, or restrictions issued by VDH; Comparison of fish tissue data to WQ Standards criterion based tissue values (TVs) for toxic pollutants found in Appendix E-1 and tissue screening values (TSVs) found in Appendix E-2.
4.	Shellfish Consumption Use	Restrictive actions, based on monitored bacteria data, for harvesting and marketing of shellfish resources made by Div. of Shellfish Sanitation of VDH
5.	Recreation/Swimming Use	Conventional Pollutant (E. coli and enterococci bacteria) and/or VDH beach closures/advisories or other available bacteria data.
6.	Public Water Supply Use	VDH closures or advisories due to excessive pollutant(s); comparison of data to applicable public water supply standards.

PART V CRITERIA TO DETERMINE DEGREE OF USE SUPPORT

Virginia bases its water quality assessment on the ability of the waters to support the associated designated uses. Support is based on the waters meeting the criteria for each use based on the numeric and/or narrative WQ Standards. The following is a description of the criteria used to determine the quality of the waters relating to each of the designated uses, and thereby the degree of use support that will be presented in the Integrated Report. Waters where no water quality data exist for any designated use(s) are categorized as insufficient data (Category 3).

1. Not Assessed

Waters with no data for any uses or a single sample (conventional data only) relative to aquatic life will not be assessed (Category 3A).

2. Insufficient Information

Waters that have a single exceedence in a small dataset (2-9 samples) are considered insufficient data (Category 3B). Waters, where the data are not QA/QC approved but the data review indicate potential degradation, are categorized insufficient but having observed effects (Category 3C). Waters where the data are not QA/QC approved but the assessment results indicate acceptable water quality will be considered insufficient data with no observed effects (Category 3D).

3. Fully Supporting

The following is a description of the types of data and the acceptable criteria used to assess waters as fully supporting designated uses. These waters would be placed in the Category 2A or 2C unless all designated uses are fully supporting, upon which the water would be placed in Category 1.

- *Conventional/Bacteria Parameters*:

Waters fully supporting designated uses can have up to 10.5% exceedences of WQ Standards for the parameters E.coli or enterococci bacteria, (recreation use) and the conventional parameters dissolved oxygen, temperature and pH (aquatic life use) without negatively affecting designated uses. This criterion is based on natural variables or analytical errors which DEQ acknowledges can produce exceedences of these criteria in the 0-10.5% range. All data assessed as fully supporting must be QA/QC approved.

The WQ Standards (9 VAC 25-260-50) criteria for D.O., pH and Temperature do **not** apply (7Q10).
7Q10 is the lowest flow averaged (arithmetic mean) over a period of seven consecutive days that can be statistically expected to occur once every 10 climatic years (a climatic year begins April 1 and ends March 31). Data for these parameters that are from flow conditions below 7Q10 will not be used in the Integrated Report.

- *Toxic Pollutants:*

For toxic pollutant assessment in free-flowing streams, waters where there are one or more samples and no exceedences of aquatic life criteria within a running 3-year period, using grab samples or SPMD data, are considered fully supporting for aquatic life and wildlife use. For public water supply and human health related criteria in other surface waters, one or more samples and no exceedences during the reporting period, using grab samples or SPMD data, are considered fully supporting for PWS and/or fish consumption use. Additional information on the details of using this approach can be found in Part VI, Section 6.5.3.

For toxic pollutant assessment in estuarine waters, where there are several types of toxic data available, a weight of evidence approach has been initiated. Additional information on the details of using this approach can be found in Part VI, Section 6.5.3

- *Fish Tissue/Sediment Contamination*

One or more samples recording no exceedences of a fish tissue Water Quality Standard TV or TSV found in Appendix E-1 or E-2 or sediment screening values (SVs) found in Appendix F are considered fully supporting.

- *Biological Evaluation*:

For free-flowing stream benthic macroinvertebrate assessments, data for the overall assessment period is rated as not impaired where the new Virginia Stream Condition Index (VSCI) or the Coastal Plain Macroinvertebrate Index (CPMI) scores are at or above their respective impairment thresholds. (60 for the VSCI or 16 for the CPMI)

A project to refine the estuarine biological assessment methodology (B-IBI) was completed in 2006 and approved for use by EPA. The same methodology will be used again for 2008. See Section 6.4.2.2 for additional information.

- *Shellfish Advisories*:

Those growing areas where no restriction or prohibition (condemnation) on shellfish harvesting, based on sampling data, is imposed as indicated by the Department of Shellfish Sanitation (DSS) summary dated January, 2007. Additional information on shellfish assessment and consumption use is contained in Part VI, Section 6.4.4 as well as Appendix C.

- *Beach Closures/Advisories:*

No VDH beach closures and/or geometric mean exceedences, based on QA/QC approved sampling data, during the assessment period.

- *Public Water Supply Source Closures:*

No VDH public water supply source closures based on sampling data during the assessment period.

4. <u>Fully Supporting but Having an Observed Effect</u>

The following is a description of the types of data and the acceptable criteria used to assess waters as fully supporting but having an observed effect for a designated use(s). <u>It is the intent of the agency to focus additional monitoring resources on the waters that are identified as having an observed effect, based on initial monitoring data analysis.</u> These waters would be placed in the federal Category 2 and the Virginia Subcategory of 2B.

- *Conventional Screening Parameters*:

Waters that have or 1 or more exceedences for sediment and/or toxicity test are considered fully supporting but having an observed effect for aquatic life use due to the lack of a Water Quality criterion for these parameters (Category 2B).

- *Toxic Pollutants:*

For toxic pollutant assessment in free-flowing streams, a single exceedence of aquatic life criteria within a 3-year period, using grab samples or SPMD data, is considered fully supporting but having an observed effect for aquatic life and wildlife. For public water supply use or human health criteria in other surface waters, a single exceedence is considered fully supporting but having an observed effect for PWS and/or fish consumption use.

For toxic pollutant assessment in estuarine waters, where there are several types of toxic data available, a "weight of evidence" approach has been initiated. If no additional toxic data is available, the water would be assessed the same as the free-flowing waters. Additional information on the details of using this approach can be found in Part VI, Section 6.5.3.

- *Fish Tissue/Sediment Contamination:*

Waters with a single exceedence of a WQ Standards based TV or TSV found in Appendix E-1 or E-2 from one or more samples for fish tissue or SPMD, or an exceedence of a SV for sediment found in Appendix F, are fully supporting but having an observed effect for fish consumption and aquatic life, respectively.

- *Biological Evaluation*:

For free-flowing streams, benthic macroinvertebrate data for the assessment period with VSCI or CPMI scores below the impairment threshold should be considered fully supporting but having an observed effect where the biologist has observed natural conditions such as recent drought or flooding, etc. that could be responsible for lowering the assessment score. For waters assessed as fully supporting but having an observed effect for aquatic life use, it is necessary for another biological assessment to be scheduled to make a final aquatic life use determination. Additional information can be found in Part VI Section 6.4.1.

A project to refine the estuarine (B-IBI) biological assessment methodology was completed in 2006 and accepted for use by EPA. The same methodology will be used for 2008. See Section 6.4.2.2 for additional information.

- *Fish Advisories:*

A VDH fish consumption advisory, where a general advisory has been issued but fish consumption is not limited, are considered fully supporting but having an observed effect.

- *Shellfish Advisories:*

Those growing areas, as indicated by the DSS summary dated January, 2007, that have been classified as conditionally approved (seasonal condemnations) are considered fully supporting but having an observed effect. Additional information on shellfish assessment and consumption use is contained in Part VI, Section 6.4.4 and Appendix C.

- *Beach Closures/Advisories*:

One short term (less than one week in duration) beach closure and/or two short term (less than one week in duration) swimming advisories due to bacteria contamination, and based on QA/QC approved data within the 6 year assessment cycle with a low probability that the pollution will recur (based on best professional judgment) is considered fully supporting with observed effects. Best professional judgment decisions will be based on scientific data indicating the source of the pollution causing the closure/advisory is transient and there are no plans to implement pollution reduction measures or other controls, or documentation shows that mitigation has occurred and the two most recent years of water quality data, subsequent to the mitigation, show an improvement that fully supports the designated use.

- *Public Water Supply Source Closure:*

One, short term, VDH public water supply source closure during the 6 year assessment cycle with a low probability that the pollution will recur is considered fully supporting but having an observed effect. The source of the pollution is generally transient and there are no VDH plans to implement pollution reduction measures or other controls.

- *Other Criteria for Waters having Observed Effects*

Waters for which "evaluated" data, trend analysis for parameters with no WQ Standards but with screening criteria, or other water quality indicators appear to indicate an apparent effect on designated use(s) or a potential for water quality problems are considered to have "observed effects". Waters can be designated as having observed effects where there is a possible loss of a designated use documented by ancillary data such as fish kills with unknown causes and/or pollution potential documented by non QA/QC approved non-agency studies or reports. These waters are considered insufficient data with observed effects (Category 3C). For monitoring purposes, waters with observed effects should be considered in the next regional monitoring plan for continued monitoring during the next reporting period as resources allow.

5. <u>Pollutant Caused Impaired Waters Not Needing a TMDL</u>

Impaired or threatened waters not needing a TMDL are those waters that are listed in the federal Category 4. These are waters that are impaired but an EPA approved TMDL has been developed (Category 4A), other "alternative control" requirements are reasonably expected to result in attainment of designated use(s) (Category 4B) and waters that are naturally impaired (Category 4C).

6. Pollutant Caused Impaired Waters Needing a TMDL

The following is a description of the types of QA/QC approved data and the acceptable criteria used to assess waters as impaired or threatened for the designated uses. Those waters impaired by pollutant(s) and needing a TMDL are included in the 303(d) list. These waters are placed in the federal Category 5 (needing a TMDL) and the Virginia sub-categories of 5A, 5B, 5D and possibly 5C and 5E.

- *Conventional Parameters*:

Waters with long term or chronic pollutant related problems based on the assessment of monitored data are considered impaired and needing a TMDL. For conventional parameters, at least two exceedences of WQ Standards and exceedences >10.5% are considered long term or chronic problems and are considered impaired and needing a TMDL. Additionally, waters with 2 or more exceedences of a geometric mean analysis are considered impaired. These geometric mean analysis are normally associated with the BEACH monitoring program conducted by VDH but also could be associated with a designed, multiple sample per month, bacteria special study.

- *Toxic Pollutants:*

For toxic pollutant assessment in free-flowing streams, waters where there are 2 or more exceedences of the same WQ Standards acute aquatic life toxic criteria in a running 3-year period using grab samples or SPMD data are considered impaired for aquatic life use and wildlife use. For public water supply or human health criteria in other surface waters, 2 or more exceedences of the same criteria within the reporting period using grab samples or SPMD data are considered impaired and needing a TMDL for PWS and/or fish consumption use.

For toxic pollutant assessment in estuarine waters, where there are several types of toxic data available, a "weight of evidence" approach has been initiated. Additional information on the details of using this approach can be found in Part VI, Section 6.5.3.

- *Fish Tissue Contamination:*

Waters exceeding the same toxic human health criteria based tissue value (TV) listed in Appendix E-1, 2 or more times are impaired for fish consumption. For example, the following situations would qualify as impaired under these guidelines. Two or more tissue samples from different fish species exceeding the same TV during one sampling event or two or more samples of the same or different species exceeding the same TV from different sampling events within the assessment period are considered impaired.

- *Biological Data*:

Free-flowing streams where the VSCI or CPMI scores are below the impairment threshold are considered impaired and needing a TMDL.

A project to refine the estuarine biological assessment methodology was completed in 2006 and accepted for use by EPA. The same methodology will be used for 2008. See Section 6.4.2.2 for additional information.

- *Fish Advisories:*

Virginia Department of Health (VDH) fish consumption prohibitions and/or advisories, where fish consumption is specifically limited, are considered to be in non-attainment of the designated use WQ Standard and therefore considered impaired and needing a TMDL.

- *Shellfish Advisories*:

Those growing areas, as indicated by the DSS summary dated January, 2007, that have been classified as prohibited and/or restricted (condemnations) based on bacteria data are considered impaired and needing a TMDL. Restricted areas that have been administratively condemned due solely to the presence of a VPDES permitted outfall or administrative closure where no data is available will not be assessed. Additional information on shellfish assessment and consumption use is contained in Part VI, Section 6.4.4 and Appendix C.

- *Beach Closures/Advisories:*

A beach is considered impaired if two or more geometric mean exceedences or one or more beach closures of one-week or more duration due to contamination or two or more swimming advisories of one week or more duration due to contamination and based on QA/QC approved data within the assessment cycle with a medium to high probability that the closure/advisory will recur (based on best professional judgment). There are no plans to implement pollution reduction measures or controls nor have any plans been implemented.

- *Public Water Supply Source Closure*:

One or more VDH public water supply source closures within the assessment cycle with a medium to high probability that the pollution will recur are considered impaired and needing a TMDL. There are plans to implement pollution reduction measures or controls.

Table 2 summarizes the designated use assessment criteria.

Table 2 Designated Use Assessment Criteria

	Fully Supporting **Category 1, 1A, 2A, or 2C**	**Fully Supporting or Insufficient data but Having Observed Effects** **Category 2B or 3C**	**Impaired or Threatened Waters Needing a TMDL** **Category 5A,5B,5C, 5D or 5F** **(Impaired with TMDL Approved = Category 4A)**
Conventional Parameters Aquatic Life Use Support (ALUS) and Recreational Use (temperature will not be assessed in tidal waters)	2 or more samples and AR ≤10.5%	**Non QA/QC approved** with exceedences > 10.5% And 2 or more exceedences in a small dataset (2-9 samples) **Nutrien**t SV exceeded > 10.5% and 2 or more exceedences in a small dataset (2-9 samples)	2 or more exceedences and AR > 10.5% of total samples
Toxic Pollutants in Water Column and/or Sediment Aquatic Life Use Support (ALUS) and Wildlife Use	One or more samples and no exceedences	A single grab or SPMD sample exceedence of a acute aquatic life criteria or 1 or more grab sample exceedences of same chronic aquatic life criteria in a 3 year period (water column only) (ALUS & Wildlife) One or more toxicity test or SV exceedence (sediment only) (ALUS)	2 or more grab sample or SPMD exceedences of the same acute aquatic life criteria in a 3-yr period (water column only) (ALUS & Wildlife) Failing the "weight of evidence" toxicity evaluation (Section 6.5.3)
Toxic Pollutants related to human health, (PWS, & Fish Consumption)	One or more samples and no exceedences	A single exceedence of a human health criteria using grab sample or SPMD data (PWS and/or fish consumption) A single exceedence of any toxic WQS TV or TSV, listed in Appendix E-1 or E-2 (fish consumption)	2 or more exceedences of the same human health criteria using grab samples or SPMD data (PWS and/or fish consumption) 2 or more exceedences of the same toxic WQS TV, listed in Appendix E-1 (fish consumption)
Biological Data	Freshwater: VSCI or CPMI assessment scores at or above the impairment threshold Estuarine: Not Impaired	Freshwater: VSCI or CPMI assessment scores below the impairment threshold where biologist's best professional judgment has determined a lack of confidence in the biological survey due to natural conditions Estuarine: See Section 6.4.2.2 for additional information.	Freshwater: VSCI or CPMI assessment scores below the impairment threshold Estuarine: See Section 6.4.2.2 for additional information.
Fish Consumption Advisories or Restrictions	No exceedences of fish tissue criteria	A VDH advisory which does not limit consumption is in effect	A VDH advisory or restriction limiting or prohibiting consumption is in effect
Shellfish Advisories	Approved shellfish harvest waters	Area classified as Conditionally Approved (seasonal condemnations)	Areas classified as Restricted or Prohibited: Excluding VPDES outfalls and administrative closures where no data is available
Recreation Use (see Conventional Parameter criteria) and Beach Closures/Advisories	No geometric mean exceedences or beach closure/advisory	No geometric mean exceedence and one short term (< 1 week) closure/advisory due to QA/QC approved bacteria data with low probability of recurrence (pollution source transient)	Two or more exceedences of a geometric mean and/or 1 or more closure and/or 2 or more advisories > 1 week duration due to QA/QC approved bacteria data with medium or high probability of recurrence
Public Water Supply (PWS) Source Closures	No closures based on sampling data	One VDH closure based on QA/QC approved data with low probability of recurrence	One or more VDH closure based on QA/QC approved data with medium or high probability of recurrence

AR = arithmetic exceedence rate
SV = screening value
ALUS = Aquatic Life Use Support
PWS = Public Water Supply

PART VI ASSESSMENT METHODOLOGY

Section 6.1 CONVENTIONAL PARAMETER METHODOLOGY

State and federal law requires DEQ to produce a biennial report on the condition of its waters to Virginia's citizens and the EPA. The waters are evaluated in terms of whether the appropriate designated uses are met: These uses are: 1) wildlife, 2) aquatic life, 3) fish consumption, 4) shellfish harvest, 5) swimming (primary and secondary contact recreation) and 6) drinking water use. DEQ employs the "Percent Method" to assess conventional pollutant impacts in waters for two uses: aquatic life use and swimming use.

6.1.1 Description of the Fixed Rate (Percent) Method

As with previous assessments, DEQ uses the percent method which is based on assumptions about the kind and frequency of data needed to support such an assessment. The objective of this method is to indicate whether waters are fully supporting or impaired for the designated uses and ultimately for the assessment unit (AU). A 10.5% exceedence threshold is used for determining full support or impairment for conventional pollutants. An exceedence rate that is > 10.5% with at least 2 exceedences is considered impaired. An exceedence rate ≤ 10.5% is considered fully supporting. A single exceedence in a small dataset (2-9 samples) is considered insufficient to indicate fully supporting or impaired.

In effect, the fixed rate assessment guidelines imply that an exceedence of a conventional numeric criterion in 10.5% of the samples taken does not impair the aquatic life designated use due to many variables associated with sampling errors and/or weather factors that can cause periodic exceedences but not affect designated uses. The rule of thumb is described in Table 3.

Table 3 Fixed Rate Assessment Guidelines

Violation Rate (AR) of Total Samples Analyzed	Assessment
AR ≤10.5%	Meets use (Category 2A, 2B or 2C)
AR > 10.5%	Fails to meet use (impaired) Categories 4A, 5A, 5B, 5C or 5D

In recent years, DEQ has been encouraged to spread its monitoring efforts over more of the State's waters. To achieve this goal with a fixed monitoring budget, the average collection frequency changed from monthly to bimonthly. This monitoring frequency has been applied to a rotating watershed scheme with 1/3 of the watersheds being monitored for a 2-year cycle with all watersheds being monitored within 6 years. The benefit from this change is that more streams and more stream miles can be assessed. The disadvantage is that the data collected from each station are fewer (12 samples/2 years). The data set has become wide geographically but shallow in frequency. This aspect somewhat concerns DEQ in that the fixed rate method assumptions are based on a monthly sampling frequency. Additional monitoring program review and possible update stems from the need for additional monitoring data for Total Maximum Daily Load (TMDL) development.

Section 6.2 MONITORING STATION DELINEATION AND SITING METHODOLOGY

6.2.1 Monitoring Station Delineation

DEQ has a vast network of active Ambient Water Quality Monitoring (AWQM) stations and a growing number of biological stations statewide. The AWQM stations are generally monitored bimonthly while the biological stations are monitored twice a year (usually in the spring and fall). Monitoring programs can be designed based on a "source targeted" (conventional) approach or a "probability based" approach or a combination of the two. Each monitoring program design has its advantages and disadvantages. Historically, most of DEQ's monitoring strategy has been based on the conventional approach. Many of the stations were located in proximity to (above and below) Virginia Pollutant Discharge Elimination System (VPDES) facility outfalls. During this reporting cycle, DEQ has continued to use a rotating watershed approach where stations are sited for 2 years of bimonthly sampling. The number of

stations per watershed is based on the drainage area of the watershed and the Department of Conservation and Recreation (DCR) nonpoint source potential rating of the watershed. In order to provide consistency between the regional planning staff and to get an accurate number of assessed stream miles in Virginia, the following stream delineation guidelines are the primary considerations used in the assessment and listing process. However, in certain cases, best professional judgment of the regional staff may be used if the delineation results are contrary to these guidelines. Where appropriate, documentation of these best professional judgment decisions should be included in the segment narrative.

1. Typically, no more than 10 miles of free-flowing stream should be assessed by the conventional pollutant data from one ambient monitoring station. Miles assessed for a toxic pollutant or biological impairment may vary from the miles assessed for conventional parameters.

2. One monitoring station should not be used to assess an entire watershed unless land use, source, and habitat are relatively homogeneous.

3. When determining the miles assessed for a free-flowing monitoring station, the following items need to be considered:

   a) WQ Standards Use Designations (i.e. Classes and/or Special Standards)

   b) point and/or nonpoint source input to the stream or its tributaries,

   c) changes in watershed characteristics such as land use,

   d) changes in riparian vegetation, stream banks, substrate, slope, or channel morphology,

   e) entry of a large tributary or diversion, or

   f) hydrologic change such as channelization or a dam.

4. For tidal and estuarine stations, EPA guidance suggests using a 4-mile radius for open water stations; a 2-mile radius for bay stations and a 0.5 mile radius for sheltered bay stations. The new Chesapeake Bay WQ Standards criteria adopted the Chesapeake Bay Program segmentation scheme.

5. Segment delineation will be performed using the EPA National Hydrography Dataset (NHD) coverage.

6. Spatial coverage for estuarine probabilistic monitoring stations should be identified in conjunction with the development of the monitoring plan and coordinated by regional monitoring and assessment staff and/or the Chesapeake Bay Program monitoring coordinator and Bay monitoring staff. Estuarine B-IBI data will be assessed according to methodology recently developed.

7. When assessing an impaired segment, it is understood via WQ Standards that the existence of a VPDES permitted mixing zone lies within the impaired segment for a specific pollutant. If a mixing zone exists, the parameter specific mixing zone length is specifically understood as not part of the impaired segment even though map delineation and/or assessment unit description may show the impairment as continuous.

8. Single physical or chemical sample free-flowing probabilistic stations will not be delineated into 303(d) segments. Probabilistic physical/chemical stations meeting Part III Rules 1 and 4 will be delineated and assessed.

Section 6.3 <u>NON DEQ EVALUATION METHODOLOGY</u>

6.3.1 Citizen and Non-agency Monitoring

For the purposes of this guidance document, a citizen water quality monitoring program, or "citizen monitoring", is defined as water quality monitoring which uses volunteers to collect the data. Some of these programs are run by local governments, soil and water conservation districts, citizen organizations, community organizations or colleges. Generally, K-12 school monitoring is conducted for educational purposes and does not fall under citizen monitoring unless working in cooperation with existing citizen monitoring efforts. Citizen monitoring is not defined as monitoring conducted by all entities external to DEQ, such as colleges and local governments, unless volunteers are used in their efforts.

DEQ does routinely receive water quality data from non-citizen volunteer sources such as local governments, universities, and other non-state or federal sources not defined in Section 6.3.2 in this guidance. The review and assessment of non-agency data is done using the same QA/QC review as with citizen monitoring data.

In 1997, Water Quality Monitoring, Information and Restoration Act (WQMIRA) was passed by the Virginia General Assembly. This bill charged DEQ with monitoring and assessing all the waters within the Commonwealth. During this same General Assembly session, the position of Citizen Monitoring Coordinator (CMC) was added into the operating budget of DEQ. The primary duties of the CMC were providing guidance and support to citizen water quality monitoring groups in the development of monitoring programs and quality assurance project plans, facilitating communication among citizen groups and other State agencies, sponsoring citizen monitoring seminars, promoting the use of citizen water quality data in a manner consistent with the data use goals of the organization and encouraging additional citizen monitoring efforts. In 2002, the Virginia General Assembly passed legislation that established the Virginia Citizen Water Quality Monitoring Program in the Code of Virginia (§62.1-44.19:11).

In 2004, the CMC position was replaced with the position of Water Quality Data Liaison (WQDL). This was done to centralize the task of requesting any and all available data collected outside of DEQ activities for inclusion into water quality assessment reports and follow up monitoring by DEQ. The duties and responsibilities of the former CMC position regarding citizen monitoring data submissions, and working with the citizen monitoring community have been maintained and expanded to include all other non-DEQ potential sources of water quality data.

Assessment Process:

1. All citizen and non-agency water quality data should be sent to the WQDL at DEQ. The WQDL and QA/QC staff in the Water Quality Monitoring and Assessment (WQMA) program will review all standard operating procedures (SOPs), QA/QC plans or Quality Assurance Project Plans (QAPPs), QA/QC plans, training manuals, and current monitoring procedures for each citizen/non-agency monitoring group submitting chemical data. The WQDL and the Biological Monitoring Program Coordinator will review all supporting documentation for biological benthic macroinvertebrate citizen/non-agency monitoring programs. Based upon the review of all procedures, the appropriate use of the data will be determined.

2. The designation of DEQ Tiered Uses of data will be determined based upon the review of all procedures and in conjunction with the organization submitting the water quality data. The organization submitting the data will be informed of the potential uses of their data and may withdraw their data from consideration of use by DEQ in an assessment. Any changes in QA/QC and/or SOP methods and/or any additions or deletions of current monitoring sites should be brought to the attention of the WQDL.

3. All data collected under documented and DEQ approved SOPs, protocols, and QA/QC procedures should be included in the 305(b) assessment as follows:

    a) All approved conventional parameter data should be summarized by major watershed and characterized according to the procedures and considerations in Part V of this manual.

b) For benthic macroinvertebrate monitoring programs used by citizen and non-agency monitoring organizations, data will be assessed based on the criteria outlined in *Guidance Memo No. 06-2010, Guidelines for DEQ Review and Approval of Biological Monitoring QAPPs*.
   i. For organizations that complete the requirements outlined in the guidance memo for Level III, DEQ staff will assess the data for the purposes of 305(b) water quality assessment and 303(d) listing and delisting of impaired waters. If a validation study showed inconclusive correlation with DEQ benthic protocols, the corresponding scores showing inconclusive correlation will not be assessed as Level III. These 'gray zone' scores may be used to characterize waters with observed effects (Category 3C, 3D).
   ii. For all other methods not validated by DEQ or using DEQ protocols, biological monitoring sites characterized by citizen and non-agency organizations as "excellent," "good" or "acceptable" should be designated as "Area of low probability for adverse conditions" (Category 3D). Biological sites periodically characterized as "fair," "poor," "unacceptable" or "moderate" should be designated as "Area of medium probability for adverse conditions" and listed as insufficient data with observed effects and prioritized for follow-up monitoring (Category 3C). Likewise, biological sites that are consistently "poor" or "unacceptable" should be characterized as "Area of high probability for adverse conditions" and listed as insufficient data with observed effects with DEQ follow up monitoring to be prioritized (Category 3C).

The Virginia Save Our Streams (VASOS) *Modified Rocky Bottom Protocol* completed the necessary validation requirements in 2007. The validation studies showed sufficient correlation to DEQ assessment of 303(d) impaired waters when SOS scores were between 0 and 5. However, VASOS has requested that DEQ not use their scores of 0-5 for 303(d) listing. Accordingly, no VASOS data will be used for listing impairments in the 2008 Report unless authorized in writing by the data generator. Such data shall be assessed based on the following conditions:

1. VASOS sites that contain at least one score in the range of 0-5 will not be assessed unless the volunteer monitoring group specifically authorizes it for 303(d) listing. Authorized data with two scores in the range of 0-5 will be assessed as impaired.
2. VASOS sites, not already meeting the requirements outlined above, shall be categorized as an area of high probability for adverse conditions (Category 3C) if the majority of observations had a VASOS score of 6-9.
3. VASOS sites, not already meeting the requirements outlined above, shall be categorized as an area of low probability for adverse conditions (Category 3D) if the majority of observations had a VASOS score of 10-12.

c) For groups that indicate they wish to be included in the assessment, the summaries of the citizen and non-agency data will be placed under a separate Citizen Monitoring/Non-Agency section of the 305(b)/303(d) Integrated Report.

d) Segment lengths represented by a monitoring site should be determined using the mileage delineation guidance found in Section 6.2.1. Specific monitoring site location, including latitude, longitude and a physical description of the site (i.e. Route 646 bridge crossing, 3 mile north of route 647) should be provided for each monitoring site. Each monitoring site should be identified with a unique station id using a system similar to the DEQ station id system. The regional office staff assigns this station id to each citizen/non-agency monitoring site and relays the station ID to the WQDL.

e) Level III data collected at sites that complement and are comparable (i.e. chemical to chemical comparisons and biological to biological comparisons) to DEQ monitoring sites, should be included in the major basin report only if cleared for inclusion in the assessment by the generator of the data. However, the final assessment of that river segment will be made using the DEQ monitoring data (found in the appropriate section of the Integrated Report). In this case, the data collected by the

monitoring organization would be used as supplemental data.

f) Level III data collected at sites that do not complement or compare (i.e. benthic to chemical comparisons) to DEQ monitored sites, should be included in the major basin report. The final assessment of the river segment should be primarily assessed using the non-DEQ monitoring data. This mileage will be counted for tracking of citizen and non-agency assessed streams. For example, Level III citizen benthic macroinvertebrate data shows impairment while a nearby DEQ chemical monitoring station does not directly show benthic impairment. The stream segment will be counted as being primarily assessed using citizen monitoring data for tracking purposes.

g) The WQDL should coordinate with each regional office regarding the final assessment of the citizen and non-agency monitored data. In coordination with the WQDL and the 305(b) coordinator, each regional office should provide any appropriate final editing of the citizen and non-agency monitoring assessment to be included in the Integrated Report.

4. The WQDL will provide all data approved by DEQ for use in the Integrated Report in basic data tables. The tables will be posted on the DEQ website along with the final Integrated Report. These data tables should include each individual sample period as well as statistical results (number of observations, maximum and minimum).

5. The WQDL will review data collected without SOPs and QAPPs plans. This data will be acknowledged in the appropriate river basin evaluation as appropriate.

6. Once the data is summarized into the data tables, they will be sent to each region for their review and comparison to similar DEQ data points.

7. If, during the regional review, a discrepancy between data from DEQ monitoring stations and data from similarly sited citizen or non-agency monitoring station and/or a citizen/non-agency monitoring technique is believed to be suspect, the WQDL should be notified and an attempt to rectify the discrepancy initiated. The WQDL should collaborate with the (WQMA) QA/QC Coordinator to evaluate the potential causes for the data disparity and/or review the QAPP and the monitoring techniques of the data submitting group. After this evaluation is complete and a problem is confirmed, the WQDL and QA/QC Coordinator will recommend appropriate corrective actions to the monitoring group for inclusion in the citizen/non-agency monitoring organization's QAPP and/or SOPs. Until the discrepancies with the data and/or methods are fully evaluated by the WQDL and the QA/QC Coordinator, the data (for either the specific parameter or for the group) should not be used in agency assessments. If corrective action is not initiated by the citizen or non-agency monitoring group, the QAPP for that parameter and/or for the group as a whole may no longer be considered valid by DEQ and the data will not be considered for state-wide water quality assessments.

8. Regional DEQ planning and monitoring staff will be given a list of all stations classified as "Area of medium probability for adverse conditions" and "Area of high probability for adverse conditions". The regional monitoring staff should review the station list results and consider including appropriate sites to their regional monitoring plan for future monitoring activities.

6.3.2 Other State and Federal Water Quality Data

After review and approval of monitoring and QA/QC protocols, DEQ will consider, for use in the Integrated Report, data generated by other State and Federal monitoring programs. DEQ has established a water quality data sharing agreement with several state and federal agencies that includes the Virginia Department of Health, National Park Service, Tennessee Valley Authority, United States Geological Survey, and the United States Forest Service (USFS) for the George Washington and Jefferson National Forests using the USFS Fisheries and Aquatic Ecology Program.

Virginia Department of Health (VDH)- DEQ receives and lists areas closed by VDH due to high bacteria levels for shellfish sanitation and primary contact uses. All Enterococcus bacteria results collected by VDH is also used in assessing water quality along with any DEQ water quality data. Any other water quality data collected by VDH that is shared with DEQ should be used by DEQ based on review by the WQDL and QA/QC officer.

United States Forestry Service (USFS)- The USFS program collected macroinvertebrate data from numerous monitoring stations within the two National Forests. Sampling for macroinvertebrates is conducted utilizing the same collection methodology (Plafkin et al 1989) that DEQ biologists use in the ambient biomonitoring program. Therefore, the raw data collected by the USFS should be highly comparable with DEQ data. The USFS has used the Macroinvertebrate Aggregated Index for Streams (MAIS) to assess this raw data and make an initial water quality interpretation.

The DEQ regional biologist and planners may use the data, provided to DEQ by the USFS, in the Integrated Report if they find it acceptable for assessment purposes. If the regional biologist or planners have information which conflicts with the initial USFS assessment or for any other reason, question the final USFS stream assessment, they may elect to disregard the USFS assessment results until further verification can be obtained. If the initial assessment is not used, documentation relating to this decision will need to be provided. The regional Biologist may elect to reevaluate the raw data using the EPA RBP-II metrics to confirm consistent assessment methodology and conclusions. If differences become apparent, the regional biologists may decide not to use the assessment data in the Integrated Report until an on-site stream visit can be performed and conditions verified. Final assessment results of the USFS data should be consistent with the ambient biological assessment criteria described in Section 6.4.2 of this guidance. Any non- approved data will not be used directly in the assessment.

Tennessee Valley Authority (TVA) - The TVA routinely monitors for E. coli bacteria along TVA reservoirs in Virginia. This data is considered acceptable for assessing water quality in Virginia.

United States Geological Survey (USGS)- The USGS monitors several water quality stations throughout Virginia. Data collected by the USGS is considered acceptable by DEQ and is used in assessing water quality including 303(d) impairment listings. For water quality parameters not listed in the most current version of the Virginia Water Quality Standards is not assessed for 303(d) impairment listing, but can be used to assess waters with observed effects (Category 3C/3D).

National Park Service- The National Park Service has several long term monitoring programs in place at many of the national parks in Virginia. Many of the parks monitor for chemical and benthic macroinvertebrate protocols. The WQDL and QA/QC officer help guide the regional office assessment staff in assessing the data received from the parks. For chemical and benthic macroinvertebrate monitoring parameters, the WQDL and DEQ QA/QC officer will determine which level applies to the data to help guide DEQ regional office assessment staff.

6.3.3 Nonpoint Source (NPS) Assessment

A nonpoint source pollution assessment of hydrologic units will be performed by the Virginia Department of Conservation and Recreation (DCR). As performed since the 2002 NPS assessments, the 2008 process will calculate net loadings of nitrogen, phosphorous, and sediment per hydrologic unit. Unlike the previous efforts however, the hydrologic units will be the smaller sixth order units of the National Watershed Boundary Dataset (NWBD) of Virginia.

Gross load calculations are done via modeling in a manner that closely approximates the results of the Chesapeake Bay Program water quality model in regards to loadings in the Bay watersheds, thereby diminishing the uncertainty of having conflicting assessment results for that portion of the state. This model is then employed to calculate similar values for non-Bay watersheds to develop consistent statewide loadings. Inputs to this modeling process include

A DCR modified land use / land cover layer

A DCR developed confined animal data set
Census of Agriculture animal numbers by jurisdiction
Virginia Department of Forestry (VDOF) forest harvesting data
Virginia Department of Mines, Minerals, and Energy (VDMME) extraction data
The USDA's Natural Resources Inventory
Chesapeake Bay Program Watershed Model output
USDA statewide and jurisdiction level soil surveys
VALUES based pasture yields
A DCR developed table of dominant crop types by modeled hydrologic unit
National Weather Service weather records for a multi state area
USGS stream flows from gage stations
Census of Population and Housing indicators of septic system use by block
Slopes developed from USGS Digital Elevation Models (DEMs)
A DCR developed indicator of stream density by modeled hydrologic unit
A DCR developed manure application schedule by manure type by region

Net loadings are formed by subtracting from calculated gross loads the reductions in nitrogen, phosphorous, and sediment that are realized from both best management practice (BMP) installations and relevant grant projects. This includes BMPs funded and installed through DCR, VDOF, and the USDA. Results will produce NPS pollution rankings per pollutant by categorized land use of the modeled hydrologic units.

In contrast to modeled potential nutrient loadings, the NPS related portions of the most current list of water quality limited waters (from the 303(d) report) will be assessed by modeled hydrologic unit. This will produce rankings of hydrologic units for the impaired waters by water regime of the modeled hydrologic units.

Aside from the NPS loadings described above, two variables used in the past NPS assessments for prioritizing watershed protection efforts for biological health will also be recalculated and ranked by modeled hydrologic unit in 2008.

An aquatic IBI score will be used to indicate modeled hydrologic units in need of aquatic species health protection. The IBI score will be developed from aquatic species data collected by DCR, the Virginia Department of Game and Inland Fisheries (VDGIF), and Virginia Commonwealth University (VCU).

As an indication of human health protection concerns, a source water population variable will be calculated by hydrologic unit. This variable will reflect the area in each hydrologic unit that is within a Zone 1 protection level of public source water intakes as defined by the Virginia Department of Health (VDH), weighted by the population served by each intake.

DCR rates modeled hydrologic units as high, medium, or low for potential NPS problems as indicated by the NPS assessment. This categorization is performed so that approximately the highest 20% of the net loadings by unit are assigned the high rank. The next highest 30% of the net loading values are assigned the medium rank. All other units are assigned a low NPS rank. Rather then make a hard and true category split at these percentages, the category breaks are made where net loading differences occur nearest to the stated percentages.

Impaired riverine waters follow a 10, 20, and 70 percent split for high, medium, and low ranking. Impaired waters of other regimes, and the biological indicators, are ranked based more on the clustering and spread of values.

Like all of DCR's NPS assessments since 2002, no single NPS ranking will be produced from the rankings of the various pollutant loadings, biological indicators, and NPS-impaired water regimes. Each user's total ranking needs can be met by deciding which of the ranked categories are pertinent to their program's cause and creating customized rankings using only those categories.

Section 6.4 DESIGNATED USE EVALUATION METHODOLOGY

6.4.1 Wildlife Use Support

Determination of the degree of use support for wildlife is based on the aquatic life toxic criteria found in 9 VAC 25-260-140 B. Two or more exceedences of the same acute criteria within a 3-year period will result in the water being impaired for wildlife use.

6.4.2 Aquatic Life Use Support

Determination of the degree of use support for aquatic life is based on conventional physical parameters (DO, pH, temperature) and aquatic life toxic criteria along with biological monitoring data and best professional judgment, relying primarily on recent data collected during the current reporting period. Up to 6 additional years of data may be used if they reflect current conditions. Additional potential chemical pollutants with no Water Quality Standard criteria are examined as well. These include sediment and nutrients and they are assessed according to Section 6.5 of this guidance.

- Conventional parameters (Dissolved Oxygen (DO), pH, temperature)

Conventional pollutant data will continue to make up the bulk of free-flowing, estuarine and lake water quality assessments. The Percent Method will be used to determine the degree of use support. The assessment determination is based only on available data except where professional judgment indicates that natural causes are responsible for the exceedences or where there is reason to believe the quality of the data are suspect. Waters not meeting WQ Standards due to natural conditions will be assessed as impaired and the source of impairment listed as "natural conditions". For DO, the instantaneous minimum standard for the specific WQ Standards designated Class of water is used to assess exceedences unless continuous monitoring data is available. A daily average, based on 24 hours of continuous data, is used for continuous DO assessment. A daily average exceedence is considered impaired. See Section 6.6 for lake/reservoir DO assessment. Additionally, Chesapeake Bay and tidal tributary estuarine waters will be assessed according to Sections 6.4.2.1 and 6.4.2.3.

6.4.2.1 Chesapeake Bay Sub-categories of Aquatic Life Designated Use

In addition to assessments for the statewide aquatic life designated use as described elsewhere in this document (e.g. see conventional parameters and toxics), the Chesapeake Bay and its tidal tributaries will be assessed through; 1) assessment of subcategories of aquatic life use specific to the Chesapeake Bay estuarine system, and 2) assessment of the general narrative standard for aquatic life use through examination of benthic invertebrate community condition. The following sections describe the aquatic life use sub-categories, applicable criteria, assessment process, segmentation issues, as well as ADB and Integrated Reporting issues.

Aquatic Life Designated Use Subcategories

Subcategories of the propagation and growth of a balanced indigenous population of aquatic life, including game fish designated use for waters in the Chesapeake Bay and its tidal tributaries are listed below.

- **Migratory Fish Spawning and Nursery Designated Use**: waters in the Chesapeake Bay and its tidal tributaries that protect the survival, growth and propagation of the early life stages of a balanced, indigenous population of anadromous, semi-anadromous, catadromous and tidal-fresh resident fish species inhabiting spawning and nursery grounds. This designated use extends from the end of tidal waters to the downriver end of spawning and nursery habitats that have been determined through a composite of all targeted anadromous and semi-anadromous fish species' spawning and nursery habitats (see boundaries in U.S. Environmental Protection Agency. 2004. *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum.* Chesapeake Bay Program Office, Annapolis, Maryland). This designated use extends horizontally from the shoreline of the body of water to the adjacent shoreline, and extends down through the water column to the bottom water-sediment interface. This use applies February 1 through May 31 and applies in addition to the open-water use described in this subsection.

- **Shallow-Water Submerged Aquatic Vegetation Designated Use**: waters in the Chesapeake Bay and its tidal tributaries that support the survival, growth and propagation of submerged aquatic vegetation (rooted, underwater bay grasses). This use applies April 1 through October 31 in tidal-fresh, oligohaline and mesohaline Chesapeake Bay Program segments, and March 1 through November 30 in polyhaline Chesapeake Bay Program segments and applies in addition to the open-water use described in this subsection.
- **Open-Water Aquatic Life Designated Use:** waters in the Chesapeake Bay and its tidal tributaries that protect the survival, growth and propagation of a balanced, indigenous population of aquatic life inhabiting open-water habitats. This designated use applies year-round but the vertical boundaries change seasonally. October 1 - May 31, the open water aquatic life use extends horizontally from the shoreline at mean low water, to the adjacent shoreline, and extending through the water column to the bottom water-sediment interface. June 1 - September 30, if a pycnocline is present and, in combination with bottom bathymetry and water column circulation patterns, presents a barrier to oxygen replenishment of deeper waters, this designated use extends down into the water column only as far as the upper boundary of the pycnocline. June 1- September 30, if a pycnocline is present but other physical circulation patterns (such as influx of oxygen rich oceanic bottom waters) provide for oxygen replenishment of deeper waters, the open-water aquatic life designated use extends down into the bottom water-sediment interface (see boundaries in U.S. Environmental Protection Agency. 2004. *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum.* Chesapeake Bay Program Office, Annapolis, Maryland). This designated use includes the migratory fish spawning and nursery and shallow-water submerged aquatic vegetation uses.
- **Deep-Water Aquatic Life Designated Use**: waters in the Chesapeake Bay and its tidal tributaries that protect the survival, growth and propagation of a balanced, indigenous population of aquatic life inhabiting deep-water habitats. This designated use extends to the tidally influenced waters located between the upper and lower boundaries of the pycnocline where, in combination with bottom bathymetry (depth, contour & shape) and water circulation patterns, a pycnocline is present and presents a barrier to oxygen replenishment of deeper waters. In some areas, the deep-water designated use extends from the upper boundary of the pycnocline down to the bottom water-sediment interface (see boundaries in U.S. Environmental Protection Agency. 2004. *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum.* Chesapeake Bay Program Office, Annapolis, Maryland). This use applies June 1 - September 30.
- **Deep-Channel Seasonal Refuge Designated Use**: waters in the Chesapeake Bay and its tidal tributaries that protect the survival of a balanced, indigenous population of aquatic life inhabiting deep-channel habitats. This designated use extends to the tidally influenced waters at depths greater than the lower boundary of the pycnocline in areas where, in combination with bottom bathymetry and water circulation patterns, the pycnocline presents a barrier to oxygen replenishment of deeper waters (see boundaries in U.S. Environmental Protection Agency. 2004. *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum.* Chesapeake Bay Program Office, Annapolis, Maryland). This use applies June 1 through September 30.

Dissolved Oxygen Criteria

Designated Use	Criteria Concentration/ Duration	Temporal Application
Migratory fish spawning and nursery	7-day mean ≥ 6 mg/l (tidal habitats with 0-0.5 ppt salinity)	February 1 - May 31
	Instantaneous minimum ≥ 5 mg/l	
Open-water [1]	30 day mean ≥ 5.5 mg/l (tidal habitats with 0-0.5 ppt salinity)	year-round
	30 day mean ≥ 5 mg/l (tidal habitats with >0.5 ppt salinity)	
	7 day mean ≥ 4 mg/l	

	Instantaneous minimum ≥ 3.2 mg/l at temperatures <29°C Instantaneous minimum ≥ 4.3 mg/l at temperatures ≥ 29°C	
Deep-water	30 day mean ≥ 3 mg/l	June 1 - September 30
	1 day mean ≥ 2.3 mg/l	
	Instantaneous minimum ≥ 1.7 mg/l	
Deep-channel	Instantaneous minimum ≥ 1 mg/l	June 1 - September 30

1= In applying this open-water instantaneous criterion to the Chesapeake Bay and its tidal tributaries where the existing water quality for dissolved oxygen exceeds an instantaneous minimum of 3.2 mg/l, that higher water quality for dissolved oxygen shall be provided antidegradation protection in accordance with 9 VAC 25-260-30 subsection A.2.

The following site-specific dissolved oxygen criteria apply to the tidal Mattaponi and Pamunkey Rivers and their tidal tributaries because of seasonal lower dissolved oxygen concentration due to the natural oxygen depleting processes present in the extensive surrounding tidal wetlands. These criteria apply June 1 - September 30 to Chesapeake Bay segments MPNTF, MPNOH, PMKTF, PMKOH and are implemented in accordance with subsection D of 9 VAC 25-260-185.

Designated use	**Criteria Concentration/ Duration**	**Temporal Application**
Open-Water	30 day mean ≥ 4.0 mg/l	June 1 - September 30
	Instantaneous minimum ≥ 3.2 mg/l at temperatures < 29°C Instantaneous minimum ≥ 4.3 mg/l at temperatures ≥ 29°C	

Submerged Aquatic Vegetation and Water Clarity Criteria

Designated Use	Chesapeake Bay Program Segment	SAV Acres[1,3]	Water Clarity Criteria (percent light-through-water)[2]	Water Clarity Acres[1,3]	Temporal Application
Shallow-Water Submerged Aquatic Vegetation Use	CB5MH	7,633	22%	14,514	April 1 - October 31
	CB6PH	1,267	22%	3,168	March 1 - November 30
	CB7PH	15,107	22%	34,085	March 1 - November 30
	CB8PH	11	22%	28	March 1 - November 30
	POTTF	2,093	13%	5,233	April 1 - October 31
	POTOH	1,503	13%	3,758	April 1 - October 31
	POTMH	4,250	22%	10,625	April 1 - October 31
	RPPTF	66	13%	165	April 1 - October 31
	RPPOH	0	-	0	-
	RPPMH	1700	22%	5000	April 1 - October 31
	CRRMH	768	22%	1,920	April 1 - October 31
	PIAMH	3,479	22%	8,014	April 1 - October 31
	MPNTF	85	13%	213	April 1 - October 31
	MPNOH	0	-	0	-
	PMKTF	187	13%	468	April 1 - October 31
	PMKOH	0	-	0	-
	YRKMH	239	22%	598	April 1 - October 31

	YRKPH	2,793	22%	6,982	March 1 - November 30
	MOBPH	15,901	22%	33,990	March 1 - November 30
	JMSTF2	200	13%	500	April 1 - October 31
	JMSTF1	1000	13%	2500	April 1 - October 31
	APPTF	379	13%	948	April 1 - October 31
	JMSOH	15	13%	38	April 1 - October 31
	CHKOH	535	13%	1,338	April 1 - October 31
	JMSMH	200	22%	500	April 1 - October 31
	JMSPH	300	22%	750	March 1 - November 30
	WBEMH	0	-	0	-
	SBEMH	0	-	0	-
	EBEMH	0	-	0	-
	LAFMH	0	-	0	-
	ELIPH	0	-	0	-
	LYNPH	107	22%	268	March 1 - November 30
	POCOH	0	-	0	-
	POCMH	4,066	22%	9,368	April 1 - October 31
	TANMH	13,579	22%	22,064	April 1 - October 31

1 = The assessment period for SAV and water clarity acres shall be the single best year in the most recent three consecutive years. When three consecutive years of data are not available, a minimum of three years within the most recent five years shall be used.

2 = Percent Light through Water = $100e^{(-KdZ)}$ where K_d is water column light attenuation coefficient and can be measured directly or converted from a measured secchi depth where K_d = 1.45/secchi depth. Z = depth at location of measurement of K_d.

3 = Values shown as zero are currently being revised and will be published in "Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries 2006 Addendum (USEPA, in press)" and subsequently adopted in VA regulation. Segments which are entirely designated as "No grow zones" will have the Shallow Water SAV designated use removed and others will have a minimal criterion.

3. Chlorophyll *a* Criteria

Designated Use	Chlorophyll *a* Narrative Criterion	Temporal Application
Open Water	Concentrations of chlorophyll *a* in free-floating microscopic aquatic plants (algae) shall not exceed levels that result in undesirable or nuisance aquatic plant life, or render tidal waters unsuitable for the propagation and growth of a balanced, indigenous population of aquatic life or otherwise result in ecologically undesirable water quality conditions such as reduced water clarity, low dissolved oxygen, food supply imbalances, proliferation of species deemed potentially harmful to aquatic life or humans or aesthetically objectionable conditions.	**March 1 - September 30**

The following site specific numerical chlorophyll *a* criteria apply March 1 - May 31 and July 1 - September 30 [as seasonal means] to the tidal James River (excludes tributaries) segments JMSTF2, JMSTF1, JMSOH, JMSMH, JMSPH and are implemented in accordance with subsection D of 9 VAC 25-260-185.

Designated Use	Chlorophyll *a* (µg/l)	Chesapeake Bay Program Segment	Temporal Application
Open-Water	10	JMSTF2	March 1 - May 31
	15	JMSTF1	
	15	JMSOH	
	12	JMSMH	

	12	JMSPH	
	15	JMSTF2	July 1 - September 30
	23	JMSTF1	
	22	JMSOH	
	10	JMSMH	
	10	JMSPH	

Assessment process

Full details of the assessment processes are described in "Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries, EPA 903-R-03-002 (USEPA, April 2003)", "Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for Chesapeake Bay and Its Tidal Tributaries - 2004 Addendum, EPA 903-R-04-005 (USEPA, October 2004)", and "Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries 2006 Addendum (USEPA, Draft March 2007)". A very general summarization of key aspects of the process follows.

The assessment period for D.O., water clarity and chlorophyll criteria shall be the most recent three consecutive years. When three consecutive years of data are not available, a minimum of three years within the most recent five years shall be used.

Attainment of the dissolved oxygen and numeric chlorophyll criteria shall be assessed through comparison of a cumulative frequency distribution of criteria exceedences to the applicable criteria reference curve for each designated use. A first step in the process involves spatial interpolation and extrapolation of data collected at individual fixed locations to project water quality conditions throughout the segment. All appropriate and readily available data will be used for this step. A subsequent step involves development of cumulative frequency distribution (CFD) of criteria exceedences combining both spatial and temporal domains over large spatial areas. A final step is to compare this CFD of criteria exceedences against a "reference" CFD of allowable exceedences to determine if the criteria are attained. If no reference curve has been published by EPA, the "default" cumulative frequency distribution reference curve which represents 10% allowable exceedences equally distributed between time and space, shall be the applicable reference curve.

For the Shallow Water Submerged Aquatic vegetation use criteria, if the submerged aquatic vegetation (SAV) acres are met in any individual Chesapeake Bay Program segment, then the shallow-water submerged aquatic vegetation use is met in that segment. If the SAV acres are not met, then the water clarity criteria shall be examined with either a CFD methodology or a "water clarity acres" methodology. If these water clarity criteria are met to the water-sediment interface, then the shallow-water submerged aquatic vegetation use is met; regardless of the number of acres of SAV in that segment. If sufficient data are not available to assess water clarity criteria and the SAV criteria acres is not met, then the water shall be considered impaired for this designated use.

The 2007 EPA Criteria addendum document has several changes and additions from the 2003 and 2004 documents. Full details are found within the 2007 document but a brief list of the more important changes or additions:

- Revised CFD reference curves for the 30-day dissolved oxygen criteria in Open Water and Deep Water designated use have been developed.
- New CFD reference curve and procedure for deep channel use dissolved oxygen instantaneous criteria has been developed.
- Certain criteria will not be assessed for the 2008 assessment due to lack of fully developed methods and/or available data. These are:
    - All 1-day and 7-day dissolved oxygen criteria.
    - All instantaneous minimum dissolved oxygen criteria except in deep channel use.

- Criteria for water clarity acres in segments which previously had zero acres as the criteria have been established.
- Procedures for assessing the water clarity acres criteria have been established.
- A method for assessing water clarity through a CFD method has been established.
- Procedures for assessment of the numerical Chlorophyll criteria in the James River have been established.

Assessment Units

The Chesapeake Bay program segmentation scheme (*Chesapeake Bay Program Analytical Segmentation Scheme-Revisions, Decisions and Rationales: 1983 -2003,* CBP/TRS 268/04. Chesapeake Bay Program, Annapolis, Maryland) shall be used as the assessment unit to determine attainment of the criteria in this section for each designated use. The spatial boundaries of each aquatic life use subcategory within each of these CBP segment are described in the *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum.* Chesapeake Bay Program Office, Annapolis, Maryland. Assessment results for each CBP segment/designated use will determine the Integrated Report listing category of all waterbodies geographically within that CBP segment/designated use. For example, the listing category of Onancock Creek will be determined by the appropriate designated use attainment of CBP segment CB7PH. In this example, it is likely that only open water and shallow water uses of CB7PH extend into Onancock Creek.

Assessment Database (ADB) Reporting Units

The Assessment Database (ADB) is used to track assessment data for all designated uses across the state. ADB assessment unit spatial boundaries are defined by many factors including the availability of data to assess for any/all designated uses. There may be several ADB assessment units included in each Chesapeake Bay program segment assessment unit.

ADB can only accept estuarine assessment units defined by surface areas (i.e. square miles). The complete water column within that assessment unit is assigned to a single overall aquatic life use attainment status. Each individual Bay segment assessment unit may have deep channel, deep water, and open water sub-categories of aquatic life designated use (that may only account for a portion of the total volume/area of the ADB assessment unit) which each have its attainment status.

Each ADB assessment reporting unit will be designated as having the aquatic life use and sub-use status according to the appropriate CBP segment/Aquatic life sub-designated use assessment. The rules to be applied are:

a) Open water designated extends from "shoreline to shoreline" within each CBP segment and thus all ADB reporting units located within each CBP segment is reported as having "open water" aquatic life use attainment consistent with the CBP segment attainment of open water criteria.
b) Deep water and deep channel designated use spatial boundaries within each CBP segment are spatially constrained as smaller areas within the larger CBP segments (see *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum.* Chesapeake Bay Program Office, Annapolis, Maryland). Thus the deep water or deep channel designated use status for each CBP segment will apply only to ADB reporting units which contain a "deep water" designated use area. The actual 2 dimensional (i.e. square miles) size of each deep channel and deep water area will be measured and reported as the actual impaired area (i.e. the area of complete ADB unit is not considered impaired if only the smaller deep water or deep channel area was impaired).
c) The Shallow Water Submerged Aquatic vegetation designated use applies only out to a maximum of 2 meter contour. Each ADB unit having this sub-use will designate the sub-use as attained or not. However, the size of the impaired use will be tracked outside of the ADB system and reported in the Integrated Report as being only the size of area within the 2 meter contour.
d) The general standard aquatic life use status of the ADB unit will be assigned to the "worst case" status of aquatic life sub-use within that ADB assessment unit (e.g. an ADB reporting unit containing an open water use which meets it's associated criteria and a deep water use which fails it's associated criteria will be

categorized as failing the general aquatic life use). Other criteria applicable to the general standard for aquatic life use (e.g. for benthic communities, toxics, or "weight of evidence" etc…) will also determine the overall aquatic life use attainment. If the general aquatic life use is impaired only due to a smaller area of aquatic life sub-use, then only the area (i.e. square mileage) of the sub-use is reported as impaired for general aquatic life use.

303(d) listing (i.e. Category 5)

All 303(d) listings will be based on the above described methods and associated Chesapeake Bay WQ Standards . Chesapeake Bay assessment units, as described in 9 VAC 25-260-185, that were listed in 2006 as not supporting the Aquatic Life Use for Dissolved Oxygen and associated subcategories of Aquatic Life Use DO criteria will continue to remain on the 303d list until all applicable criteria are attained (e.g. any 7-day mean or instantaneous criteria must be assessed and attained as well as the 30-day criteria). An exception to this is if a segment and use (e.g. open water 30 day mean DO use of segment CB7PH) was listed as impaired solely due to failure of the 30-day mean open water and/or deep water DO criteria with insufficient data for other DO related use assessments and a subsequent 30-day mean DO use assessment is now in attainment and other DO criteria have not been assessed for lack of sufficient data, then the assessment unit will be delisted (i.e. changed from category 5A-impaired and needing a TMDL to category 3B- insufficient assessment of all Bay DO criteria).

6.4.2.2 Free-Flowing Biological Assessment

Biological monitoring of streams and rivers using benthic macroinvertebrates is an integral component of the water quality monitoring program in the Commonwealth of Virginia. Biological monitoring allows the Virginia DEQ to assess the ecological condition of streams and rivers. Benthic macroinvertebrate surveys are used to determine if the waterbodies meet their designated aquatic life uses.

The Virginia Stream Condition Index (VSCI)

In 2000, the United States Environmental Protection Agency (USEPA) contracted TetraTech to develop a multimetric macroinvertebrate index for Virginia. This index contains eight core metrics that when calculated into one number is known as the Virginia Stream Condition Index (VSCI). TetraTech developed the VSCI using Virginia's existing biomonitoring database, which contained a significant amount of upstream (reference) control sites for use with the USEPA's Rapid Bioassessment Protocols.

Using an independent, new probabilistic database (sample n=350) with data collected from 2001-2004, Virginia has validated the VSCI using a spatially diverse (ecoregionally and stream size) data set free of psuedoreplication. These probabilistic data sets have allowed DEQ to narrow data gaps and test the proposed VSCI against many classification variables, which include season, stream size, ecoregion, bioregion, river basin, regional office, and sampling technique. The VSCI validation study was designed to incorporate suggestions provided through public comment from the Academic Advisory Committee (AAC), the USEPA and the regulated community.

The validation study using probabilistic biological data has confirmed that the VSCI works well to discriminate between sites with acceptable water quality and habitat versus sites with degraded water quality and habitat. A VSCI impairment threshold score of 60 was determined from statistical analyses of the original TetraTech report and the DEQ validation study. The VSCI validation study and the aquatic life use assessment guidance using the VSCI has been reviewed and approved by the USEPA. The validation study "Using Probabilistic Monitoring Data to Validate the Non-Coastal Virginia Stream Condition Index" can be found at http://www.deq.virginia.gov/probmon/pdf/scival.pdf .

Aquatic Life Use Determination

The DEQ uses the VSCI for non-coastal streams for biological assessment as well as the Coastal Plain Macroinvertebrate Index (CPMI) for coastal plain streams. Assessment rankings, based on a single VSCI or CPMI bioassessments, are the result of the data evaluation and reduction of numerous measurements and observations conducted during the biomonitoring survey. Bioassessment measures the response of the biological community to all perturbations it has experienced, integrated over time. A single, properly conducted, VSCI or CPMI bioassessment is

not a "single data-point" analogous to a single Dissolved Oxygen (DO) measurement or fecal coliform sample. Non-coastal streams with VSCI scores ≥ 60 or coastal plain streams with CPMI scores ≥16 will be assessed as "fully supporting for aquatic life use". VSCI scores < 60 and CPMI scores < 16 will result in streams being listed as "impaired".

If the biologist has observed natural conditions, such as recent drought or flooding, etc, that could be responsible for a ranking below the impairment threshold, they should note the lack of confidence in the survey and the stream will be listed as "fully supporting but having observed effects for aquatic life use" until further analysis can be conducted.

The regional biologists should review the biological assessments for the assessment cycle and they should make a final biological assessment ranking based on these data. Since biomonitoring surveys are records of the condition of the community at the time of the survey, the most recent bioassessment should be the most accurate indicator of stream ecological health. An attempt to average the data would weaken the ability to accurately predict current conditions. In cases where biological assessment rankings fall above and below the impairment threshold over multiple sampling events, more weight should be given to the most recent bioassessment. In cases where only one biomonitoring survey was conducted, a stream may be assessed for aquatic life use based on a single VSCI or CPMI score. A standardized fact sheet, as found in Appendix B of this manual, has been developed to help the regional biologists review and assess the data for the assessment cycle. The fact sheet allows for consideration of supplemental information about the watershed that is important in making the final assessment decision.

6.4.2.3 Estuarine Biological Assessment

In cooperation with EPA Region III (R III) and the State of Maryland, DEQ has developed an assessment methodology for estuarine benthic community biological (B-IBI) data. This methodology assures Bay wide consistency in determinations of estuarine benthic impairments and requires a sample size > 10 for statistical purposes. In order to assist with meeting the sample size requirement, a six-year data window is used. This corresponds with the data window used for the assessment of other non-Chesapeake Bay criteria data.

The methodology incorporates uncertainty in the reference condition and is based on the confident limit and bootstrap simulation concept described in Alden et al. (2002). Bootstrap simulation (Efron and Tibshirani 1998) will be applied to incorporate uncertainty in reference conditions as well as sampling variability in the assessment data. For each habitat, a threshold based on percentiles in an unimpaired reference data set will be applied (i.e. 5th percentile). This threshold is not intended to serve as criteria for classifying individual B-IBI scores, rather it will be used to categorize the segment as impaired or not based on the proportion of samples below the threshold and the variance associated with this estimate.

The impairment assessment for each segment is based on the proportion of samples below the threshold with the variance in this proportion estimated by simulation. In each simulation run, a subset of the reference "unimpaired" data for each habitat is selected at random, and the threshold is determined (i.e., the B-IBI score at the 5th percentile of the un-impaired dataset). A random subset of the assessment data is compared to the threshold value to estimate the proportion of sites below the threshold. By repeating this process over and over again (2000 runs) we estimate the variance in the proportion of sites below the threshold from the bootstrap estimates. For this analysis, it is assumed that each reference 'un-impaired" data set (by habitat) is a representative sample from a "super population" of reference sites.

The assessment result for each benthic segment (i.e. % of area with IBI score below 5th percentile threshold) is then statistically compared ($p<.05$) with the percentage that would be expected even if the segment is unimpaired. This percentage under "un-impaired" conditions is assumed to be 5%.

In addition to an assessment of impairment, a discriminant analysis tool (benthic diagnostic tool) has been developed that can be used to identify sources of stress affecting benthic community condition in the Chesapeake Bay (Dauer et al. 2002). The results can distinguish stress due to contaminants versus stress due to other factors (e.g., low

dissolved oxygen, or unknown). This tool will be used to identify which impaired segments have high probability of sediment contamination. Separately from the discriminant tool, the B-IBI metric scoring will also be used to identify (1) insufficient abundance patterns consistent with a low dissolved oxygen effect and (2) excessive abundance patterns consistent with eutrophication effects in the absence of low dissolved oxygen events. The combined use of these causal analyses will be used to assign causes for benthic impairments to either 1) Sediment chemical contaminants 2) Low dissolved oxygen 3) Eutrophication or 4) Unknown.

The spatial assessment unit for determining attainment of the general standard for aquatic life use using benthic community data will be the same as used in the 2006 assessment report. These criteria assessment units are described in "*Chesapeake Bay Program Analytical Segmentation Scheme-Revisions, Decisions and Rationales: 1983 -2003,* CBP/TRS 268/04. Chesapeake Bay Program, Annapolis, Maryland" with the additional caveat that minor tidal tributaries are considered separate benthic assessment segments.

Assignment of aquatic life use status, as determined by benthic assessments to ADB reporting waterbodies, will be the same as described previously for the new Bay criteria assessments found in Section 6.4.2.1. Each ADB reporting unit will be assigned the general aquatic life use status of the benthic assessment segment in which it is geographically located.

References:

Alden, R.W. III. 1992. Uncertainty and sediment quality assessments: Confidence limits for the Triad. Environmental Toxicology and Chemistry 11:645-651.

Alden, R.W. III, D.M. Dauer, J.A. Ranasinghe, L.C. Scott, and R.J. Llansó. 2002. Statistical verification of the Chesapeake Bay Benthic Index of Biotic Integrity. Environmetrics 13:473 498.

Dauer, D.M., M.F. Lane, and R.J. Llansó. 2002. Development of diagnostic approaches to determine sources of anthropogenic stress affecting benthic community condition in the Chesapeake Bay. Report submitted to the USEPA Chesapeake Bay Program Office, Annapolis, Maryland, by Old Dominion University Department of Biological Sciences, Norfolk, Virginia. 65 pp.

Efron, B. and R. Tibshirani. 1998. An Introduction to the Bootstrap. Chapman & Hall/CRC.

Llansó, R.J., J.H. Vølstad, and D.M. Dauer. 2003. Decision Process for Identification of Estuarine Benthic Impairments. Final Report submitted to Maryland Department of Natural Resources, Tidewater Ecosystem Assessments, Annapolis, Maryland, by Versar, Inc., Columbia, Maryland.

6.4.3 Fish Consumption Use

The support of the fish consumption use can be based on several types of information. The first type include consumption advisories (limiting consumption) or restrictions (no consumption) issued by the VDH as per the Memorandum of Understanding (MOU) with DEQ. The second type includes the comparison of fish tissue data to WQ Standards criterion based tissue values (TVs) and tissue screening values (TSVs). Waters exceeding the same toxic WQ Standards derived value (TV) listed in Appendix E-1, for fish tissue two or more times are impaired for fish consumption. For example, both of the following situations would qualify as impaired under these criteria. Two fish samples from different species exceeding the same TV during one sampling event or two or more samples of the same or different species exceeding the same TV from different sampling events within the assessment period are considered impaired. See Section 6.5.2 for additional information on fish tissue analysis. Waters are assessed as impaired for fish consumption use if an advisory, specifically limiting consumption, or a restriction has been enacted. For additional information, fish consumption use support will be determined according to criteria found in Part V. Finally, support of the fish consumption use is determined by comparison to the human health criteria in public water supplies and other surface waters, as listed in the WQ Standards.

6.4.4 Shellfish Consumption Use

Shellfish consumption use support is based on the determination of restrictions or condemnations on the harvesting and marketability of shellfish resources made by the VDH-Division of Shellfish Sanitation (DSS) as of the most recent condemnation list (January 2007) associated with the reporting period. The DSS is the State agency with the statutory authority to determine shellfish harvesting and marketability status. The DSS uses four classifications for

describing the status of shellfish waters. They are approved, conditionally approved, restricted, and prohibited and these are assessed according to the considerations found in Part V. A description of these terms follows:

Approved area:	Growing areas from which shellfish may be taken for direct marketing at all times.
Conditionally Approved:	Growing areas where the water quality may be affected by seasonal or sporadic use of boat docks or harbor facilities are considered conditionally approved. Normally, this would occur during the boating season (April 30 through October 31).
Restricted Area:	Growing areas where a sanitary survey indicates a limited degree of pollution which makes it unsafe to market shellfish for direct marketing. Shellfish from such areas may be marketed after purifying or relaying activities in accordance with certain VDH-DSS requirements.
Prohibited Area:	Growing areas where the sanitary survey indicates dangerous numbers pathogenic microorganisms or other contaminants that might reach that area. The harvesting of shellfish from these areas for direct marketing, relaying, or depuration is prohibited.

Specific information regarding DSS assessment methodology and the listing/delisting flowchart for shellfish waters can be found in Appendix C of this guidance document. For the 305(b)/303(d) Integrated Report, listing and delisting will be based on data assessed for the reporting period. However, as the TMDL begins development, if new or more recent data shows the shellfish water is no longer impaired, a petition for delisting will be crafted and submitted to EPA for their approval by the Watershed Program (TMDL) staff.

6.4.5 Recreation Use

Based on the requirements of Section 305(b), support of the primary and secondary contact recreation uses are assessed together using the similar procedures used in past reports. However, for the 2008 report, E.coli (freshwater) and enterococci (transition zone and saltwater) data will be assessed. Fecal coliform will not be assessed as this indicator is being removed from WQ Standards. However, previous fecal coliform impairments will continue to remain on the 303(d) list until the appropriate bacteria indicator is sampled and assessed independently. Waters should be assessed as impaired for recreation use if E. coli or enterococci bacteria data or bathing area closure indicates less than full support. See Part V for additional recreation use assessment information.

6.4.6 Public Water Supply Use

Toxics in drinking water are assessed according to the WQ Standards criteria (9 VAC 25-260-140 B.) for public water supply and support of this use will be based on methodology described in Part V.

Section 6.5 ADDITIONAL PARAMETER ASSESSMENT

6.5.1 Fish Tissue and Sediment Toxics Assessment

- **Fish Tissue (Consumption) Use**

As described in Section 6.4.3, the WQ Standards and Biological Monitoring Programs known as WQSBP, collect fish tissue samples from designated monitoring stations for contaminant analysis. WQSBP staff identifies the results of any analysis that exceeds the WQ Standards criterion based tissue value (TV) or tissue screening value (TSV) found in Appendix E-1 and E-2 respectively, for the toxic contaminants and provides this data to water quality assessment (WQA) staff. Older fish tissue data may be included where deemed appropriate.

Fish tissue data collected at stations during routine monitoring throughout Virginia represent Tier 1 monitoring data. These Tier 1 monitoring data are meant to identify sites where concentrations of contaminants in the edible portions of commonly consumed fish indicate a potential health risk to humans. Usually, three fish tissue composite samples are analyzed for chemical contaminants at each Tier 1 station. Each is a composite of edible fillets for one species of fish from a top-level predator, a mid-level predator, and a bottom feeder. If Tier 1 results reveal potential problems, a more intensive Tier 2 study is initiated by the WQSBP staff to determine the magnitude, geographical extent, and potential sources of contamination in the fish. The need for a more intensive Tier 2 study takes into consideration the severity of the potential concern and is initiated as soon after the discovery of a potential problem as resources allow. Generally, if additional information is requested by the Virginia Department of Health for determining the need for fish consumption advisories, a follow-up monitoring effort is initiated the year after the discovery of the potential problem. If limited resources prevent this, the waterbody will be sampled more intensely as soon as resources allow and at least during the next rotation of monitoring in the river basin which is conducted on a rotational basis every three to five years.

Analytical results for fish tissue are expressed in wet-weight and are compared to WQ Standards TVs and TSVs for the toxic pollutants using EPA risk assessment techniques for noncarcinogen and carcinogen effects. WQ Standards human health calculations use the 10^{-5} risk level adopted by the State Water Control Board in 1992, an average human body weight of 70 kg and a lifetime average fish consumption rate of 6.5 grams per day (general U.S. population). These same values are used to calculate the human health water quality criteria found in 9 VAC 25-260-140 B. Also included in the calculation are toxicological data pertinent to human health effects. A reference dose (RfD) is used for non-carcinogen toxic effects and a cancer oral slope factor is used for carcinogen effects. TV's are based on the same toxicological data (and body weight, fish consumption, and cancer risk level) that form the basis for the water quality criteria listed in 9 VAC-25-260-140.B, under the column labeled "Human Health, All Other Surface Waters". These water quality criteria are water column concentrations that are based on a specific fish tissue concentration, which were calculated to represent a safe or acceptable minimal human health risk level. The water quality criteria are designed to prevent the fish from bioconcentrating the toxic contaminants to levels greater than these fish tissue concentrations. The TV concentrations listed in Appendix E-1 represent the same fish tissue concentrations that are the basis for the water quality criteria listed in 9 VAC-25-260-140 B and may be considered the fish tissue concentration equivalent of those water quality criteria. Appendix E-1 contains TV's for all chemicals for which Virginia has adopted water quality criteria. However, many of the TV's listed in Appendix E-1 do not bioaccumulate and are not often found in fish tissue and have been included for completeness. All TVs are rounded to two significant digits.

Appendix E-2 also lists TSVs for additional toxic chemicals for which Virginia has not adopted water quality criteria that are based on fish tissue concentrations (those criteria listed under "All Other Waters" in 9 VAC-25-260-140.B). It includes chemicals recommended for monitoring by EPA or of special interest to DEQ as well as some chemicals that are based on recent changes to toxicological data and /or exposure assumptions that are different from those used to calculate the water quality criteria found in 9 VAC-25-260-140.B. The TSVs are updated using available data from the EPA IRIS database and/or recommendations from EPA or the VDH before each assessment effort.

If a fish tissue composite sample exceeds a single WQ Standards TV or TSV, the water body should be delineated as fully supporting but having an observed effect for the fish consumption use. If the TV for the same toxic pollutant is exceeded in two or more samples from the same site, the water is considered impaired. For example, both of the following situations would qualify as impaired under this criterion: two different fish samples from different species during one sampling event or two or more different samples of the same or different species from different sampling events. Data from all Tier 1 and Tier 2 monitoring studies are evaluated by DEQ as well as provided to the VDH for their consideration of the need for establishing fish advisories. DEQ and VDH have signed a Memorandum of Agreement (MOA) that describes how the agencies exchange information regarding the results of all Tier 1 and Tier 2 fish tissue monitoring. If VDH issues a

fishing ban or advisory, limiting consumption, the segment should be designated impaired for fish consumption use based on the advisory. The results of the Tier 2 study should be clearly communicated in the Integrated Report narrative.

- **Sediment (aquatic life use)**

Similar to the sediment monitoring and analysis conducted by WQSBP, the regional offices will assess the AWQM sediment data. For freshwater sediments above the fall-line and tidal fresh zones, as described in the WQ Standards, the Consensus Based Probable Effects Concentrations (PEC; MacDonald et al. 2000) should be applied. Estuarine sediment contaminant data collected during scheduled AWQM monitoring should be compared to National Oceanic and Atmospheric Administration (NOAA *Screening Quick Reference Tables* (SQuiRT) Tables 1999) for effects-range-median (ER-M) SVs for sediment. Transition zones should be assessed against the more stringent of the two screening values. One or more exceedences of an ER-M/PEC value results in a fully supporting but having observed effects status for aquatic life use support. In these cases, additional biological monitoring should be scheduled to assess actual aquatic life use support. For National Coastal Assessment, a "weight of evidence" approach using sediment toxicity and sediment chemistry will be used to determine aquatic life designated use. See Section 6.5.3 for additional information. All metals contaminant screening values found in Appendix F have been converted to parts per million (ppm) for consistency.

6.5.2 Additional Toxics Evaluation

- **Freshwater Toxics Evaluation**

For overall freshwater toxics evaluation, DEQ uses the Virginia WQ Standards for human health in surface waters, other than public water supplies (9 VAC 25-260-140 B). These same values are used to assess the fish consumption use in public water supplies as well as all other surface waters. (Please note the criteria for human health in public water supplies will be used to assess the drinking water use in PWSs only). For metals assessment, only dissolved metals data will be used. In conformance with water quality management plans and VPDES permitting procedures, water column toxicant data collected up to 6 years prior to the current 305(b) period should be assessed along with current data if they reflect current conditions. When assessing the aquatic life and wildlife use support for toxic contaminants, compliance should be based on meeting the aquatic life WQ Standards found in 9 VAC 25-260-140 B. See Part V for additional information.

For 2008, Virginia will declare waters impaired for aquatic life use and included in Category 5A if a 30-day semi-permeable membrane device (SPMD) sampled parameter exceeds a water quality criteria two or more times within a 3-year period. As in the past, DEQ will identify other waters of concern as having observed effects and will schedule additional monitoring, if appropriate, to determine if the designated uses are being met.

- **Estuarine Toxics Evaluation**

The primary objective of ambient toxics monitoring is to perform a quick screening of the medium of interest (water, sediment, fish tissue, etc.) to determine whether the presence of toxic pollutants occurs and could potentially have a negative impact on aquatic life or human health. Toxic effects that may be observed within the biota include individual survival, growth and reproduction, which are generally measured as the results of toxicity tests, and/or the status of the resident benthic community. While ambient water can be the focus of these efforts, if there is a nearby source of toxics and the dissolved concentrations are elevated, sediment is more often the medium of interest because chemical contaminants have a greater affinity for suspended particles that ultimately settle to the bottom in all water bodies. Historically, ambient toxics monitoring of sediment focused solely on the analysis of bulk chemical concentrations or simultaneous collection of both chemicals and the benthic community. The interpretation and subsequent assessment of data based on one or two evaluation methods were often filled with uncertainty and frequently led to the recommendation for additional sampling if the community was stressed. To reduce uncertainty in ambient toxics-related studies, Virginia, the EPA Chesapeake Bay Program, and other Federal efforts (NOAA, and the National Coastal Assessment Program) have adopted a more holistic approach. Ambient sediment toxicity studies performed in the Chesapeake Bay Estuary (*e.g.*, Hall et al., 1997) have employed a three-tiered method that

focuses on toxic pollutants found in the sediment and their potential affects on the biological communities. These studies were designed to follow the "Sediment Quality Triad" (SQT) concept that was originally developed by Long and Chapman (1985), was further applied by Chapman et al. (1986, 1987), and which has continued to be one of the preferred approaches (Chapman, 1992; Chapman et al., 1997; McGee et al., 2001; Roberts et al., 2002; Roberts et al., 2003).

The SQT is an effects-based approach that describes the condition of the sediment and associated benthic infaunal communities relative to toxic pollutants. The three main data components that are integrated into the "weight-of-evidence" (WOE) analysis include: (1) sediment bulk chemical concentrations, (2) sediment toxicity test results, and (3) an evaluation of benthic infauna community condition. Rather than considering each data type individually, the complementary methods integrate biological responses with chemical data (Chapman, 1992) for a more scientifically defensible assessment process. Chapman (1992) provides eight possible scenarios from which conclusions can be drawn with the SQT approach. It is this concept that serves as the foundation required for implementing the "weight of evidence" assessment from triad data (Table 4).

The objective of this guidance is to provide an explanation for interpreting data generated by the traditional SQT approach, but with added insight on how to consider "weighting" of each triad component. This is not to suggest that sound scientific interpretation and best professional judgment are unnecessary, but does provide some degree of process standardization. Conceptually, this is a similar approach used by the Chesapeake Bay Program and its partners for the Toxics Characterization of the Bay (EPA 903-R-00-010, June 1999). The use of this guidance will provide assistance in applying "weights" to the different triad components, which are then inserted into the classic SQT matrix. The bulk chemistry results, for example, can receive additional weighting based on the magnitude of exceedence of the applicable Sediment Quality Guideline (SQG). For toxicity tests, greater weight is applied with two or more statistically significant sediment toxicity tests than what is applied to a single significant test, for the affected endpoint. The type of toxicity test endpoints that exhibit statistical significance must also be given consideration, since the ecological consequence of not surviving is greater to a population of a species than the growth of individuals. Therefore, survival would receive a greater weight.

Benthic community alteration is often evaluated by integrating various individual metric scores into a single Benthic Index of Biotic Integrity (B-IBI) based on previously established thresholds (e.g., Weisberg et al., 1997), and then comparing the overall site B-IBI score with the defined ranges characteristic of specific habitat types (e.g., Llansó et al., 2003 for the Chesapeake Bay). Weighting the overall benthic community condition with this B-IBI is straight-forward, as there are four previously established categories ranging from good to severely degraded. (Please refer to Table 5, below). An alternate B-IBI, developed for estuaries of the Middle Atlantic Region (Llansó et al., 2002a, 2002b), is used for assessment in Atlantic coastal estuarine waters. Index values < 3.0 for this B-IBI are considered to be indicative of stressed benthic assemblages and degraded conditions. When one or more measurements essential for the calculation of either of these B-IBIs is lacking, a third alternative is available. Paul et al. (2001) developed a "benthic index of estuarine condition for the Virginian Biogeographic Province" (Cape Cod to the mouth of Chesapeake Bay), based on the 1990-1993 results of EPA's Middle Atlantic Integrated Assessment (MAIA) Program. This index is used in the weight-of-evidence assessment when neither of the B-IBIs is available or considered inappropriate. In the original publication of the MAIA benthic index, calculated as a linear discriminant function, final values greater than zero (> 0.000) were interpreted as an indication of non-degraded conditions and values less than zero (< 0.000) were interpreted as an indication of degraded sites. No indeterminate "gray zone" was specified. For the purpose of weight-of-evidence assessment, discriminant scores of this index between -0.1 and +0.1 are considered "marginal." Although no systematic salinity-induced bias has been demonstrated for any of these B-IBIs, it should be noted that all three are notably less reliable in low-salinity habitats, *i.e.*, oligohaline and tidal fresh waters (salinity < 5 ppt). Approximately 20% of Virginia's estuarine probabilistic sites sampled between 2001 and 2006 were within this salinity range.

Back Bay and the North Landing River, in southeast coastal Virginia, constitute a unique tidal freshwater region that is so isolated from Albemarle Sound and the Atlantic Ocean that none of the previously described benthic indices may be appropriate. Most of the benthos in this region is more characteristic of freshwater than of tidal estuarine waters. For the purpose of assessment in this region, all three benthic indices are compared and a tentative characterization is based on the relative degree of concordance among them and other individual metrics of species richness, diversity and abundance.

Table 4. Possible SQT Conclusions and Listing Decisions for Estuarine Toxics Evaluation. Adopted from Chapman (1992).

Scenario	Chemistry	Toxicity	Benthic Community Alteration	Possible Conclusions	Listing Decision (Weight dependent)
1	1-3 "+"	1-3 "+"	1-3 "+"	If "+++" in all three categories, strong evidence for chemical contaminant-induced degradation.	**VA Category 5A (cause = toxics)**
2	-	-	-	Strong evidence for absence of chemical contaminant-induced degradation.	**VA Category 2A**
3	1-3 "+"	-	-	Chemical contaminants are not bioavailable.	**VA Category 2A (or 2B)**
4	-	1-3 "+"	-	Unmeasured chemical contaminants or conditions may exist that have the potential to cause degradation.	**VA Category 2A**
5	-	-	1-3 "+"	Alteration is probably not due to chemical contaminants.	**Va Category 3B or 5A (cause Water Quality)**
6	1-3 "+"	1-3 "+"	-	Chemical contaminants are likely stressing the system.	**VA Category 3B (or 2B)**
7	-	1-3 "+"	1-3 "+"	Unmeasured chemical contaminants are causing degradation. Slight or moderate benthic degradation => 3B (or 2B); severe benthic degradation => 5A.	**VA Category 3B (or 2B); 5A**
8	1-3 "+"	-	1-3 "+"	Chemical contaminants are not bioavailable or benthic alteration is not due to chemical contaminants.	**VA Category 3B**

"+" Indicates measured difference between test and control, reference conditions, or bulk chemistry and applicable SQG.
"–" Indicates no measurable difference between test and control, reference conditions, or bulk chemistry and applicable SQG.

Scenario 1. With many possible variations, all three triad attributes must be evident at a high level. Best professional judgment will be necessary in cases where "+ + +" are not attained in all three categories.

Scenario 2. There are no other variations as all three data types overwhelmingly demonstrate the aquatic life designated use is being met in stream.

Scenario 3. With a lack of biological effects, it is rather unlikely the chemical contaminant(s) are in a form that is bioavailable. It is possible, although unlikely that a toxicant could exceed its SQG $\geq$ 2x but fail to yield toxic affects (ancillary data such as AVS or TOC would be supportive). It can be concluded there is attainment of the aquatic life designated use.

Scenario 4. Unmeasured chemical contaminants may be contributing to the observed toxicity. Without benthic degradation, there are several other possibilities. The unmeasured toxicants are not bioavailable instream, or toxicity test conditions are highly favorable for expressing the toxicant effects from the unkown(s), or perhaps the associated toxicity is an artifact of the test itself (i.e. ammonia or salinity adjustment). If more than one species is affected, best professional judgment shall be applied.

Scenario 5. Some possibilities for benthic alteration could be a result of nutrient enrichment, habitat condition, habitat type, or a high energy environment. However, toxic contaminants are an unlikely cause of the stressed community.

Scenario 6. Best professional judgment should be applied by assessing the magnitude of both the chemical stressors and their toxicological effects. On the other hand, significant weight must be given to the B-IBI as an indicator capable of integrating all in-situ stressors over time.

Scenario 7. Chemical contaminants cannot be ruled out as targeted analytes are not very extensive and observed biological effects could be a result of unknown contaminant(s). Additive or synergistic effects from chemical contaminants could also be occurring. Again, best professional judgment should be applied.

Scenario 8. The benthic community could be impacted for reasons highlighted in Scenario 5 above. However, the magnitude of the chemical contaminant component must be considered. Lack of sediment toxicity suggests the chemical contaminants may not be bioavailable or perhaps the toxicity test organism(s) are not sensitive to the toxicants. Best professional judgment is warranted.

Note: *The symbols used in the Excel Workbook matrix differ somewhat from those used in Chapman's original "Sediment Quality Triad / Weight-of-Evidence" matrix described above. In the workbook matrix, a dash ("-") is replaced with a zero ("0") but retains the same meaning of "no measured effect". A numerical score of "1-3" is used to indicate the magnitude of the effect and is equivalent to the number of pluses ("+") shown in the matrix. Finally, the sum (Total Score) is used as a 'qualitative' evaluation of the total affect observed during the SQT W-o-E Assessment.*

Table 5. Chesapeake Bay B-IBI Ranges and Benthic Community Condition.

B-IBI	Benthic Community Condition
≥ 3.0	Meets Goal
2.7-2.9	Marginal
2.1-2.6	Degraded
≤ 2.0	Severely Degraded

Data Assessment

Bulk Chemistry concentration data are compared with the appropriate Sediment Quality Guideline (SQG). It is recognized that extra caution must be applied for SQGs where weaker relationships existed between the threshold and an effect (e.g., ER-M – Nickel; PEC – Mercury, Nickel, Total PCBs, Total DDT, and DDE). If the study sites are located in a Tidal Fresh or Oligohaline (Transition Zone) area, the lower value of either the ER-M (for estuarine waters) or PEC (for freshwaters) is applicable, whereas the ER-M has greater applicability within the more saline habitats. Based on the uncertainty associated with SQGs, the magnitude of exceedence is considered in the weighting process. For example, a contaminant that exceeds its guideline by a factor of four is more likely to be the cause of, or contribute to the observed toxicity, although a Toxicity Identification Evaluation (TIE) would be necessary for confirmation. If available, ancillary data such as Acid Volatile Sulfide (AVS) and/or total organic carbon (TOC) can be considered within the weighting, as these are important relative to the bioavailability of some metals (AVS) and organic compounds (TOC). Other factors worthy of consideration include: (1) length of the chemical target analyte list (many toxicants could be excluded so their presence/absence is unknown), and (2) sediment quality guidelines have not been developed for the majority of organic chemicals, so a basis for comparative analysis for potential toxicity does not exist. Average and summed quotient values are also calculated from the SQGs although little, if any weight is presently applied to these generalized descriptive statistics.

The magnitude of observed effects can be considered for sediment toxicity. The survival of test organisms, expressed by the survival endpoint, is generally associated with higher levels of toxicants (although chemical additivity, antagonism and synergism can also play a role). Sub-lethal test endpoints that provide a measure of exposure effects at an increased level of sensitivity, with lower toxicant concentrations, include organism growth (expressed in weight), reburial (amphipods), reproductive rate, etc. In relative terms, the ecological significance of these endpoints is not likely as critical as the measure of survival. Therefore, less weight is applied in cases where these endpoints show effects. In situations where the survival endpoint yields statistically significant effects by one or more species, greater weight would be applied accordingly. It is important to factor into the weighting the number, type and associated sensitivities of the test species. Attention must also be applied to artificial toxicity such as in the case of naturally occurring sediment ammonia. Another is salinity adjustment, which can geo-chemically alter the sediment, thus leading to changes in chemical bioavailability and ultimately affecting sediment toxicity (Roberts et al., 2002). Indigenous predators can also significantly alter the test outcome.

Benthic community alteration and application of an associated "weight" is easily obtained (refer to Table 5, see Figure 1). Best professional judgment may be necessary in cases where a degraded community could be a consequence of the habitat type. Alden et al, (2002) statistically determined there is greater uncertainty associated with scores derived from tidal fresh, oligohaline, and mesohaline habitats and labeled these as either degraded, non-degraded or of intermediate/ indeterminate quality. These scores were a result of habitat uncertainty rather than sediment quality.

While potential scenarios are too numerous to list, for many sites the conclusion should be obvious. For example, chemical contaminants are commonly detected but at concentrations below their respective SQGs. The biological results from the same samples indicate a lack of effects, as demonstrated by no sediment toxicity and a healthy benthic community. The resultant listing would be VA Category 2A (fully supporting designated use). On the opposite end of the spectrum, three components of the triad may show extreme effects and sediment would consequently be listed in the 5A category (impaired for toxics - needing a TMDL). For those instances where the conclusions are not obvious, it will be necessary to obtain consensual agreement between Central Office and the Regional Office associated with that water. If agreement cannot be attained, advice from the Academic Advisory Committee should be sought.

Figure 1 contains a flow chart and Table 4 includes Chapman's (1992) SQT matrix that was adapted for this process. When assessing each data type at a particular site, the resultant weighting can be incorporated into the triad matrix from

which scenario comparisons can be made and a proper conclusion drawn. Included are eight possible scenarios with descriptions for toxics-related problems and the associated relationship to Virginia's impaired waterbody list. It is preferred that this approach only be applied when all three sediment data components are available from a particular site. It is still possible, however, to implement this process if only two elements are available, as long as data on the condition of the resident benthic community is included (e.g., sediment chemistry and benthic IBI or sediment toxicity and benthic IBI) and they are both in agreement as to the condition of the site (e.g., degraded or severely degraded). In those instances, a corresponding assessment may be attained (i.e., Category 5A with toxics as the cause). If only sediment chemistry and sediment toxicity data are available, follow-up monitoring should be scheduled (Virginia Assessment Category 3B), even if both chemical and toxicological results are in agreement on the potential existence of a toxic condition.

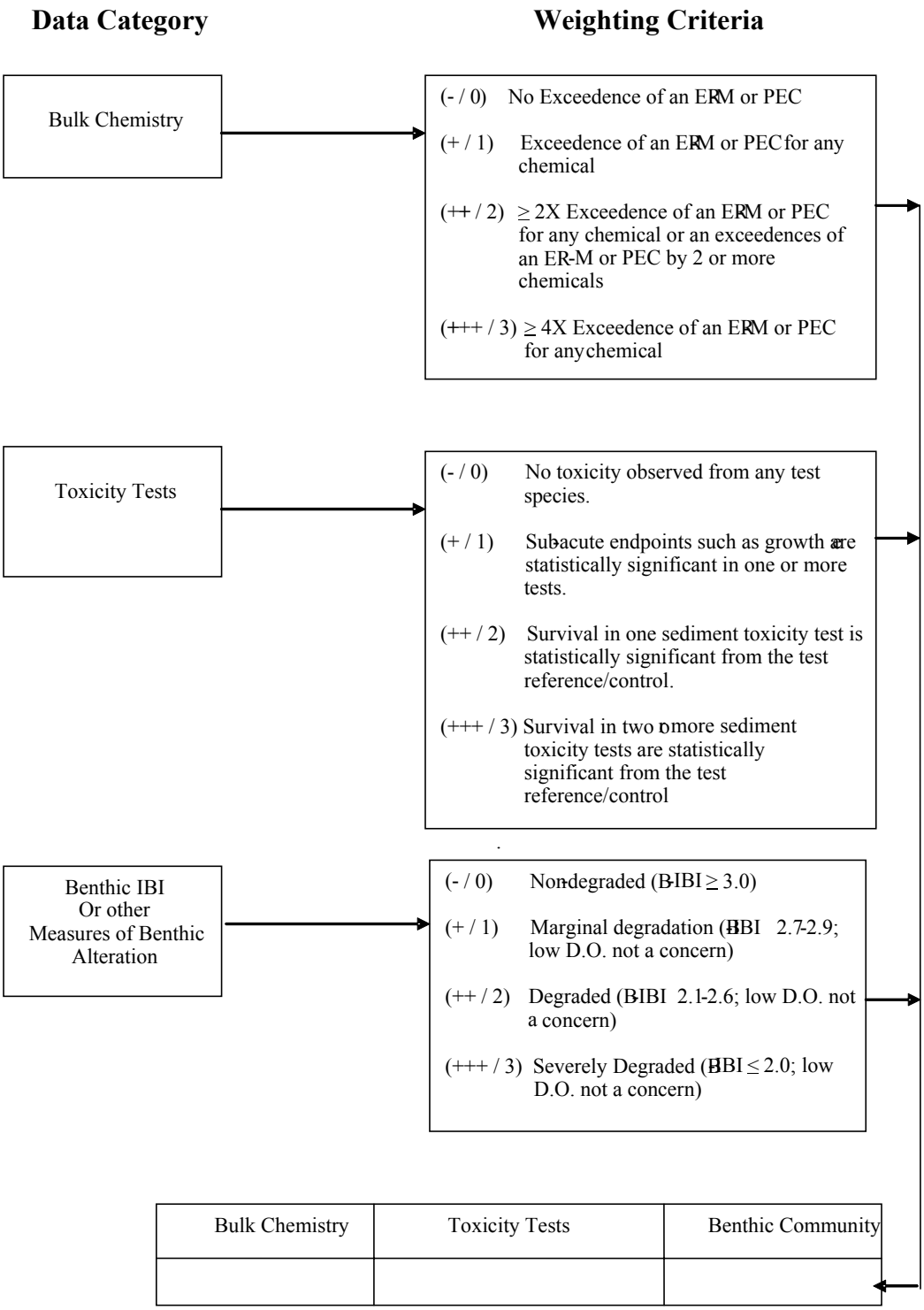
An Excel Workbook has been developed to help implement this process in a standardized, systematic manner. An example of this Excel workbook is electronically linked to this Assessment Guidance Manual:

Weight-of-Evidence Assessment Workbook - Ver 3.0a Template.xls

An example of a completed workbook is also included for the additional information to help with the Weight-of-Evidence assessment process:

Example - Weight-of-Evidence Assessment (7-CHE004.52)

Figure 1 - Flow diagram used to establish weighting for Sediment Quality Triad data generated by ambient toxics monitoring.



References

Chapman, PM, RN Dexter, SF Cross and DG Mitchell. 1986. A field trial of the Sediment Quality Triad in San Francisco Bay. NOAA Technical Memorandum NOS OMA 25. National Oceanic and Atmospheric Administration, San Francisco, CA. 127 pp.

Chapman, PM, RN Dexter and ER Long. 1987. Synoptic measures of sediment contamination toxicity and infaunal community structure (the Sediment Quality Triad). *Mar Ecol. Prog. Ser*. 37:75-96.

Chapman, PM, 1992. Sediment Quality Triad Approach. In: Sediment Classification Methods Compendium. EPA 823-R-92-006 Ch. 10 pp. 1-18.

Chapman, PM, B Anderson, S Carr, V Engle, R Green, J Hameedi, M Harmon, P Haverland, J Hyland, C Ingersoll, E Long, J Rodgers Jr, M Salazar, P Sibley, P Smith, R Swartz, B Thompson and H Windom. 1997. General guidelines for using the sediment quality triad. *Mar Pollut Bull* 34(6):368-372.

Hall, LW and RW Alden III. A review of concurrent ambient water column and sediment toxicity testing in the Chesapeake Bay watershed: 1990-1994. Environ. Toxicol. Chem. 16:1607-1617.

Llansó, RJ, and DM Dauer. 2003. Methods for Calculating the Chesapeake Bay Benthic Index of Biotic Integrity. Chesapeake Bay Program. 24 pp. www.baybenthos.versar.com

Llansó, R.J., L.C. Scott, J.L. Hyland, D.M. Dauer, D.E. Russell, and F.W. Kutz. 2002. An Estuarine Benthic Index of Biotic Integrity for the Mid-Atlantic Region of the United States. II. Index Development. Estuaries Vol. 25, No. 6A, p. 1231–1242 December 2002.

Long, E.R., and P.M. Chapman. 1985. A sediment quality triad: Measures of sediment contamination, toxicity and infaunal community composition in Puget Sound. Mar. Pollu. Bull. 16(10): 405-415.

Long, E.R., D.D. MacDonald, S.L. Smith, F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental Management vol 19(1):81-97.

Long, E.R., D.D. MacDonald, C.G. Severn, and C.B. Hong. 2000. Classifying the probabilities of acute toxicity in marine sediments with empirically-derived sediment quality guidelines. Environmental Toxicology & Chemistry 19(10): 2598-2601.

Long, E.R., C.G. Ingersoll, and D.D. MacDonald. 2006. Calculation and uses of mean sediment quality guideline quotients: A critical review. Environmental Science and Technology (March 2006 issue).

McGee, BL, DJ Fisher, J Ashley and D Velinsky. 2001. Using the Sediment Quality Triad to characterize toxic conditions in the Chesapeake Bay (1999): An assessment of tidal river segments in the Bohemia, Magothy, Patuxent, James, and York Rivers. EPA 903-R-01-008, CBP/TRS 257/01, Environmental Protection Agency, Chesapeake Bay Program Office, Annapolis, MD, 35 pp + Appendices.

Paul, J.F., K.J. Scott, D.E. Campbell, J.H. Gentile, C.S. Strobel, R.M. Valente, S.B. Weisberg, A.F. Holland and J.A. Ranasinghe. 2001. Developing and applying a benthic index of estuarine condition for the Virginian Biogeographic Province. Ecological Indicators 1: 83-99.

Roberts, MH Jr, MA Vogelbein, MA Richards, L Seivard, and PF De Lisle. 2002. Chemical and Toxicological Characterization of Tidal Freshwater Areas in the James River, Virginia. EPA 903-R-02-006, CBP/TRS 264/02, Environmental Protection Agency, Chesapeake Bay Program Office, Annapolis, MD, 123 pp + Appendices.

Roberts, MH Jr, MA Vogelbein, MA Richards, L. Seivard, and PF De Lisle. 2002. Chemical and Toxicological Characterization of Tidal Freshwater Areas in the James River, Virginia Between Jordan Point and Richmond. Final report to VA Department of Environmental Quality. 49 pp +Appendices.

Roberts, MH Jr, MA Richards, PF DeLisle. 2003. Chemical and Toxicological Characterization of the Lower Mobjack Bay, York River, Virginia Segment of the Chesapeake Bay. Final Report to VA Department of Environmental Quality. 46 pp + Appendices.

US EPA. 1999. *Targeting Toxics: A Characterization Report. A Tool for Directing Management and Monitoring Actions in the Chesapeake Bay's Tidal Rivers.* CPB/TRS 222/103, US EPA, Chesapeake Bay Program, Annapolis, MD.

Weisberg, SB, JA Ranasinghe, DM Dauer, LC Schaffner, RJ Diaz and JB Frithsen. 1997. An estuarine benthic index of biotic integrity (B-IBI) for Chesapeake Bay. *Estuaries* 20: 149-158.

6.5.3 Natural Low DO and pH Evaluation in Swamp Waters

Virginia's list of impaired waters currently identifies many waters as not supporting the aquatic life use due to exceedences of pH and/or DO criteria that are designed to protect aquatic life in Class III waters. However, there is reason to believe that most of these streams or stream segments have been misclassified and should more appropriately be classified as Class VII, Swamp Waters. A procedure for assessing if natural conditions are the cause of the low pH and/or low DO levels in a given stream or stream segment has been developed.

The level of dissolved oxygen (DO) in a water body is determined by a balance between oxygen-depleting processes (*e.g.*, decomposition and respiration) and oxygen-restoring processes (*e.g.*, aeration and photosynthesis). Certain natural conditions promote a situation where oxygen-restoring processes are not sufficient to overcome the oxygen-depleting processes. The level of acidity, as registered by pH in a waterbody, is determined by a balance between organic acids produced by decay of vegetative material and buffering capacity.

Conditions in a stream that would typically be associated with naturally low DO and/or naturally low pH include slow-moving, ripple-less waters. In such waters, the decay of organic matter depletes DO at a faster rate than it can be replenished and produces organic acids (tannins, humic and fulvic substances). These situations can be compounded by anthropogenic activities that contribute excessive nutrients or readily available organic matter to these systems.

The general approach to determine if DO and pH impairments in streams are due to natural conditions is to assess a series of water quality and hydrologic criteria to determine the likelihood of an anthropogenic source. A logical 4-step process for identifying natural conditions that result in low DO and/or pH levels and for determining the likelihood of anthropogenic impacts that will exacerbate the natural condition is described below. DEQ is using this approach to implement State Water Control Law 9 VAC 25-260-55, Implementation Procedure for Dissolved Oxygen Criteria in Waters Naturally Low in Dissolved Oxygen.

Waters that are shown to have naturally low DO and pH levels will be re-classified as Class VII, Swamp Waters, with the associated pH criterion of 4.3 to 9.0 SU. An associated DO criterion is currently being developed from swamp water data. A TMDL is not needed for these waters. An assessment category of 4C will be assigned until the waterbody has been re-classified.

LOW DISSOLVED OXYGEN (DO) AND pH NATURAL CONDITIONS ASSESSMENT

Following a description of the watershed (including geology, soils, climate, and land use), a description of the DO and/or pH water quality problem (including a data summary, time series and monthly data distributions), and a description of the water quality criteria that were the basis for the impairment determination, the available information should be evaluated in four steps.

Step 1. Determine appearance and flow/slope.

Streams or stream segments that have naturally low DO (< 4 mg/L) and low pH (< 6 SU) are characterized by very low slopes and low velocity flows (flat water with low reaeration rates). Decaying vegetation in such swampy waters provides large inputs of plant material that consumes oxygen as it decays. The decaying vegetation in swamp water also produces acids and decreases pH. Plant materials contain polyphenols such as tannin and lignin. Polyphenols and partially degraded polyphenols build up in the form of tannic acids, humic acids, and fulvic acids that are highly colored. The trees of swamps have higher polyphenolic content than the soft-stemmed vegetation of marshes. Swamp streams (blackwater) are therefore more highly colored and more acidic than marsh streams.

Appearance and flow velocity (or slope if flow velocity is not available) must be identified for each stream or stream segment to be assessed for natural conditions and potential re-classification as Class VII "swamp water". This can be done through maps, photos, field measurements or other appropriate means.

Step 2. Determine nutrient levels.

Excessive nutrients can cause a decrease in DO in relatively slow moving systems, where aeration is low. High nutrient levels are an indication of anthropogenic inputs of nitrogen, phosphorus, and possibly organic matter. Nutrient input can stimulate plant growth, and the resulting die-off and decay of excessive plankton or macrophytes can decrease DO levels.

USGS (1999) estimated national background nutrient concentrations in streams and groundwater from undeveloped areas. Average nitrate background concentrations are less than 0.6 mg/L for streams, average total nitrogen (TN) background concentrations are less than 1.0 mg/L, and average background concentrations of total phosphorus (TP) are less than 0.1 mg/L.

Nutrient levels must be documented for each stream or stream segment to be assessed for natural conditions and potential re-classification as Class VII swamp water. Streams with average concentrations of nutrients greater than the national background concentrations should be further evaluated for potential impacts from anthropogenic sources.

Step 3. Determine degree of seasonal fluctuation (for DO only).
Anthropogenic impacts on DO will likely disrupt the typical seasonal fluctuation seen in the DO concentrations of wetland streams. Seasonal analyses should be conducted for each potential Class VII stream or stream segment to verify that DO is depressed in the summer months and recovers during the winter, as would be expected in natural systems. A weak seasonal pattern could indicate that human inputs from point or nonpoint sources are impacting the seasonal cycle.

Step 4. Determine anthropogenic impacts.
Every effort should be made to identify human impacts that could exacerbate the naturally low DO and/or pH. For example, point sources should be identified and DMR data analyzed to determine if there is any impact on the stream DO or pH concentrations. Land use analysis can also be a valuable tool for identifying potential human impacts. Lastly, a discussion of acid rain impacts should be included for low pH waters.

7Q10 Data Screen

If the data warrant it, a data screen should be performed to ensure that the impairment was identified based on valid data. All DO, temperature or pH data that violate WQ Standards should be screened for flows less than the 7Q10. Data collected on days when flow was < 7Q10 should be eliminated from the data set and the violation rate recalculated accordingly. Only those waters with violation rates determined days with flows > or = 7Q10 flows should be classified as impaired.

In some cases, data were collected when flow was 0 cfs. If the 7Q10 is identified as 0 cfs as well, all data collected under 0 cfs flow would need to be considered in the water quality assessment. In those cases, the impairment should be classified as 4C, "impaired due to natural conditions", no TMDL needed. However, a reclassification to Class VII may not always be appropriate.

NATURAL CONDITION CONCLUSION MATRIX

The following decision process should be applied for determining whether low pH and/or low DO values are due to natural conditions and justify a reclassification of a stream or stream segment as Class VII, Swamp Water.

If velocity is low or if slope is low (<0.50%) AND
If wetlands are present along stream reach AND
If no point sources or only point sources with minimal impact on DO and pH AND
If nutrients are < typical background
- ❖ average (= assessment period mean) nitrate less than 0.6 mg/L
- ❖ average total nitrogen (TN) less than 1.0 mg/L, and
- ❖ average total phosphorus (TP) are less than 0.1 mg/L AND

For DO: If seasonal fluctuation is normal AND
For pH: If nearby streams without wetlands meet pH criteria OR if no correlation between in-stream pH and rain pH,

THEN determine as impaired due to natural condition
→ assess as category 4C in next assessment
→ initiate WQ Standards reclassification to Class VII Swamp Water

→ get credit under consent decree

The analysis must state the extent of the natural condition based on the criteria outlined above. A map showing land use, point sources, water quality stations and, if necessary, the delineated segment to be classified as swamp water should be included.

In cases where not all of these criteria apply, a case by case argument must be made based on the specific conditions in the watershed.

EXAMPLE ANALYSIS – pH

Following a description of the watershed (including geology, soils, climate, and land use); a description of the DO and/or pH water quality problem (including a data summary, time series and monthly data distributions); and a description of the water quality criteria that were the basis for the impairment determination, the available information should be evaluated as follows:

- Step 1: Are there low velocities or low slope? Are there large inputs of decaying vegetation in a wetland that produce acids and lower pH as they decay?
- Step 2: Are there excessive nutrients instream that can indicate human activity?
- Step 3: N/A
- Step 4: Does evidence of human impact through discharges or land use warrant a TMDL?

Example Stream: White Oak Swamp

APPEARANCE/FLOW or SLOPE:
Visual inspection upstream and downstream of bridges at Rt. 156 and Poplar Springs Rd, revealed very swampy conditions usually with standing water in woods on either side of the channel (provide photos and map of area).

The hydrologic slope from the 110 ft topographic contour at rivermile 6.60 downstream to the 50 ft contour at rivermile 1.12 is estimated at 0.21%, considered low slope.

NUTRIENTS:
- Total Phosphorus Av. 0.047 mg/l (n=78)
- Orthophosphorus Av. 0.024 mg/l (n=70)
- Total Kjeldahl Nitrogen Av. 0.61 mg/l (n=78)
- Ammonia as N Av. 0.03 mg/l (n=78)
- Nitrite + Nitrate as N Av. 0.10 mg/l (n=6)

→ Below USGS Average Backgrounds

HUMAN IMPACTS:
- Capital Regional Airport Commission (VA090301) reported pH twice per year for 2000 - 2003 at pH 7.19, 5.10, 6.56, 6.89, 6.44, and 8.44. One pH 4.20 in Aug 2001 during no flow period. Max flow 1357 cfs at Beulah Rd. stormwater outfall during Nov. 2001 to Apr 2002.
- Henrico MS4, 3 General Ind. Minors and 5 Ind. Stormwaters have no pH reporting requirements.
- High Intensity Commercial / Industrial land use comprised 9.0 % of watershed (1586 ac), however only 6.7% pH violations at Beulah Rd, with highest pH values.
- Watershed predominately forested (57.3 percent), with 9.2 percent wetlands and open water.
- Human E. coli impairment at 22% of annual load, therefore it is possible that human activities impact watershed in headwaters.
- Acid rain impact analysis
  - White Oak Swamp is located east of the fall line and an acid rain impact analysis developed for the nearby Mechumps Creek can be applied
  - 10 stations within 17 miles of Mechumps Creek have 2 to 15 years of pH data.
  - If acid rain is an impact, all stations should have low pH impairment, however:

- 5 stations within 13 miles to the west above the Fall line have higher pH and no impairment (mean pH 6.63 - 7.01); Little, Newfound, and South Anna Rivers, Falling Creek, Stony Run.
- 5 stations within 17 miles to the east below the Fall line have low pH and natural impairment (mean pH 5.89 - 6.44); Hornquarter, Herring, Totopotomoy, Monquin, and Matadequin Creeks.

CONCLUSIONS:
- Low slope, with predominantly wetlands, not indicative of human impact.
- Low nutrients, not indicative of human impact.
- Human activity above Beulah Rd. can affect pH in headwaters, but there was no observed pH impact downstream at Rt. 156 attributed to the headwaters commercial / industrial land use.
- Low pH is more related to swamp water from low slope swamps below the Fall Line than to acid rain.

→ White Oak Swamp and its tributaries exhibit low pH due to natural conditions and should be re-classified as Class VII, Swamp Water, with the associated pH criterion range of 4.3 to 9 SU. An associated DO criterion is currently being developed from swamp water data. A TMDL is not needed for these waterbodies. An assessment category of 4C will be assigned until the waterbody has been re-classified.

EXAMPLE ANALYSES - DO

Following a description of the watershed (including geology, soils, climate, and land use); a description of the DO and/or pH water quality problem (including a data summary, time series and monthly data distributions); and a description of the water quality criteria that were the basis for the impairment determination, the available information should be evaluated as follows:
- Step 1: Are there low velocities or low slope? Are there large inputs of decaying vegetation in a wetland that produce acids and lower DO as they decay?
- Step 2: Are there excessive nutrients in-stream that can indicate human activity?
- Step 3: Do seasonal changes lower DO in summer and raise it in winter?
- Step 4: Does evidence of human impact though discharge or land use warrant a TMDL?

Example Stream: Tuckahoe Creek

APPEARANCE/FLOW or SLOPE:
Visual inspection at bridges on Rt. 6 and Rt.650 revealed very swampy conditions. A large wetland named Big Swamp exists for 4 miles above Rt. 6. There are wetlands noted on the land use map along Tuckahoe Creek and Little Tuckahoe Creek from just below Rt. 250 downstream approximately 8 miles to below Rt. 650. Wetlands promote input of decaying vegetation throughout this 8 mile segment, which causes low DO from bacterial decomposition (provide photos and map of area).

The hydrologic slope from the 150 ft topographic contour at river mile 10.55 below Rt. 50 downstream to the 120 ft contour at river mile 2.59 above the old railroad grade below Rt. 650 is estimated at 0.07%, considered very low slope.

NUTRIENTS:
- Total Phosphorus Av. 0.074 mg/l (n=226)
- Orthophosphorus Av. 0.043 mg/l (n=218)
- Total Kjeldahl Nitrogen Av. 0.64 mg/l (n=224)
- Ammonia as N Av. 0.067 mg/l (n=226)
- Nitrite + Nitrate as N Av. 0.31 mg/l (n=23)

→Below USGS average backgrounds, and below background levels in a permitted livestock study by DEQ.

SEASONAL FLUCTUATIONS:
Seasonal fluctuations of DO values where within normal ranges.

HUMAN IMPACTS:
- Henrico Water Treatment Plant (VA0091197) is not required to report DO or CBOD.

- Henrico County MS4 (VA0088617) is not required to report DO or CBOD.
- Two general stormwater permittees, Henrico WTP and Short Pump Town Center, are not required to report DO or CBOD.
- High Intensity Residential, Commercial / Industrial land use comprise 21 % of watershed (8647 ac), located in the eastern portion of the watershed.
- Watershed is predominately forested (52 percent), with 5 percent wetlands / open water.
- Human E. coli impairment is at 12% of annual load, the lowest among three watersheds in Henrico County receiving bacterial TMDLs. However it is still possible that human activities impact watershed.

CONCLUSIONS:
- Low slope, predominantly wetland in impaired segment, not indicative of human impact.
- Low nutrients, not indicative of human impact.
- Normal seasonal DO fluctuation.
- Unknown if DO impact observed at Rt. 6 can be attributed to human activity. Henrico WTP has little impact on DO. The Henrico MS4 has an unknown impact on DO, but discharges following rain events with high velocity, promoting elevated DO from reaeration, and unknown BOD loads. Residential, Commercial / Industrial land use (21%) has suspected effect on watershed.

The impaired segment of Tuckahoe Creek exhibits low DO due to natural conditions and should be re-classified as Class VII, Swamp Water, with the associated pH criterion range of 4.3 to 9 SU. An associated DO criterion is currently being developed from swamp water data. A TMDL is not needed for this waterbody. An assessment category of 4C will be assigned until the waterbody has been re-classified.

Low DO values in the two tributaries appear to be at least partially due to anthropogenic inputs. However, 7Q10 analysis resulted in changed violation rates for two tributaries from 12.1% to 8.9% (Little Tuckahoe Creek) and from 15.9% to 9.6% (Deep Run).

Section 6.6 LAKE and RESERVOIR ASSESSMENT

The current agency guidance on the monitoring of targeted lakes and reservoirs is the April 8, 2002 Department Guidance Memo No. 02-2004 "Targeted Lake and Reservoir Monitoring" which can be found at **http://www.deq.virginia.gov/waterguidance/pdf/022004.pdf.** The document includes guidance on how to prioritize the many lakes and reservoirs in the Commonwealth for monitoring. This prioritization allows the Department to focus on the most important lakes as they relate to designated uses. Limited resources will then be able to be utilized for these significant lakes and an intensive monitoring schedule can be conducted that will allow a thorough assessment of those priority lakes.

For the 2008 assessment, the lakes and/or reservoirs which meet the following definition of a "significant lake" will be reviewed as available data allow. A list of current significant lakes is included in Appendix G of this document.

1. All publicly accessible public water-supply lakes and/or;
2. All publicly accessible lakes 100 acres or more in size and/or;
3. the 116 man-made lakes and reservoirs identified under the new nutrient standards for lakes and reservoirs (9 VAC 25-260-187) and the two natural lakes Mountain Lake and Lake Drummond which have been assigned special standards for nutrients (9 VAC 25-260-310).

This definition includes the federally owned lakes which meet these criteria, but all other federally owned lakes would be excluded from the agency lakes monitoring program.

At least one of these two criteria must be met for the lake assessment consideration:

1. lakes and reservoirs should have exceedences of numerical WQ Standards, with actual data observations in DEQ files, as well as confirmation made by more than a single data point, or

2. for any parameters for which DEQ does not have a Water Quality Standard, a loss of designated use (fishable, swimmable, public water supply) documented by ancillary data (such as records of conditions preventing swimming and/or boating, recurrent fish kills, other QA/QC approved non-agency studies or reports, etc.)

A separate guidance document "Implementation Guidance for Assessment, TMDL Delisting, Monitoring and Permitting of the Nutrient and Dissolved Oxygen Criteria Amendments for Lakes and Reservoirs" is under development. Section 6.6.2 incorporates guidance from that document on how nutrients and dissolved oxygen data collected from the 116 man-made lakes and reservoirs listed in section (§)187 and the two natural lakes listed in the special WQ Standards section (9 VAC 25-260-310) will be assessed by DEQ for the 2008 305(b) report. (If monitoring data are available for assessment of lakes or reservoirs not captured in the recent amendments, the nutrient criteria would not be applicable to such a water body and the water body would not be assessed for nutrients.)

6.6.1 Interpretation/Assessment Issues Unique to Lakes and Reservoirs

The assessor should provide a complete narrative documenting assessment decisions. If uses are impacted, document those uses impacted and how they are impacted. Name causes and sources where possible, (e.g. nuisance algal blooms preventing swimming during summer months, numerous complaints on file or aquatic weed growth preventing free navigation of lake and/or expensive mechanical or chemical clearing, etc).

6.6.2 Nutrient Evaluation of Reservoirs

Both nutrient (chlorophyll *a* and also total phosphorus if there is documented use of algaecides any time during the Department's seven month monitoring period from April through October) and dissolved oxygen/pH data are assessed for aquatic life use. (Bacterial data are used to assess recreational use and observations regarding nuisance algal or plant growths or discolored water are assessed using the general standard as the basis; the recent criteria amendments for lakes and reservoirs did not modify these existing criteria.)

Trophic State Index (TSI) is replaced by regulatory nutrient criteria in 2008 assessment report:
The assessment guidance for 2006 reflected the combined TP/DO TSI approach of assessing lakes for nutrients which EPA found to be an acceptable method in lieu of regulatory nutrient criteria. The methodology was developed because VA DEQ did not have numerical criteria for nutrients in lakes and reservoirs with the intention of using this approach until the public process was completed for these lake related criteria. Therefore, beginning with the 2008 assessment report, the regulatory nutrient criteria will replace the TSI approach for the lakes and reservoirs listed in §187 of the WQ Standards.

Assessment for aquatic life (fishery) use of 116 man-made lakes and reservoirs for chlorophyll a and total phosphorus (if documented algaecide use):
This assessment procedure for nutrients replaces the combined TP/DO TSI approach used in 2006 for nutrient assessment. The nutrient criteria only apply in the lacustrine zone of the 116 man-made lakes and reservoirs listed in §187 of the WQ Standards. If total phosphorus or chlorophyll a data are collected outside the lacustrine zone in the riverine or transitional zone, the data from these two zones can not be used in the assessment for lake or reservoir impairment due to nutrients. In addition, the nutrient criteria can not be used for assessment of lakes and reservoirs that are not listed in §187 of the WQ Standards. For lakes and reservoirs without defined nutrient criteria, but with DO impairments, the TSI approach may still be used.

The regional office staff will base their determination of algaecide use on discussions with the lake owner regarding use of algaecides during the monitoring period and/or DEQ monitoring staff observations of algaecide applications during their monitoring runs on the lake or reservoir. (The intent is to use both chlorophyll a and total phosphorus when algaecides are applied within any zone of the reservoir.)

Nutrient data from the two most recent monitoring years are assessed separately. The aquatic life (fishery) use of an impoundment (not just the lacustrine zone but rather the entire impoundment) listed in §187 is considered impaired for nutrients if the criterion for either chlorophyll a or total phosphorus (note: total phosphorus is used in the assessment only if there is documentation of algaecide use during the monitoring period) is exceeded in each of the two most recent monitoring years. For each nutrient criterion, chlorophyll a and total phosphorus (if documented algaecide use), the

assessor will pool all data collected at one meter or less in any given year for all months and all stations within the lacustrine portion collected between April and October. For the pooled chlorophyll a data, the 90th percentile of these data is the value used to compare to the criterion for that particular impoundment. For the pooled total phosphorus data, the calculated median value is used to assess against the criterion.

Clarification of "two most recent monitoring years" for application of the nutrient criteria:

A monitoring year is considered to be the April 1 through October 31 monthly sampling period for one calendar year. Man-made lakes and reservoirs listed in §187 must be sampled with one or more observations per month for at least 6 of the seven sampling months (April – October within the same calendar year). If the impoundment is sampled with one or more observations per month for less than six of the seven sampling months, the lake or reservoir is considered to have insufficient data for assessment and additional sampling required in a subsequent year for the missed months. The combined seven month sampling over the two year period counts as one assessment year.

The chlorophyll a or total phosphorus criterion (applicable only if there is documented algaecide use during the monitoring period) would have to be exceeded for both of the two most recent monitoring years for the impoundment to be listed as impaired for nutrients. If one or both of the applicable nutrient criteria were exceeded during the first monitoring period of seven months, it is recommended (but not required) for regional staff to do a second year of monitoring within the six year window of sampling. Rather than use data from an earlier assessment period, it would be preferable (but not required) for regional staff to do a second year of monitoring within the current six year window of sampling if one or both of the applicable nutrient criteria were exceeded during the first monitoring period of seven months.

Assessment for aquatic life (fishery) use for nutrients in the two natural lakes:
Assessments of the two natural lakes in the special standards section will follow the guidelines above for chlorophyll *a* and total phosphorus except that orthophosphate-P rather than total phosphorus applies to Mountain Lake.

Use of citizen and other external data:
In order to use citizen data in assessments for nutrient impairments, the collector must provide documentation that the data meet QA/QC requirements for chlorophyll a and total phosphorus (orthophosphate-P for Mountain Lake) and that the location of the sampling was within the lacustrine portion of the reservoir and outside the littoral (near shore) zone.

6.6.3 Dissolved Oxygen Evaluation

The dissolved oxygen criteria are based on the appropriate criteria established for that class of waters in section 9 VAC 25-260-50. Dissolved oxygen information is used for assessment of aquatic life use.

Assessment for aquatic life use of lakes and reservoirs for the dissolved oxygen criterion:

The 10.5% rule is applicable to 2008 assessments for the minimum dissolved oxygen criterion in all lakes and reservoirs, not just the 116 man-made lakes and reservoirs and two natural lakes included in the recent water quality standards amendments.

All dissolved oxygen water monitoring observations for all months within the assessment period at all stations within the constructed impoundment or natural lake collected in the epilimnion if thermally stratified or the upper one third of the water column if not stratified at the time of sampling are assessed against the minimum dissolved oxygen criterion. A lake or reservoir is considered stratified if there is a difference of $\geq$ 1ºC /meter of depth (June through September). If the differential is < 1ºC /meter, the lake is not considered stratified .Two or more exceedences and >10.5% exceedence of total samples are required before a water body is listed as impaired for the minimum dissolved oxygen criterion (4 mg/l for most freshwater lakes and reservoirs) under § 62.1-44.19:5 and 7 of the Code of Virginia.

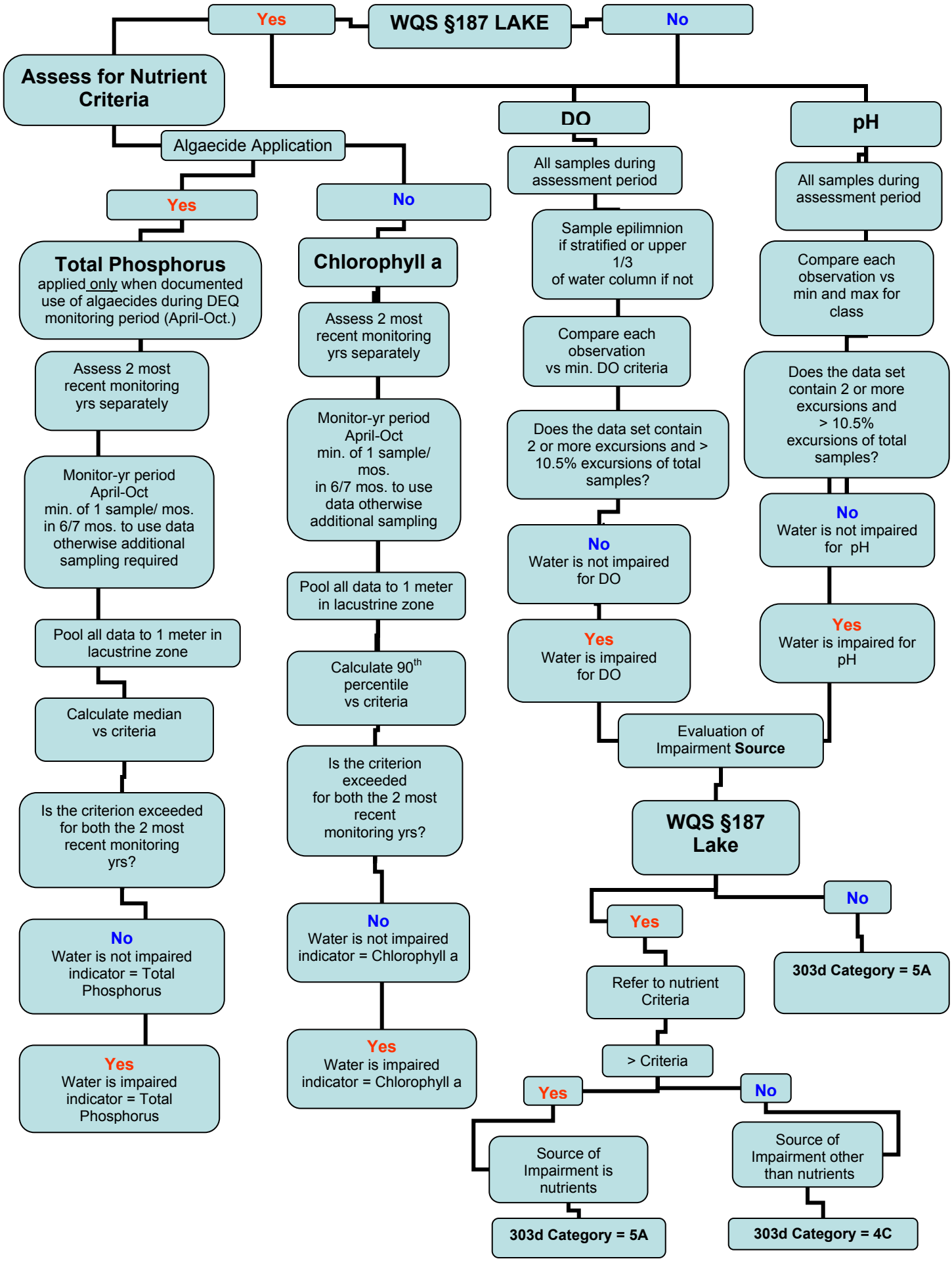
6.6.4 pH Evaluation

The pH criteria are based on the appropriate criteria established for that class of waters in section 9 VAC 25-260-50. pH information is used for assessment of aquatic life use.

Assessment for aquatic life use of lakes and reservoirs for the pH criterion:

The 10.5% rule is applicable to 2008 assessments for the pH criterion range in all lakes and reservoirs, not just the 116 man-made lakes and reservoirs and two natural lakes included in the recent WQ Standards amendments.

All pH water monitoring observations collected for all months within the assessment period at all stations within the constructed impoundment or natural lake are assessed against the pH criterion range. Two or more exceedences and ≥10.5% exceedences are required before a water body is listed as impaired for pH. In cases where the applicable nutrient criteria are met for the 116 man-made lakes/reservoirs listed in §187 but the maximum pH criterion is exceeded, the lake or reservoir should be classified as Category 4C and recommended for a WQ Standards review due to natural pH fluctuations. In lakes that are not in § 187, the lake/reservoir would be listed as impaired (Category 5A). See lakes/reservoir assessment flowchart below.


WQS §187 LAKE
Yes
No
Assess for Nutrient Criteria
Algaecide Application
Yes
No
Total Phosphorus
applied only when documented use of algaecides during DEQ monitoring period (April-Oct.)
Assess 2 most recent monitoring yrs separately
Monitor-yr period April-Oct min. of 1 sample/ mos. in 6/7 mos. to use data otherwise additional sampling required
Pool all data to 1 meter in lacustrine zone
Calculate median vs criteria
Is the criterion exceeded for both the 2 most recent monitoring yrs?
No
Water is not impaired indicator = Total Phosphorus
Yes
Water is impaired indicator = Total Phosphorus
Chlorophyll a
Assess 2 most recent monitoring yrs separately
Monitor-yr period April-Oct min. of 1 sample/ mos. in 6/7 mos. to use data otherwise additional sampling
Pool all data to 1 meter in lacustrine zone
Calculate 90th percentile vs criteria
Is the criterion exceeded for both the 2 most recent monitoring yrs?
No
Water is not impaired indicator = Chlorophyll a
Yes
Water is impaired indicator = Chlorophyll a
DO
All samples during assessment period
Sample epilimnion if stratified or upper 1/3 of water column if not
Compare each observation vs min. DO criteria
Does the data set contain 2 or more excursions and > 10.5% excursions of total samples?
No
Water is not impaired for DO
Yes
Water is impaired for DO
pH
All samples during assessment period
Compare each observation vs min and max for class
Does the data set contain 2 or more excursions and > 10.5% excursions of total samples?
No
Water is not impaired for pH
Yes
Water is impaired for pH
Evaluation of Impairment Source
WQS §187 Lake
Yes
No
Refer to nutrient Criteria
303d Category = 5A
> Criteria
Yes
No
Source of Impairment is nutrients
Source of Impairment other than nutrients
303d Category = 5A
303d Category = 4C

Section 6.7 COASTAL ASSESSMENT

Virginia has 120 miles of Atlantic Ocean coastline and approximately 2,500 square miles of estuary. This resource has a prominent place in Virginia's history and culture. It is valued for its commercial fishing, wildlife, sporting, and recreational opportunities, as well as its commercial values in shipping and industry. In the 1970's adverse trends in water quality and living resources were noted and prompted creation of the Federal-Interstate Chesapeake Bay Program (CBP). The coastal assessment is conducted in the same manner as the estuarine assessments previously described in Sections 6.4.1.2 and 6.5.3.2. Additionally, the recently enacted federal BEACH program, which is being implemented by the VDH, has begun collecting recreational use data during the swimming season and assessment of this data is being incorporated into the 2008 Integrated Report.

Section 6.8 WETLANDS ASSESSMENT METHODOLOGY

Background:
Impacts to tidal wetlands, including vegetated tidal wetlands and non-vegetated shoreline between mean low and mean high water, are regulated under the Virginia Tidal Wetlands Act (Title 28.2, Chapter 13 of the Code of Virginia) enacted in 1972 and revised in 1982. The Virginia Marine Resources Commission (VMRC) is the regulating authority for the tidal wetlands laws while localities in Tidewater Virginia have the option to regulate their own tidal wetlands through citizen Wetlands Boards with oversight from VMRC. The Virginia Department of Environmental Quality (DEQ) is responsible for providing Section 401 Certification of Clean Water Act for Section 404 federal permits for tidal and nontidal wetlands and water withdrawals, through the Virginia Water Protection Permit (VWPP) Program, first developed in 1992. In 2000, Virginia passed a Nontidal Wetlands Act that amended Section 62.1-44.15:5 of the Code of Virginia relating to wetlands. The Nontidal Wetlands Act mandates that the Commonwealth implement a nontidal wetlands regulatory program to achieve no net loss of existing wetland acreage and function, and to develop voluntary and incentive based programs to achieve a net resource gain in wetlands. Amendments to the VWPP program, fully implemented in October 2001, provide additional state jurisdiction and require a state permit for the following activities in a wetland: excavation, filling or dumping, activities in a wetland that cause drainage or otherwise significantly alter or degrade existing wetland acreage or function, and permanent flooding or impounding. The VWPP can serve as the Section 401 certification of a federal permit or as a state permit when no federal permit is required. The permit process for both tidal and nontidal wetlands relies on a Joint Permit Application (JPA) which receives independent and concurrent review by local wetlands boards, VMRC, DEQ and the U.S. Army Corps of Engineers (Corps), as appropriate.

By statute and by regulation, Virginia adopted the same definition of wetlands as the federal definition, and requires that wetlands be defined in the field using the Corps' 1987 Manual. Specifically, wetlands are defined as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." Wetlands are part of state waters, which are defined as "all water, on the surface and under the ground, wholly or partially within or bordering the Commonwealth or within its jurisdiction, including wetlands."

Tidal wetlands are defined to include tidally influenced areas within Tidewater Virginia contiguous to mean low water extending landward to an elevation 1 1/2 times the mean tide range at a site and upon which is growing certain listed plant species. They also include "nonvegetated wetlands" which include unvegetated lands between mean low water and mean high water tides.

Section 62.1-44.15:5 of the Code of Virginia specifies that the state utilize the Corps' Wetlands Delineation Manual (Technical Report Y-87-1, January 1987, Final Report) as the approved method for delineating wetlands, and that the state shall adopt appropriate guidance and regulations to ensure consistency with the Corps' implementation of delineation practices.

Purpose:
The overall wetland monitoring strategy is to establish baseline conditions in various broad contexts, including land use, watershed, and wetland type. This information can then be used to guide management decisions regarding wetland

restoration efforts, programmatic compensatory mitigation, and integration with overall WQ Standards. This strategy provides the ultimate framework for an ongoing assessment of the status of the Commonwealth's wetland resources and the success of both wetland regulatory and voluntary programs. The wetlands monitoring strategy will be coordinated with Virginia's comprehensive water quality monitoring program strategy. The monitoring objectives are designed to support regulatory decision-making, allow reporting of wetland conditions, and provide information for policy development.

The wetland monitoring program will also meet the Clean Water Act objectives for water monitoring programs by addressing the quality of the Commonwealth's wetlands and their condition as part of the overall condition assessment of state waters.

DEQ is preparing a strategic plan for integrating existing and new programs into wetland monitoring. The plan will include tasks to accomplish, timelines for their completion, budget needs, and plans for funding these initiatives. This strategy will provide the ultimate framework for an ongoing assessment of the status of the Commonwealth's wetland resources and the success of both our wetland regulatory and voluntary programs. The end result will be the incorporation of on-going wetland monitoring and assessment into the Commonwealth's water monitoring programs.

Wetlands Assessment:
Virginia has begun application of a hierarchical suite of assessments that constitute a three level approach to wetlands sampling and analysis. Comprehensive coverage of all mapped wetlands is achieved with a GIS based analysis of remotely sensed information (Level 1 analysis). These data are summarized on the basis of small watersheds or hydrologic units. It provides a first order evaluation of the condition and functional capacity of wetlands based on their landscape position.

The second level assessment is intended for use in a statistically selected sub-sample of the watershed wetland population and involves a more sophisticated analysis of remotely sensed information and a site visit for verification and additional data collection. The third level assessment involves very detailed analysis of wetland performance of specific functions (i.e., habitat and water quality). This involves extensive sampling of a limited number of sites, specifically chosen to allow validation of the conceptual model of wetland function that underlies the Level 1 and Level 2 assessments.

Monitoring Program Development:
The DEQ wetlands program, in coordination with the overall DEQ water quality monitoring program, has developed a ten-year plan for wetland monitoring and assessment in Virginia. This work is being accomplished as work products under EPA State Wetland Development Grants CD-983380-01, CD 983815-01, BG 983924-4, and BG-983925-01 to the Department of Environmental Quality. The development of this strategy follows the EPA October 2002 draft document "Elements of a Wetland Monitoring and Assessment Program Checklist," Application of Elements of a State Water Monitoring and Assessment Program for Wetlands" (USEPA, April 2006) and will include a discussion of the following 'Ten Essential Elements of a State Water Monitoring and Assessment Program' (USEPA, March 2003):

1. Monitoring Program Strategy
2. Monitoring Objectives
   Information derived from monitoring will be used to:

   - Report ambient wetland conditions in Virginia's Clean Water Act (CWA) Section 305(b) reports;
   - Assist in the evaluation of environmental impacts of proposed impacts to wetlands during permit review as part of Virginia's regulatory program;
   - Evaluate the performance of wetland restoration and compensatory wetland mitigation in replacing wetland acreage and function; and
   - Evaluate the cumulative impacts of wetland loss and restoration in watersheds relative to ambient ecological conditions.
3. Monitoring Design

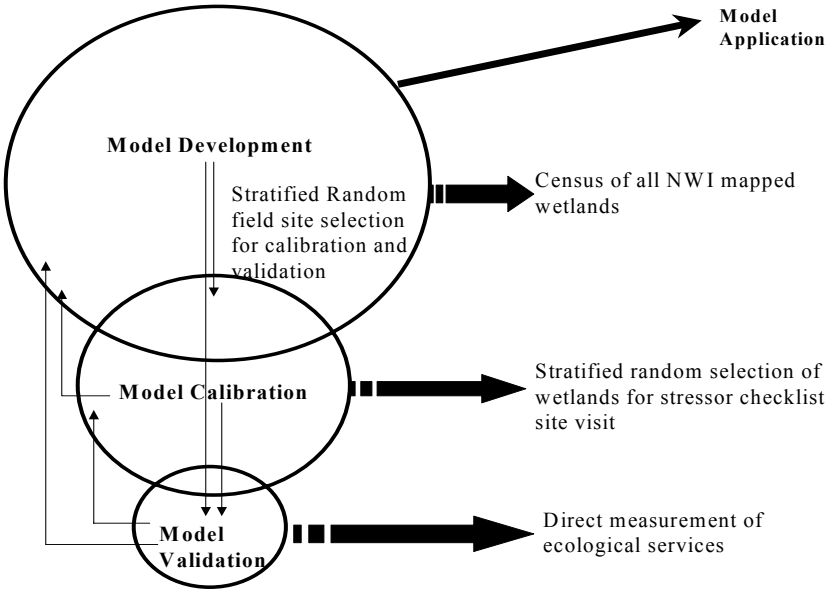
4. Core and Supplemental Water Quality Indicators
5. Quality Assurance
6. Data Management
7. Data Analysis/Assessment
   Examples of different wetland quality data analyses may include:

   - Comparison of wetland quality within a watershed and between watersheds
   - Comparison of wetland quality within a locality and between different localities
   - Comparison of wetland quality within a watershed or locality over time
   - Comparison of wetland quality between wetland types
   - Correlation of wetland type and specific stressor
   - Comparison of wetland quality within and between hydrogeomorphic (HGM) classes
   - Comparison of wetland quality within a specific wetland over time
8. Reporting
9. Programmatic Evaluation
10. General Support and Infrastructure Planning

As part of the overall development of a wetland monitoring and assessment strategy, an interagency committee of other state agencies involved in wetland issues, including the Chesapeake Bay Local Assistance Department, the Virginia Marine Resources Commission, the Department of Game and Inland Fisheries, and various programs within the Department of Conservation and Recreation was established. This interagency committee reviewed and commented on the monitoring and assessment strategy, and will provide periodic updates on what other agencies are doing with regard to wetland resources. Further, DEQ and VIMS have collaborated with EPA and academic institutions to peer review the monitoring design and data collection/analysis portions of the project. Further, all work has been and will continue to be closely coordinated with other EPA-Region III nontidal wetlands programs through the Mid-Atlantic Wetlands Workgroup (MAWWG) of which Virginia is a member, as well as with EPA headquarters and other regions through active participation in EPA's National Wetlands Monitoring Workgroup.

The protocol for wetland monitoring and assessment developed in Virginia consists of a multi-tiered sampling design coupled with methods for regulatory updates and field office data delivery (see Figure 2 below). Each assessment level informs the other levels, and is essential in development of the final assessment protocol.

Figure 2. Multi-tiered sampling design.



To date, model development (Level I) has been completed for Virginia. By Spring 2007, model calibration (Level II) will be completed for the Coastal Plain and Piedmont physiographic provinces. Model validation (Level III) is ongoing in the Coastal Plain. By December 2008, we plan to complete model calibration (Level II) by conducting field visits in the Valley and Ridge, Blue Ridge, and Appalachian Plateau, and to begin model validation (Level III) in the Piedmont. The elements of Virginia's wetland monitoring and assessment program are listed in Table 6 below.

TABLE 6 - Wetland Monitoring and Assessment Program Elements	
Monitoring Strategy	Establish baseline condition of nontidal wetlands by broad category scaleable from individual wetland to small watershed to physiographic province to entire State. Guide management decisions regarding restoration, compensation, and regulation of wetlands.
Monitoring Objectives	Support regulatory decision-making. Report wetland condition. Guide policy development. Evaluate cumulative impacts of wetland loss. Evaluate wetland restoration and compensatory mitigation effectiveness.
Survey Design	Three-Tiered: Sample Frame = all NWI wetlands Enhanced GIS analysis (census) – Level I. Probability-based sampling for field assessment of anthropogenic stressors – Level II. Intensive study of biological endpoints (birds, amphibians, water quality) along stressor gradient – Level III+
Assessment Indicators and Methods	Level I: land use adjacent, within 200m, and within 1000m of wetland, wetland size, type, hydroperiod, proximity to other wetlands, road type, road density, and road alignment. Level II: Field assessment of anthropogenic stressors within 30m of wetland assessment point and within 100m of wetland assessment point. Level III: Population and community structure metrics for birds and amphibians. Water quality modification metrics.
Quality Assurance	An EPA-approved Quality Management Plan coupled with the Center Quality Assurance Plan used to prevent random and systematic errors. Techniques include direct electronic field data assimilation to prevent transcription error as well as random return site visits and redundant QA assessment loops.

Virginia has completed Phase 1 through 2.1 of the wetland inventory and monitoring strategy (see Table 7 below). Phase 1 was designed to take the initial steps toward reaching the goal of assessing the location, extent and general quality of the Commonwealth's nontidal wetlands and supporting a comprehensive database to track wetland losses and gains. Phase 1 also involved the development of a long-term strategy for wetland monitoring and assessment, including the goals and objectives of a state wetland monitoring and assessment program and a time frame for implementation. The strategy developed in Phase 1 provides the framework for the ongoing assessment of the status of the Commonwealth's wetland resources and performance measures for both the wetland regulatory and voluntary programs.

With the completion of Phase 1, the development of a model for an assessment (Level I) that provides a comprehensive coverage of all mapped wetlands (approximately 222,000 wetland units- polygons, arcs, points) by small watersheds utilizing a GIS-based analysis of remotely sensed information has been completed for the entire Commonwealth. In addition, model calibration (Level II) sampling of the Coastal Plain and Piedmont has been completed. The level I (model development) analysis, combined with validation and calibration from the level II and level III assessments, will

provide an evaluation of the condition of wetlands based on their position in the landscape. This information is directly applicable to status and trends reporting under Clean Water Act Section 305(b), and can be utilized in permitting programs to assess cumulative impacts to wetlands within watersheds. Phase 2.2 will be completed in September 2007 and involves finalizing the assessment of level II sites in the Coastal Plain and Piedmont.

Table 7: Long-term wetlands field assessment strategy for Virginia			
Phase 1	Oct. 2003	Begin Level I assessment for Virginia.	Complete
	Dec. 2004	Begin Level II site assessment of Coastal Plain wetlands.	Complete
	Dec. 2005	Complete Level I assessment of Virginia, Complete Level II site assessment of Coastal Plain, Develop protocol for Level III assessment for Coastal Plain physiographic province.	Complete
Phase 2	Dec. 2005	Begin Level II site assessment of Piedmont physiographic province.	Complete
	Sept. 2007	Complete Level II site assessment of Piedmont. Begin Level III sampling for coastal plain sites.	On-going
Phase 3	Oct. 2007	Complete enhanced wetland site selection for Valley and Ridge, Blue Ridge, and Appalachian Plateau Level II site assessment using a protocol for probable wetlands location. Continue Level III sampling for Coastal Plain and begin Level III sampling for Piedmont.	On-Going
	Sept. 2008	Complete Level II site assessment for Valley and Ridge, Blue Ridge, and Appalachian Plateau physiographic provinces.	Planned
Phase 4	Dec. 2010	Begin Level III (model calibration) sampling for Valley and Ridge, Blue Ridge, and Appalachian Plateau. Continue Level III sampling for Piedmont and Coastal Plain.	Planned
Phase 5	Dec. 2011	Begin Level I re-sample of Virginia for trends analysis. Begin Level II re-sample coastal plain subset for calibration.	Planned

The additions of data sets and GIS layers will allow Virginia to continue to develop a GIS-based wetland data viewer for use by regulatory agencies and the general public (see Figure 3). Our success will be measured by an increasing trend in the statistically-reliable Level I protocol and a decreasing trend in cumulative wetland impacts. By having a statistically-validated tool that measures wetland quality as a function of habitat and water quality parameters, our permit staff will be able to make better permit decisions relative to potential cumulative impacts. Further, we will also be able to measure how well we are protecting the function of our more vulnerable wetlands (i.e. isolated wetlands, vernal pools, white cedar swamps), by comparing the condition of wetland habitat and water quality parameters, as a function of the assessment scoring over time.

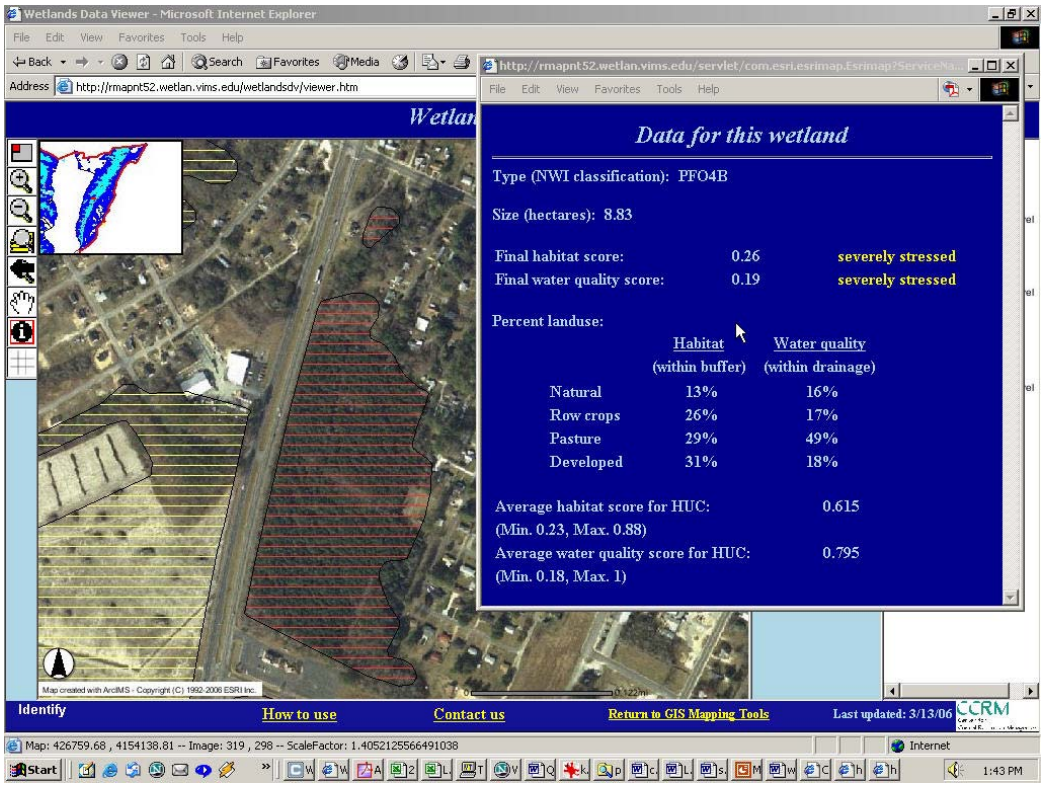


Figure 3: Wetlands data viewer development

The wetland data viewer illustrated above is currently under design modifications and testing, and is not expected to be available for general use until late 2007 or early 2008. The overall outcome of this continued focus on wetland monitoring and assessment will be better protection of wetlands and more definitive and defensible information on wetland condition over time and documentation of how we are achieving no net loss of wetland acreage and function in Virginia.

Section 6.9 FRESHWATER PROBABILISTIC ASSESSMENT

The freshwater probabilistic monitoring program is designed to allow Virginia DEQ make estimates of water quality with known confidence for 100% of Virginia's freshwater stream miles. Freshwater probabilistic monitoring is not designed to make segment / assessment unit decisions. However, a small number of parameters collected at probabilistic sites can be used to determine use support.

The following parameters will be used for assessment unit decisions:

1) Dissolved Oxygen (if 2 out of 2 violate standard for stream class)
2) pH (if 2 out of 2 violate standard for stream class)
3) Temperature (if 2 out of 2 violate standard for stream class)
4) Virginia Stream Condition Index – Using the guidance set forth in the benthic assessment guidance.

PART VII 303 (d) LISTING/DELISTING and TMDL PRIORITY RANKING

Section 7.1 "EFFLUENT LIMITED" and ALTERNATIVE CONTROL WATERS (Category 4B/5E)

Rule 1

When reviewing waters receiving effluent from facilities with water quality based effluent limits in VPDES permits, the following should be considered in developing the 303(d) list;

1. If the permit has been issued with no compliance schedule and the limits are to be met upon permit issuance, then listing is not necessary.

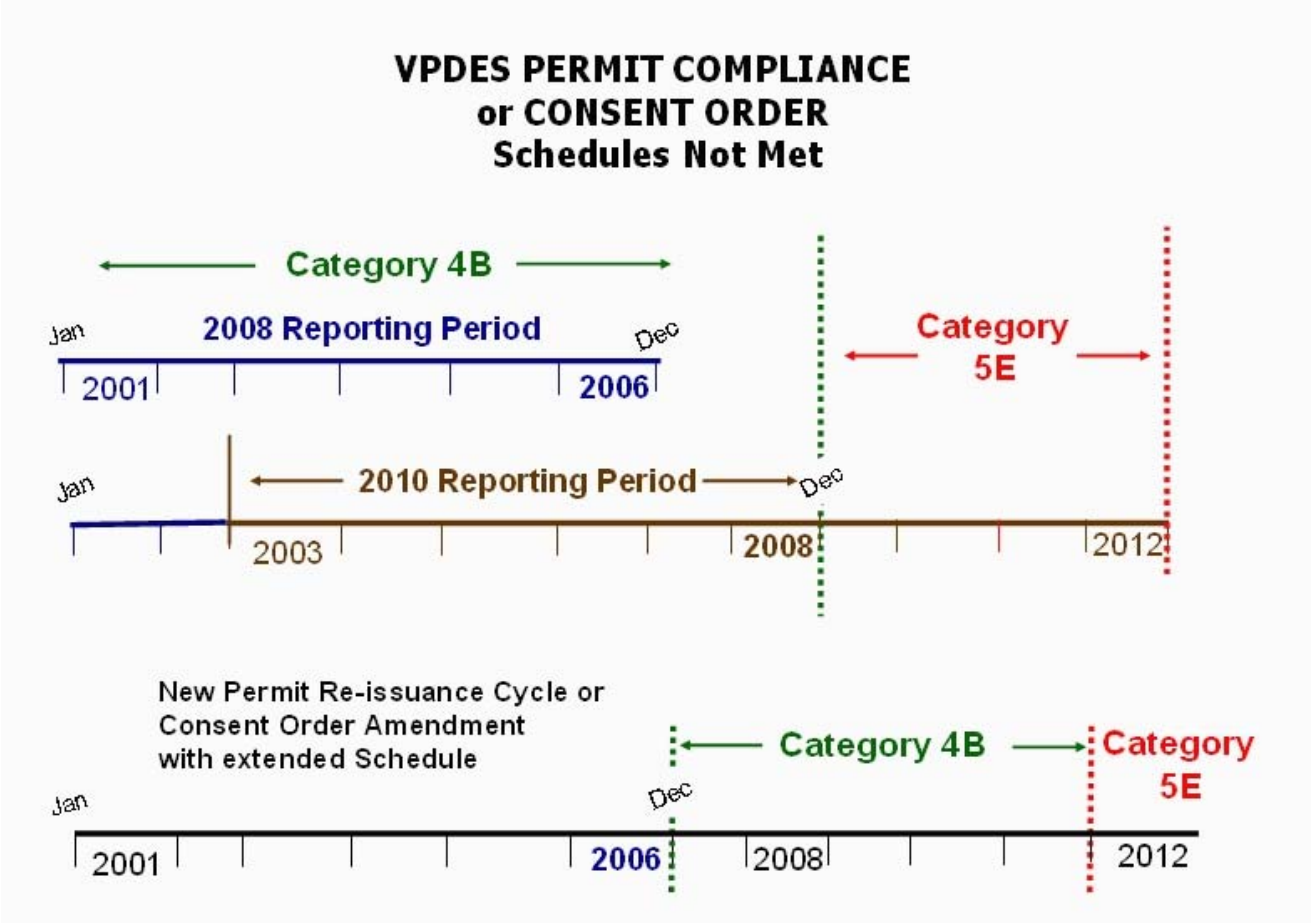
2. If the permit for a previously listed water has since been issued with no compliance schedule and the limits are required to be met upon permit issuance, then delist the facility. EPA must be provided a verification package for delisting waters (see Section 7.1 Rule 2).

3. If achievement with the existing permit compliance schedule or consent order has not occurred by the end of the 2008 reporting period (12/31/06) and the permit is still in effect but is anticipated to meet the schedule by the end of the 2008 reporting period (12/31/08) it is Category 4B.

4. If the existing permit expiration date does not extend past the 2008 ending date (12/31/06) and the compliance schedule or consent order compliance date extends beyond the 2010 reporting period ending (12/31/08) it is Category 5E.

5. If a permit re-issuance occurs with a compliance or consent order schedule after the 2008 ending date (12/31/06) but prior to the 2010 ending date (12/31/08):

    a. And compliance with the previous permit compliance or consent order schedule was not achieved.
    b. And a new compliance schedule or consent order date extends beyond the 2010 reporting ending date (12/31/08) up to 12/31/11. Then the water is Category 4B based on the five year permitting cycle.
    c. If a staged or phased permit compliance schedule (greater than the permit five year cycle) or consent order extends beyond 12/31/11 then the water is Category 5E.



Rule 2

The verification process for removing or delisting effluent limited waters must consider the following;

- The removal or delisting process applies only to waters impacted by a single point source discharge. TMDLs will have to be developed and approved by EPA prior to delisting waters impacted by multiple discharges or a single point source with a significant nonpoint source "load allocation" component. A water listed in Part II for NH3-N discharging into a segment listed for nonpoint source fecal coliform bacteria could be removed since the bacteria problem is unrelated to the NH3-N.

- If compliance with the Water Quality (WQ) based effluent limits is not met by the compliance date, the waters should not be removed from the list or should be relisted in Category 4B if previously removed and a new compliance schedule requiring compliance by the end of the next reporting period is in place. If a new compliance schedule has not been negotiated or extends past the next reporting period, the water should be listed as Category 5E. If post operational water quality data shows that WQ Standards are not being met, the water should remain on the list or be relisted in Category 5A.

If the above conditions are met, the following information should be submitted to EPA for delisting those waters identified in Category 4B of the 2008 303(d) Report. Waters that do not meet the above conditions should be listed or remain in Category 4B of the 2006 303(d) Report.

Verification Packet for VPDES Permits:
Hydrologic Unit Code (HUC), Watershed Identity Number, Stream Name, Parameter, and VPDES Permit Number, Owner/Facility Name and recent DMRs showing compliance.

- A statement identifying the basis for delisting the water. The statement should confirm that water quality based effluent limits were in place by the compliance date, and these effluent controls are sufficient to attain or maintain WQ Standards. If the facility will meet the water quality based effluent limits within the listing cycle required by federal law and WQ Standards are expected to be attained or maintained, the verification should describe the facility's progress in meeting the effluent requirements and the expectation that the compliance date in the permit will be met.

- Copy of water quality analysis modeling conducted as part of permit development that shows the level of controls necessary to implement WQ Standards.

- Copy of permit page (and/or any State compliance order and associated interim limits and schedule to achieve the final limit) that contains the required control levels.

- Copy of permit page that provides the compliance date for water quality based controls.

Rule 3

Category 4B – Alternative Control

EPA's 2006 IR Guidance acknowledged that the most effective method for achieving water quality standards for some water quality impaired segments may be through controls developed and implemented prior to the TMDL development and/or implementation (referred to as a "4B alternative"). DEQ requests EPA to evaluate, on a case-by-case basis, the Commonwealth's decisions to exclude or delist certain segment/pollutant combinations from Category 5 (the section 303(d) list) based on the 4B alternative. A 4B rationale will be provided to EPA in the submission of the DEQ 2008 IR which supports the Commonwealth's conclusion that there are "other pollution control requirements" sufficiently stringent to achieve applicable water quality standards within a reasonable period of time.

Required elements of the 4B rationale:

Specifically, this rationale should include:
(1) a statement of the problem causing the impairment,

(2) a description of the proposed implementation strategy and supporting pollution controls necessary to achieve water quality standards, including the identification of point and non-point source loadings that when implemented assure the attainment of all applicable water quality standards,
(3) an estimate or projection of the time when water quality standards will be met,
(4) a reasonable schedule for implementing the necessary pollution controls,
(5) a description of, and schedule for, monitoring milestones for tracking and reporting progress to EPA on the implementation of the pollution controls,
and
(6) a commitment to revise, as necessary, the implementation strategy and corresponding pollution controls if progress towards meeting water quality standards is not being shown.

Section 7.2 IMPAIRED WATERS (Category 5)

Rule 1

Waters listed as impaired and needing a TMDL in the Integrated Report will remain on the list and tracked in subsequent Integrated Reports until:

- An EPA approved TMDL is developed for all pollutants causing impairment

OR

A subsequent assessment of new monitoring data or in special cases, modeling results show that the water is no longer impaired and EPA approves the delisting of the water. (see Section 7.2 Rule 2 for necessary delisting documentation)

Rule 2

Documentation required by EPA for delisting previously listed impaired waters that are now restored:

Scenario # 1: when new data demonstrates a previously impaired waterbody is currently attaining WQ Standards, DEQ should submit the following documents to justify the delisting of this segment from the next 303(d) list.

- Hydrologic Unit Code (HUC), Federal TMDL ID (if available), Cause Group Code, Watershed Identity Number, Stream Name and Listed Parameter
- Rationale for the decision to remove the previously impaired segment from the next 303(d) list
- Copies of the data that are being used to justify the removal of the segment
- Copies of the previous data which were used to list the segment
- Any differences between the sampling techniques should be documented and submitted
- A description of the water including but not limited to: stream name, impaired miles (acres or sq. mi.), beginning and ending river miles, impairment, watershed identification code and hydrologic unit code (HUC)

Scenario # 2: when new water quality modeling determines the stream is now attaining WQ Standards, DEQ should submit the following documents to justify the removal of this segment from the next 303(d) list.

- Hydrologic Unit Code (HUC), Federal TMDL ID (if available), Cause Group Code, Watershed Identity Number, Stream Name and Listed Parameter.
- Rationale for the decision to remove the previously impaired segment from the next 303(d) list
- Submission of any new data that were used in the modeling
- A copy of the EPA approved model that was used. A summary of the differences between the new and the old models. The reasons why the stream attains WQ Standards under the new model opposed to the former model (data, modeling assumptions, modeling applications, etc)

A description of the water including but not limited to: stream name, impaired miles (acres or sq. mi.), beginning and ending river miles, impairment, watershed identification code and hydrologic unit code (HUC)

Scenario # 3: when new management practices from point and/or nonpoint sources lead to the attainment of WQ Standards, DEQ should submit the following documents to justify the removal of this segment from the next 303(d) list.

- Hydrologic Unit Code (HUC), Federal TMDL ID (if available), Cause Group Code, Watershed Identity Number, Stream Name and Listed Parameter.
- Rationale for the decision to remove the previously impaired segment from the next 303(d) list.
- Submission of the most recent 2 years of water quality data that indicate the water is a candidate for delisting and
- A description of the new management practices and other changes that have occurred in the watershed to explain the change in water quality.
- A description of the water including but not limited to: stream name, impaired miles (acres or sq. mi.), beginning and ending river miles, impairment, watershed identification code and hydrologic unit code (HUC).

The TMDL staff should apply the Proactive Approach, as appropriate, any time a TMDL is scheduled for development. Appendix D contains additional procedural information on this approach.

Scenario # 4: when errors are detected in the rationale for the initial listing of the segment or WQ Standards have been modified and the segment is attaining WQ Standards, DEQ should submit the following documents to justify the removal of this segment from the next 303(d) list.

- Hydrologic Unit Code (HUC), Federal TMDL ID (if available), Cause Group Code, Watershed Identity Number, Stream Name and Listed Parameter.
- Rationale for the decision to remove the previously impaired segment from the next 303(d) list
- Documentation of the errors in the initial listing
- A copy of the data and/or modeling that demonstrates the segment attains WQ Standards at least 90% of the time
- A description of the water including but not limited to, stream name, impaired miles (acres or sq. mi.), beginning and ending river miles, impairment, watershed identification code and hydrologic unit code (HUC).

In certain cases EPA may request additional documentation to justify the removal of the segment from the 303(d) list.

Rule 3

Impaired bacteria waters falling geographically within an EPA approved TMDL bacteria study area and having assigned pollutant loadings should be identified, incorporating the Federal TMDL ID (if available) and Cause Group Code into ADB and the TMDL database for the assessment unit and subsequently listed as Category 4A (impaired and TMDL has been completed and EPA approved). For benthic impairments within an EPA approved benthic TMDL, professional justification and documentation is necessary indicating the new impairment is covered by the approved TMDL allocations.

Rule 4

Section 303(d) requires States to "establish a priority ranking" for the waters it identifies on the impaired waters list, taking into account the severity of the pollution and the uses to be made of such waters, and to establish TMDLs "in accordance with the priority ranking." Federal regulations provide that "schedules for submissions of TMDLs shall be determined by the Regional Administrator and the State" (40 CFR 130.7(d)(1)). Other reasonable factors such as the State's use of a rotating basin approach or commitments specified in court orders or consent decrees may also be considered when States develop priorities and schedules.

For the waters covered by the June 1999 Consent Decree pertaining to Virginia's TMDL program, DEQ has developed a TMDL development schedule ending on May 1, 2010. A specific TMDL development schedule for the period ending on May 1, 2008 was noticed for public comment and is available on the DEQ web site. For waters listed as impaired

subsequent to the Consent Decree, TMDLs are expected to be completed within 12 years of the first listing date. Outside of the specific TMDL development schedule, TMDL due dates assigned to each water body reflect the date when a TMDL must be established. However, if subsequently listed waters are within a Consent Decree watershed, every effort will be made to address the impairments at the same time. This may result in TMDL development much sooner than the 12 years generally anticipated. Also, in response to concerns raised by the United States Fish and Wildlife Service during the development of the 2002 303(d) List, certain impaired waters of concern to them have accelerated TMDL development dates.

In preparing the TMDL development schedule, Virginia does not specifically identify each TMDL as high, medium or low priority. Instead, DEQ uses the TMDL schedule itself to reflect Virginia's priority ranking. The CWA does not prescribe a particular method of expressing a priority ranking, and DEQ believes a TMDL schedule is a reasonable, efficient way to demonstrate priority ranking.

In scheduling TMDLs for development, every effort should be made to address all related impairments in a watershed at the same time. If endangered species are affected by an impairment listing, TMDL development should be scheduled as expeditiously as possible. If a public water supply is affected by an impairment listing, TMDL development should be scheduled as expeditiously as possible. In the absence of impacts to public water supplies or endangered species, a watershed approach should be used for TMDL development scheduling. Other factors that may impact TMDL scheduling include public interest and support, locally available funding to implement controls, or coordinating TMDL development efforts with an adjoining state.

After the TMDL schedule has been developed, the order in which TMDLs are established might be subject to some modifications to accommodate logistical efficiencies or data availability. The process is a dynamic process and any priority ranking may be changed if substantial factors change or become apparent during the scheduling process.

APPENDIX A

Clean Water Act Sections

Sec.305. WATER QUALITY INVENTORY

(b) (1) Each State shall prepare and submit to the Administrator by April 1, 1975, and shall bring up to date by April 1, 1976, and biennially thereafter, a report that shall include—

(A) a description of the water quality of all navigable waters in such State during the preceding year, with appropriate supplemental descriptions as shall be required to take into account seasonal, tidal, and other variations, correlated with the quality of water required by the objective of this ACT (as identified by the Administrator pursuant to criteria published under section 304(a) of this Act) and the water quality described in subparagraph (B) of this paragraph;

(B) an analysis of the extent to which all navigable waters of such State provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water;

(C) an analysis of the extent to which the elimination of the discharge of pollutants and a level of water quality which provides for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allows recreational activities in and on the water, have been or will be achieved by the requirements of this Act, together with recommendations as to additional action necessary to achieve such objectives and for what water such additional action is necessary;

(D) an estimate of (1) the environmental impact, (ii) the economic and social costs necessary to achieve the objective of this Act in such State, (iii) the economic and social benefits of such achievement, and (iv) an estimate of the date of such achievement; and

(E) a description of the nature and extent of nonpoint sources of pollutants, and recommendations as to the programs which must be undertaken to control each category of such sources, including an estimate of the costs of implementing such programs. (2) The Administrator shall transmit such State reports, together with an analysis thereof, to Congress on or before October 1, 1975, and October 1, 1976, and biennially thereafter.

GRANTS FOR SEC. 106. POLLUTION CONTROL PROGRAM

(e) Beginning in fiscal year 1974 the Administrator shall not make any grant under this section to any State which has not provided or is not carrying out as a part of its program—

(1) the establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor, and to compile and analyze data on (including classification according to eutrophic condition), the quality of navigable waters and to the extent practicable, ground waters including biological monitoring; and provision for annually updating such data and including it in the report required under section 305 of this Act;

SEC. 204 LIMITATION AND CONDITIONS

(a) Before approving grants for any projection for any treatment works under section 201(g)(1) the Administrator shall determine—

"that (A) the State in which the project is to be located (1) is implementing any required plan under section 303(e) of this Act and the proposed treatment works are in conformity with such plan, or (ii) is developing such a plan and the proposed treatment works will be in conformity with such plan, and (b) such State is in compliance with section 305(b) of this Act;"

SEC. 314. CLEAN LAKES

(a) Each State shall prepare or establish, and submit to the Administrator for his approval—

"(A) an identification and classification according to eutrophic condition of all publicly owned lakes in such State;
"(B) a description of procedures, processes, and methods (including land use requirements), to control sources of pollution of such lakes;
"(C) a description of methods and procedures, in conjunction with appropriate Federal agencies, to restore the quality of such lakes;
"(D) methods and procedures to mitigate the harmful effects of high acidity, including innovative methods of neutralizing and restoring buffering capacity of lakes and methods of removing from lakes toxic metals and other toxic substances mobilized by high acidity;
"(E) a list and description of those publicly owned lakes in such State for which uses are known to be impaired, including those lakes which are known not to meet applicable WQ Standards or which require implementation of control programs to maintain compliance with applicable standards and those lakes in which water quality has deteriorated as a result of high acidity that may reasonably be due to acid deposition; and
"(F) an assessment of the status and trends of water quality in lakes in such State, including but not limited to, the nature and extent of pollution loading from point and nonpoint sources and the extent to which the uses of lakes is impaired as a result of such pollution, particularly with respect to toxic pollution.

"(2) SUBMISSION AS PART OF 305(b) (1) REPORT. – The information required under paragraph (1) shall be included in the report required under section 305(b) (1) of this Act, beginning with the report required under such section by April 1, 1988.

APPENDIX B

Virginia Department of Environmental Quality
Biological Monitoring Program
305(b) Assessment Fact Sheet

Regional Office:
Regional Biologist's Signature: _____
Review Date:
River Basin:
Stream Name and Site Location:
Station ID #:
Reference Station ID #:
Assessment Method:
VSCI
Coastal Plain (MACS)

Biological Assessments for the Last Six Years

Year	Spring score	Spring assessment	Fall score	Fall assessment
2001				
2002				
2003				
2004				
2005				
2006	0.0		0.0	
Seasonal avg 6-yrs	0.0		0.0	
Seasonal avg last 2-yrs	0.0		0.0	
Final 6-yr average	0.0		0.0	
Final 6-yr average	0.0		0.0	

Note, because of the long, six-year time frame covered by this review and for a variety of reasons, some sites may not have been sampled during every year or season and/or an assessment ranking or score may not be available for every "cell" in the above table. The above table is intended to be a convenient method to summarize and review all the data available for the reporting period. The final assessment ranking for each site should be based on a review of all the available rankings shown in the above table and any pertinent supplemental data described below. For the purpose of Integrated Report preparation, if more recent bioassessment rankings differ significantly from earlier rankings, primary consideration should be given to the more recent assessed data. This is described in more detail of section 6.4.2.2 of the Integrated Report Guidance Manual.

Supplemental Information (if applicable):

Are any seasonal differences noted?

Summary of any comments associated with assessments.

Have any factors been observed in watershed that may be affecting the benthic community? Have there been any recent changes in activity in the watershed that may have affected the more recent bioassessments. Are these changes likely to affect the benthic community for a short or long term basis?

Final Assessment Rating:

APPENDIX C

Classification of Virginia's Shellfish Growing Areas

Robert E. Croonenberghs, PhD

The Division of Shellfish Sanitation (DSS) follows the requirements of the National Shellfish Sanitation Program (NSSP), which is regulated by the U.S. Food and Drug Administration. The NSSP classification uses the shoreline survey as its primary tool for classifying shellfish growing waters. Fecal coliform concentrations in seawater samples collected in the immediate vicinity of the shellfish beds function to verify the findings of the shoreline surveys, and to define the border between approved and condemned (unapproved) waters.

DSS uses the shoreline survey to locate as many sources of pollution as possible on the watersheds of shellfish growing areas. DSS conducts a property-by-property inspection of the onsite sanitary waste disposal facilities of most properties on un-sewered sections of watersheds, and investigates other sources of pollution such as wastewater treatment facilities (WWTF), marinas, livestock operations, landfills, etc. The information is compiled into a written report with a map showing the location of the sources of real or potential pollution found, and sends it to the various state agencies that are responsible for regulating these concerns and the city or county. The local health departments (LHDs) of the Virginia Department of Health (VDH) play a major role in the process by obtaining correction of the onsite sanitary waste disposal problems. Most of the Division's effort is focused on locating fecal contamination, and in this manner we prevent significant amounts of human pathogens from getting into shellfish waters. I believe that this is the primary reason why we have not had a confirmed shellfish-borne disease outbreak due to Virginia-grown shellfish in over 35 years. VDH is reducing the input of these pathogens to back yards, waterways, unofficial swimming areas and shellfish waters. The shoreline survey work is the heart of the shellfish program.

In addition to the shoreline survey, the NSSP requires that DSS collect seawater samples in the growing areas as part of the classification procedure. States must use the most recent 30 samples, collected randomly with respect to weather (scheduled one month in advance), to classify a station. The two part standard for fecal coliforms in waters for direct shellfish harvest to market is a geometric mean no greater than 14 MPN fecal coliforms/100 ml and an estimated 90th percentile no greater than 49. Exceeding either number requires closure of that station.

To a lesser degree, the Division collects shellfish samples from sentinel growing areas and has them analyzed for heavy metals and chlorinated hydrocarbons (pesticides and PCBs). Such toxic substances are not a public health threat in Virginia's waters, with the potential exception of the Elizabeth River and perhaps Little Creek, both of which are located in the Hampton Roads area.

Thus, classification based on fecal pollution is a multi-layered and multi-step process. Initially one uses the shoreline survey to determine if there are any actual or potential sources of fresh fecal pollution to the growing area. If so, then the area cannot be used for the direct harvest of shellfish for marketing. Hampton Roads is an example. Most of Hampton Roads is permanently closed, due to the tremendous amount of shipping and the concern of runoff from the urban watershed. However, microbiological results are generally acceptable.

Another example of actual or potential pollution that requires closure is a discharge, such as from a WWTF or the potential discharge from boats in marinas. DSS uses relatively simple computer models developed by VIMS, which employ fairly sophisticated mathematics, to determine the size of buffer zones around these sources. These models use inputs of fecal coliforms (from NPDES permits, or factors related to the number and size of boats in marinas), die-off factors, and readily available tidal current and channel configuration information. Buffer zones around marinas are only in effect during the warmer boating months (April 1 - Oct 31). Once these buffer zones are determined, they do not change in size unless the capacity of the WWTF or the marina changes.

Our third layer of classification, and our most common in Virginia, consists of evaluating areas that are not affected by urban runoff or significant wastewater discharges. One must evaluate the watershed for the potential impacts of known failing onsite sanitary waste facilities to estimate whether their input could be of such a magnitude as to require closure, even if the water quality data is acceptable. If the impact from these failing systems does not appear to pose an undue threat, then the water quality data can be used to verify whether the waters should be classified as approved or not.

Since DSS collects samples monthly, this means that our geometric mean incorporates data reaching back 2.5 years. Heavy rainfall or very high tides due to winds or moon phase can wash unusually high concentrations of fecal coliforms into shellfish growing areas that can increase the geometric mean or the 90th percentile beyond the allowed standard. As more data is collected and the unusually high concentrations fall off the trailing end of the data set, the water quality then appears to improve. This is one of the factors that can cause a continual fluctuation in the classification of the water quality at the interface between impacted upstream waters and the relatively unaffected downstream water body.

Since DSS is not a research organization, we cannot do much to determine the cause of water quality deterioration in areas. However, the Division has tried over the years to do so, and we have encouraged the State to put resources into determining those causes. The Division has found that *obviously* failing septic systems are almost never the cause of deteriorating water quality in a *large* body of water. We have seen areas where impacts on fecal coliform concentrations in smaller bodies of water occur due to failing onsite sanitary waste disposal systems, but these seem to be rare. This should not be taken to downplay the concern from such failing onsite sanitary waste disposal systems, since even small inputs of fecal coliforms from these systems are quite likely to contain significant concentrations of human pathogens. Indeed, failing onsite sanitary waste disposal systems are one of the types of pollution sources of greatest concern with regard to the consumption of bivalve molluscan shellfish. New data indicates that drainfields located in seasonally high water tables may contribute significant numbers of fecal coliforms to impact water quality, and research into this potential source is needed and ongoing.

In Virginia's urban suburban watersheds like the Lynnhaven River in Virginia Beach are clearly impacted by the flushing action of rapid runoff from storm drains. Water quality in the Lynnhaven River has deteriorated over the year's right along with development, and high counts after runoff events are predictable. Other areas are much less predictable. Sometimes heavy rainfalls cause elevated counts in rural areas and sometimes they do not. Part of this is due to spotty thunderstorms that are not reflected by the relatively few rain gauge sources.

In more rural areas the wildlife component of fecal coliform inputs is significant, as can be the human input. Wildlife, such as raccoons, muskrats and deer, living near the intertidal zone, can have dramatic local impacts on fecal coliform concentrations in the adjacent shellfish waters. Wildlife within in a watershed are potential sources for *Cryptosporidium* and *Giardia* inputs, though the NSSP has not decided how to handle these problems specifically. New data indicates that wildfowl can have significant impacts on water quality too. Wildlife inputs of fecal material are basically accounted for by the seawater sampling data.

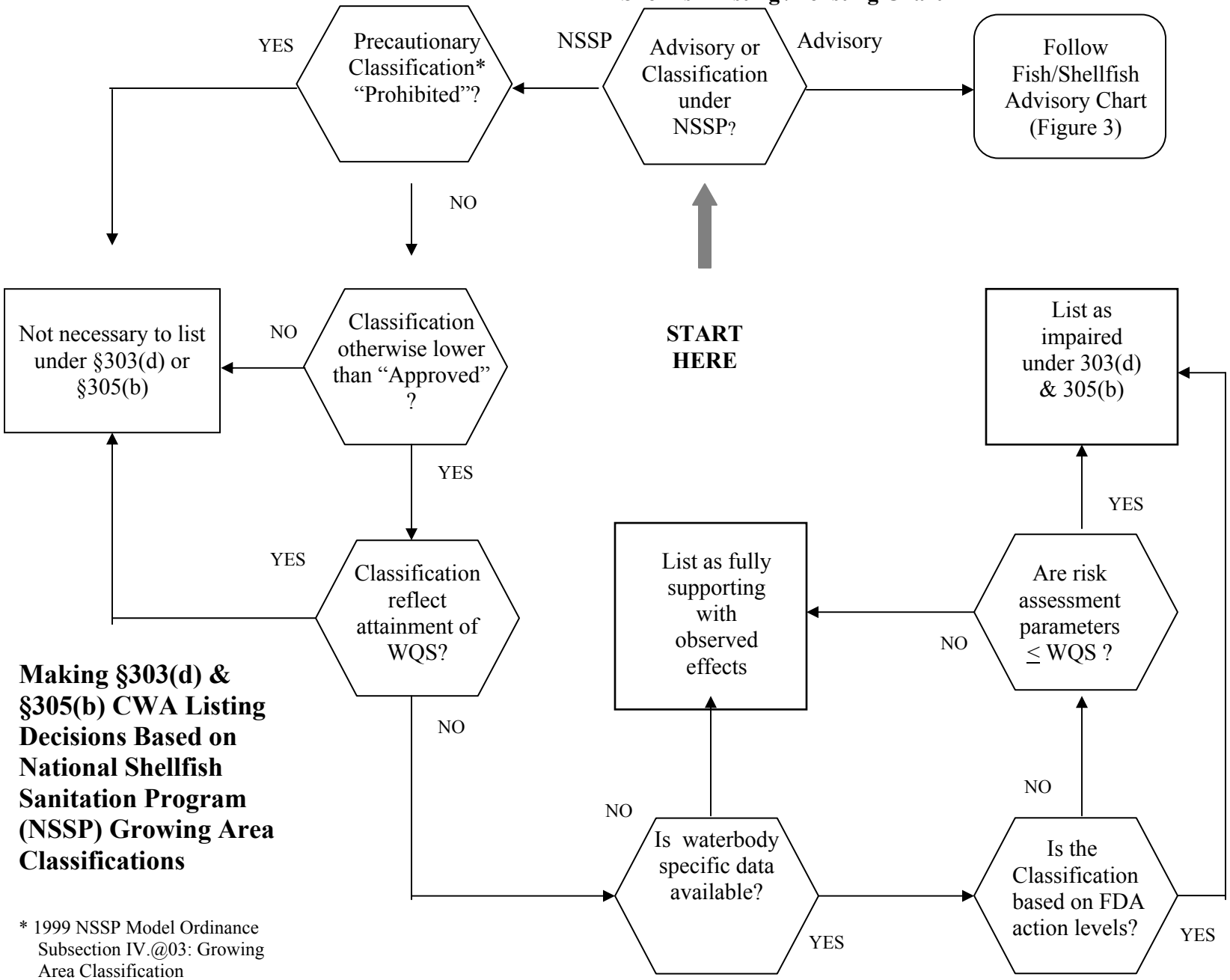
The Division is not seeing a steady increase in the number of acres of condemned in the state. Instead, what we see are fluctuations in the location of the border between acceptable and unacceptable water quality measurements moving up and down tributaries over time. Again, these fluctuations seem to be due largely to changing factors on the watershed, chance weather events (rain, high tides), changes in wildlife populations near shore or unknown factors (perhaps movement of livestock from one field to another, migratory bird flocks, or runoff from recently plowed fields that later contribute little when crops stabilize the soil).

Man does directly impact the fecal coliform counts in the waters. The headwaters of smaller streams are impacted by development due to the loss of the filtering and detention of runoff waters through upland swamps and other slow moving water areas. These natural detention areas provide the extended time element so that predators (rotifers and ciliates) and sunlight can reduce the numbers of fecal coliforms. When these are replaced with drainage systems the fecal coliforms are directly discharged into the shellfish waters.

In the past, without gene probes or other advanced tools to determine the type of animal/human source of fecal coliforms, the State has been thoroughly frustrated in trying to effect a change in the water quality of shellfish waters. Fortunately, this lack of "typing" is changing due to EPA's Total Maximum Daily Load (TMDL) requirement that pertains to fecal coliforms (along with other pollutants). The Department of Environmental Quality is developing TMDLs for shellfish waters, and DSS is collecting samples and actively working with DEQ and other State agencies to try to determine the types of sources of fecal coliforms to individual shellfish areas. This new data is exactly what has been needed for years to help in finding and correcting sources of fecal coliforms to shellfish waters.

Figure 4

EPA Shellfish Listing /Delisting Chart



Making §303(d) & §305(b) CWA Listing Decisions Based on National Shellfish Sanitation Program (NSSP) Growing Area Classifications

* 1999 NSSP Model Ordinance Subsection IV.@03: Growing Area Classification

APPENDIX D

Incorporating the *Proactive Approach* to delisting 303(d) listed segments into the 2008 Water Quality Assessment

For the 1998 assessment cycle, EPA changed the data analysis period for the 305(b) assessment from two to five years. Virginia's water quality assessments and the subsequent 303(d) list have since been based on a 5-year data window. For the 2008 assessment, the data window has been expanded to six years to coincide with the two-year watershed rotation ambient monitoring schedule. The data window for 2008 is January 1, 2001 through December 31, 2006.

In August 2001, the Office of Water Quality Programs negotiated with EPA an approach, termed the *Proactive Approach*, which results in the proposed delisting of waters on the Section 303(d) list through assessment of less than five years of data. Correspondence and information related to the issue is attached to this memorandum. In short, EPA Region III has consented that Virginia can delist a segment on the 303(d) list if the following requirements are met:

1) For conventional parameters, no more than one of twelve samples taken over a two-year period exceeds the water quality criteria (<10.5 percent exceedence for larger data sets).
2) For biological impairment, a minimum of 2 consecutive samples, taken over a one to two year period, show attainment of the applicable standard.
3) The samples are taken at the same location (monitoring station) which demonstrated the impairment.
4) A rationale document is submitted to EPA justifying why the State believes the waters are achieving WQ Standards. This rationale document can consist of a description of measures taken in the watershed which are considered to be responsible for improvement of the water quality.

Eligibility and Water Quality Assessment

The following procedure is to be used to consider the eligibility of, and to subsequently assess, any particular waterbody segment submitted for consideration for delisting under the *Proactive Approach*.

Locations where proactive measures are being taken to improve water quality through the TMDL or Water Quality Management Plan program such that the *Proactive Approach* is eligible for consideration are to be provided by the DEQ TMDL program. Assessment staff can recommend segments for consideration, but only those locations provided by the DEQ TMDL program as candidates for the *Proactive Approach* are to be considered for assessment under the *Proactive Approach*. Notification must be made in writing through memorandum to the affected regional assessment manager, copied to the DEQ 305(b) coordinator, and must include the required documentation supporting consideration of the *Proactive Approach*. At a minimum, this is to include documentation of those implementation measures considered to be responsible for improvement in water quality and subsequent achievement of WQ Standards.

Regional assessment staff members are responsible for assessment of water quality in their respective regions and for the defense of their assessments. Therefore, the decision for delisting consideration is to be made by regional assessment staff based on the analysis of the proactive measures being taken, available monitoring data, any ancillary information collected, and their professional knowledge of site specific influences on water quality in the affected segment.

Where there is agreement between TMDL program and assessment staff that it is appropriate to pursue delisting based on implementation of the *Proactive Approach*, the assessment must be performed based on the requirements outlined in 1, 2 and 3 above. For a scheduled 305(b)/303(d) assessment, only the last two years of the assessment window are to be used for assessment of eligible segments. For delisting assessment at any other time, the most recent two years of data must be used.

Assessment Documentation and Delisting Procedure

ADB Database	A segment meeting the above criteria is considered monitored, fully supporting. The assessment comments section should include the phrase *Proactive Approach Assessment*. The *Proactive Approach* data window used must be specifically identified.
Delisting Documentation	Documentation must include the information provided by the TMDL program related to control measures implemented using the *Proactive Approach* (requirement 4, above), and the results of data analysis related to requirements 1, 2, and 3 above.
EPA Review, Approval and Public Participation	Fulfillment of EPA review and approval requirements, and fulfillment of public participation requirements for removal of waterbody segments (delisting) at EPA required 303(d) list submittal dates, is the responsibility of the Monitoring and Assessments Program. At other times, fulfillment of these requirements in an effort to delist waters not needing TMDLs is the responsibility of the TMDL program. Final documentation for segments delisted by the TMDL program staff must be provided to the regional assessment manager and copied to the DEQ 305(b) coordinator at least five months prior to any EPA required 303(d) list submittal date, if time permits.

APPENDIX E-1

Fish Tissue Values (TV)

COMPOUND		NON CARCINOGEN	CARCINOGEN
		CRITERION BASED TISSUE VALUE (TV)	CRITERION BASED TISSUE VALUE (TV)
	CAS #	PPB (wet–weight)	PPB (wet-weight)
Acenaphthene	83-32-9	650,000	
Acrolein	107-02-8	170,000	
Acrylonitrile	107-13-1		200
Aldrin	309-00-2		6.3
Anthracene	120-12-7	3,200,000	
Antimony	7440-36-0	4,300	
Benzene	71-43-2		3,700
Benzidine	92-87-5		0.47
Benzo(a)anthracene	56-55-3		15
Benzo(b)fluoranthene	205-99-2		15
Benzo (k)fluoranthene	207-08-9		15
Benzo(a)pyrene	50-32-8		15
Bis2-chloroethyl ether	111-44-4		98
Bis2- chloroisoproply ether	108-60-1	430,000	
Bromoform	75-25-2		14,000
Butyl benzyl phthalate	85-68-7	2,200,000	
Carbon tetrachloride	56-23-5		830
Total Chlordane	57-74-9		310
Chlorobenzene	108-90-7	220,000	
Chlorodibromomethane	124-48-1		1,300
2-Chloronaphthalene	91-58-7	860,000	
Chloroform	67-66-3		18,000
2-Chlorophenol	95-57-8	54,000	
Chrysene	218-01-9		15
Cyanide	57-12-5	220,000	
DDD	72-54-8		450
DDE	72-55-9		320
Total DDT	50-29-3		320
Dibenz(a,h)anthracene	53-70-3		15
Dibutyl phthalate	84-74-2	1,100,000	
Dichloromethane	75-09-2		14,000
1,2-Dichlorobenzene	95-50-1	970,000	
1,3-Dichlorobenzene	541-73-1	140,000	
1,4-Dichlorobenzene	106-46-7	140,000	
3,3-Dichlorobenzidine	91-94-1		240
Dichlorobromomethane	75-27-4		1,700
1,2-Dichloroethane	107-06-2		1,200
1,1-Dichloroethylene	75-35-4	97,000	
1,2-Trans-dichloroethylene	156-60-5	220,000	
2,4-Dichlorophenol	120-83-2	32,000	
1,2-Dichloropropane	78-87-5		1,600
1,3-Dichloropropene	542-75-6	3,200	
Dieldrin	60-57-1		6.7
Diethyl phthalate	84-66-2	8,600,000	
Di-2-ethylhexyl phthalate	117-81-7		7,700
2,4-Dimethylphenol	105-67-9	220,000	
Dimethyl Phyhlate	131-11-3	110,000,000	
Di-n-butyl phthalate	84-74-2	1,1000,000	
2,4-Dinitrophenol	51-28-5	22,000	
2-Methyl-4,6-dinitrophenol	534-52-1	4,200	

2,4-Dinitrotoluene	121-14-2		350
Dioxin	1746-01-6		0.0062
1,2-Diphenylhydrazine	122-66-7		130
Endosulfan (1 and II)	115-29-7	65,000	
Endosulfan sulphate	1031-79-8	65,000	
Endrin	72-20-8	3,200	
Endrine aldehyde	7421-93-4	3,200	
Ethylbenzene	100-41-4	1,100,000	
Fluoranthene	206-44-0	430,000	
Fluorene	86-73-7	430,000	
Heptachlor	76-44-8		24
Heptachlor epoxide	1024-57-3		12
Hexachlorobenzene	118-74-1		67
Hexachlorobutadiene	87-68-3		1,400
Hexachlorocyclohexane (alpha-BHC)	319-84-6		17
Hexachlorocyclohexane (beta – BHC)	319-85-7		60
Hexachlorocyclohexane (lindane) (gama-BHC)	58-89-9		60
Hexachlorocyclopentadiene	77-47-4	75,000	
Hexachloroethane	67-72-1		7,700
Indeno(1,2,3-cd)pyrene	193-39-5		15
Isophrone	78-59-1		110,000
Mercury (Methyl)	22967-92-6	1,100	
Methyl bromide	74-83-9	15,000	
Monochlorobenzene	108-90-7	220,000	
Nickel	744-00-2	220,000	
Nitrobenzine	98-95-3	5,400	
N-nitrosodimethylamine	62-75-9		2.11
N-nitrosodiphenylamine	86-30-6		22,000
N-nitrosodi-n-propylamine	621-64-7		15
PCB Total/congeners	1336-36-3		54
Pentachlorophenol	87-86-5		900
Phenol	108-95-2	6,500,000	
Pyrene	129-00-0	320,000	
Selenium	7782-49-2	54,000	
1,1,2,2-Terachloroethane	79-34-5		540
Tetracholoethylene	127-18-4		2,700
Thalium	7440-28-0	730	
Toluene	108-88-3	2,200,000	
Toxaphene	8001-35-2		98
1,2,4-Trichlorobenzene	120-82-1	110,000	
1,1,2-Trichloroethane	79-00-5		1,900
Trichloroethylene	79-01-6		860
2,4,6-Trichlorophenol	88-06-2		9,800
Vinyl Chloride	75-01-4		72

APPENDIX E-2

RISK-BASED TISSUE SCREENING VALUE (TSVs) FOR FISH TISSUE UPDATED FROM INTEGRATED RISK INFORMATION SYSTEM (IRIS) FOR GENERAL POPULATION (ADULT)

BODY WEIGHT (KG)	70
RISK LEVEL	10^{-5}
CONSUMPTION RATE (KG/DAY)	0.0065

Fish Tissue Screening Values (TSV)

COMPOUND		NON CARCINOGEN	CARCINOGEN
		TISSUE SCREENING VALUE (TSV)	TISSUE SCREENING VALUE (TSV)
	CAS #	PPB (wet-weight)	PPB (wet-weight)
Arsenic (inorganic)	7440-38-2		72**
Barium	7440-39-3	750,000	
BHC isomers	608-93-1		20
Brominated Diphenyl ethers (BDEs)		5,000	
Cadmium	7440-43-9	11,000	
Chromium III	16065-83-1	16,000,000	
Chromium VI	18540-29-9	32,000	
Chlorpyrifos	2921-88-2	32,000	
Diazinon	333-41-5	970	
Dicofol	115-32-2	11,000	
Dioxin	1746-01-6		0.003**
Disulfoton	298-04-4	430	
Ethion	563-12-2	5,400	
Kepone	143-50-0	300	
Mercury (Methyl)	22967-92-6	300 (EPA2001)** (500VDH)**	
Methoxychlor	72-43-5	54,000	
Mirex	2385-85-5	2,200	
Oxyfluorfen	42874-03-3		830
PAHs (sum PEC) ***			15
Terbufos	13071-79-9	1400	
Tributyltin	56-35-9	320	

** These values are based on recent changes to the toxicological data used to calculate the screening values, or recent recommendations from U.S. EPA or the Virginia Department of Health. These screening values are not based on the same toxicological data that were used to develop the existing water quality criteria.

*** Mixtures of seven polynuclear aromatic hydrocarbons (PAHs) that are classed as probable human carcinogens were assessed based on a screening value concentration of 15 ppb calculated as a sum potency equivalency concentration (PEC) using methods described in EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol. 1, (EPA 823-R-95-007) and Vol. 2 (EPA 823 B-00-008) using the following equation;

$$PEC = \sum_{i} (RPi \times Ci)$$

where; RPi = relative potency for the ith PAH
Ci = concentration of the ith PAH in fish tissue)

The relative potency estimates used for these PAHs were:

Benzo(a)pyrene	1.0
Benzo(a)anthracene	0.145
Benzo(b) fluoranthene	0.167
Benzo(k)fluoranthene	0.020
Chrysene	0.0044
Dibenz(a,h)anthracene	1.11
Indeno(1,2,3-cd)pyrene	0.055

APPENDIX F

Freshwater Consensus- Based Sediment Screening Values (SVs)

Analyte (Metals)	**Consensus PEC (ppm) dry weight**
Arsenic	33
Cadmium	4.98
Chromium	111
Copper	149
Lead	128
Mercury	1.06
Nickel	48.6
Silver	NA
Zinc	459
Analyte (Organics/Pesticides)	**Consensus PEC (ppb) dry weight**
Acenaphthene	NA
Acenaphthylene	NA
Anthracene	845
Benzo-a-pyrene	1,450
Benz(a)Anthracene	1,050
Chrysene	1,290
Dibenz[a,h]Anthracene	NA
Fluoranthene	2230
Fluorene	536
Methylnaphthalene, 2-	NA
Naphthalene	561
Phenanthrene	1,170
Pyrene	1,520
LMW PAHs	NA
HMW PAHs	NA
Total PAHs ** (see footnote)	22,800
Chlordane	17.6
DDD	28
DDE	31.3
DDT	62.9
DDT, total	572
Dieldrin	61.8
Total PCBs	676
Endrin	207
Heptachlor Epoxide	16
Lindane	4.99
PECs taken from MacDonald et al. 2000	
NA = Not Available	

Estuarine NOAA-based ER-M Sediment Screening Values (SVs)

• **Trace Elements –parts per million (ppm), dry weight**	
Substance	**ER-M Value**
(Metals)	**ppm (dry weight)**
Antimony (Sb)	NA
Arsenic (As)	70
Beryllium	NA
Cadmium (Cd)	9.6
Chromium (Cr)	370
Copper (Cu)	270
Lead (Pb)	218
Manganese (Mn)	NA
Mercury (Hg)	0.71
Nickel (Ni)	51.6
Selenium (Se)	NA
Silver (Ag)	3.7
Thallium	NA
Zinc (Zn)	410

• **Pesticides and Other Organic Substances –parts per billion dry weight**			
CAS #	**Substance**	**ER-M Value**	
		(dry weight) (ppb)	
1336363	Polychlorinated Biphenyls (PCBs)	180	
309002	Aldrin	NA	
57749	Chlordane	6	
NA	total DDT (include metabolites)	46.1	
72548	DDD	20	
50293	DDT	7	
72559	DDE	27	
60571	Dieldrin (EPA proposed criteria)	8	
72208	Endrin	NA	
76448	Heptachlor	NA	
1024573	Heptachlor epoxide	NA	
118741	Hexachlorobenzene	NA	
608731	Hexachlorocyclohexane	NA	
58899	Lindane	NA	
2385855	Mirex	NA	
108952	Phenol	NA	
117817	Di (2-Ehtylhexyl) Phthalate	NA	
84742	N-Butyl Phthalate	NA	
83329	Acenapthene	500	LMW PAH
208968	Acenapthylene	640	LMW PAH
120127	Anthracene	1100	LMW PAH
50328	Benzo-A-Pyrene	1600	HMW PAH
191242	Benzo [GHI] Perylene	NA	HMW PAH
56553	Benz[A] Anthracene	1600	HMW PAH
218019	Chrysene	2800	HMW PAH
53703	Dibenz [A,H] Anthracene	260	HMW PAH
206440	Fluoranthene	5100	HMW PAH

86737	Fluorene	540	LMW PAH
193395	Indeno (1,2,3-CD) Pyrene	NA	HMW PAH
91576	Methylnaphthalene , 2	670	LMW PAH
91203	Naphthalene	2100	LMW PAH
85018	Phenanthrene	1500	LMW PAH
129000	Pyrene	2600	HMW PAH
NA	Low Molecular Weight (LMW) PAHs	3160	
NA	High Molecular Weight (HMW) PAHs	9600	
NA	Total PAHs ** (see footnote)	44,792	

*Changes or updates to any of the ER-M or PEC screening values should be updated in the assessment spreadsheet used to calculate the estuarine weight of evidence.
**sum of 24 Polyaromatic hydrocarbons used in previous reports, also polynuclear aromatic hydrocarbons (PNAs)

DEQ acknowledges the use of the ER-M or PEC may be limited (for several reasons) in their ability to accurately predict biological effects. Given that DEQ continues to employ the collection of bulk sediment with chemical analysis as a cost-effective way to monitor a great number of sediment sites, these thresholds are an appropriate tool for assessing sediment data relative to its potential harm to aquatic life.

Citation:

Freshwater PECs: MacDonald, D.D., C.G. Ingersoll, T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. *Arch. Environ. Contam. Toxicol.* 39:20-31.

Estuarine ER-Ms: Buchanan, M.F. 1999 National Oceanic and Atmospheric Administration *Screening Quick Reference Tables,* NOAA HAZMAT Report 99-1 Seattle, WA, Hazardous Materials Response and Assessment Division, 12 pages.

APPENDIX G

SIGNIFICANT LAKES/RESERVOIRS BY REGION

Northern Regional Office – 18 Reservoirs/Lakes

Abel Lake	Stafford Co.	185 (Acres)	PWS
Lake Anna	Louisa, Spotsylvania, Orange	9,600	
Aquia Reservoir (Smith Lake)	Stafford Co.	219	PWS
Beaverdam Reservoir	Loudoun Co.	350	PWS
Breckenridge Reservoir	Prince William Co.	85	PWS
Burke Lake	Fairfax Co.	218	VDGIF
Curtis Lake	Stafford Co.		
Goose Creek Reservoir	Loudoun Co.	140	PWS
Hunting Run Reservoir	Spotsylvania Co.	430	PWS
Lake Orange	Orange Co.	124	VDGIF
Lake Manassas	Prince William Co.	741	PWS
Lunga Reservoir	Prince William Co.	420	PWS
Motts Run Reservoir	Spotsylvania Co.	160	PWS
Mountain Run Lake	Culpeper Co.	75	PWS
Ni Reservoir	Spotsylvania Co.	400	PWS
Northeast Creek Res.	Louisa Co.	49	PWS
Occoquan Reservoir	Fairfax, Prince William Co.	1700	PWS
Lake Pelham	Culpeper Co.	253	PWS

Piedmont Regional Office – 12 Reservoirs/Lakes

Airfield Pond	Sussex Co.	105	VDGIF
Amelia Lake	Amelia Co.	110	VDGIF
Brunswick Lake	Brunswick Co.	150	VDGIF
Lake Chesdin	Chesterfield Co.	3196	PWS
Chickahominy Lake	Charles City Co.	1500	PWS
Diascund Reservoir	New Kent Co.	1700	PWS
Emporia Lake	Greensville Co.	210	PWS
Falling Creek Reservoir	Chesterfield Co.	110	
Great Creek Reservoir	Lawrenceville	305	
Harrison Lake	Charles City Co.		
Swift Creek Lake	Chesterfield Co.	156	
Swift Creek Reservoir	Chesterfield Co.	1800	PWS

South Central Regional Office – 24 Reservoirs/Lakes

Briery Creek Lake	Pr. Edward Co.	845	VDGIF
Phelps Creek Reservoir	Campbell Co.	26	PWS
Cherrystone Reservoir	Pittsylvania Co.	118	PWS
Georges Creek Reservoir	Pittsylvania Co.	10	PWS
Lake Gordon	Mecklenburg Co.	112	VDGIF
Graham Creek Reservoir	Amherst Co.	48	PWS
Banister Lake	Halifax Co.	381	PWS
Holiday Lake	Appomattox Co.	115	
Kerr Reservoir (Va.'s portion)	Halifax Co.	33251	ACOE/PWS
Keysville Reservoir	Charlotte Co.	42	PWS

Lake Conner	Halifax Co.	103	VDGIF
Lake Gaston (Va.'s portion)	Brunswick Co.	5530	PWS
Lunenburg Beach Lake	Town of Victoria	12	PWS
Mill Creek Reservoir	Amherst Co.	189	
Modest Creek Reservoir	Town of Victoria	21	PWS
Nottoway Falls Lake	Lunenburg Co.	32	PWS
Fort Pickett Reservoir	Nottoway Co.	198	
Lake Nottoway	Nottoway Co.	55	PWS
Pedlar Lake	Amherst Co.	117	PWS
Roaring Fork	Pittsylvania Co.	25	PWS
Sandy River Reservoir	Prince Edward Co.	740	
Stonehouse Creek Reservoir	Amherst Co.	125	
Thrashers Creek Reservoir	Amherst Co.	110	
Troublesome Creek Reservoir (SCS Impoundment #2)	Buckingham Co.	72	PWS

Southwest Regional Office – 11 Reservoirs

Big Cherry Lake	Wise Co.	106	PWS
J. W. Flannagan Reservoir	Dickenson Co.	1143	ACOE/PWS
Hungry Mother Lake	Smyth Co.	108	DCR
Lake Keokee	Lee Co.	100	VDGIF
Laurel Bed Lake	Russell Co.	210	VDGIF
North Fork Pound Reservoir	Wise Co.	154	ACOE/PWS
South Holston Reservoir	Washington Co.	1810	TVA/PWS
Wise Reservoir	Wise Co.	30	WISE/PWS
Rural Retreat Lake	Wythe Co.	85	VDGIF
Hidden Valley Lake	Russell Co.	90	VDGIF
Bark Camp Lake	Scott Co.	47	USFS

Tidewater Regional Office – 21 Reservoirs/Lakes

Lake Cahoon	Suffolk City	508	PWS
Lake Burnt Mills	Isle of Wight Co.	711	PWS
Harwood Mills Reservoir	York Co.	300	PWS
Lake Kilby	Suffolk City	226	PWS
Lake Lawson	Virginia Beach		
Lee Hall Reservoir	Newport News	230	PWS
Little Creek Reservoir	Norfolk City	193	PWS
Little Creek Reservoir	James City Co.	860	PWS
Lone Star Lake F	Suffolk City	20	PWS
Lone Star Lake G	Suffolk City	50	PWS
Lone Star Lake I	Suffolk City	39	PWS
Lake Meade	Suffolk City	511	PWS
Lake Prince	Suffolk City	946	PWS
Lake Smith	Norfolk City	193	PWS
Speights Run Lake	Suffolk City	94	PWS
Stumpy Lake	Virginia Beach		
Waller Mill Reservoir	York Co.	315	PWS
Lake Whitehurst	Norfolk City	480	PWS
Lake Wright	Norfolk City		
Western Branch Reservoir	Norfolk City	1265	PWS
Lake Drummond	Suffolk City	3198	

Valley Regional Office – 18 Reservoirs/Lakes

Beaver Creek Reservoir	Albemarle Co.	104	PWS
Douthat Lake	Bath Co.	35	
Coles Run Reservoir	Augusta Co.	7	USFS/PWS
Elkhorn Lake	Augusta Co.	55	USFS/PWS
Lake Albemarle	Albemarle Co.		
Lake Frederick	Frederick Co.	120	VDGIF
Lake Nelson	Nelson Co.		
Lake Robertson	Rockbridge Co.		
Mount Jackson Reservoir	Shenandoah Co.		
Ragged Mount Reservoir	Albemarle Co.	54	PWS
Rivanna Reservoir	Albemarle Co.	390	PWS
Shenandoah Lake	Rockingham Co.		
Silver Lake	Rockingham Co.	10.9	PWS
Staunton Dam Lake	Augusta Co.	30	PWS
Strasburg Reservoir	Shenandoah Co.		
Switzer Lake	Rockingham Co.	110	USFS/PWS
Sugar Hollow Reservoir	Albemarle Co.	47	PWS
Totier Creek Reservoir	Albemarle Co.	66	PWS

West Central Regional Office – 18 Reservoirs/Lakes

Beaverdam Creek Reservoir	Bedford Co.	70	PWS
Bedford (Stony Cr.) Reservoir	Bedford Co.	25	PWS
Carvin Cove Reservoir	Botetourt Co.	668	PWS
Claytor Lake	Pulaski Co.	4349	PWS
Clifton Forge (Smith Cr.) Reservoir	Alleghany Co.	12	PWS
Falling Creek Reservoir	Bedford Co.	18	PWS
Fairystone Lake	Henry Co.	123	
Gatewood Reservoir	Pulaski Co.	182	PWS
Hogan Lake	Pulaski Co.	43	PWS
Leesville Reservoir	Bedford Co.	2728	PWS
Little River Reservoir	Montgomery Co.	63	PWS
Martinsville Reservoir	Henry Co.	192	PWS
Lake Moomaw	Bath Co.	2303	ACOE
Philpott Reservoir	Henry Co.	2893	ACOE
Smith Mountain Lake	Bedford Co.	19994	PWS
Spring Hollow Reservoir	Roanoke Co.	121	PWS
Talbott Reservoir	Patrick Co.	125	
Townes Reservoir	Patrick Co.	21	

Total 122 Significant Reservoirs/Lakes statewide
PWS = Public Water Supply
VDGIF = Virginia Department of Game and Inland Fisheries
ACOE = Army Corps of Engineers
TVA = Tennessee Valley Authority
Bold = Nutrient WQ Standards apply