The 2010 Integrated Report of Surface Water Quality in Maryland

Submitted in Accordance with Sections 303(d), 305(b) and 314 of the Clean Water Act

Martin O'Malley – Governor
Anthony G. Brown – Lt. Governor

Shari T. Wilson, Secretary
Robert M. Summers, Deputy Secretary

John R. Griffin, Secretary
Eric Schwaab, Deputy Secretary

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

Maryland's 2010 Integrated Report (IR) is submitted in compliance with sections 303(d), 305(b) and 314 of the federal Clean Water Act (CWA). This biennial report describes ongoing efforts to monitor, assess, track and restore the chemical, physical and biological integrity of Maryland waters. This report presents the current status of water quality in Maryland by placing all waters of the State into one of five categories.[1] In addition, the report provides information about the progress on addressing impaired waters (Categories 4 & 5) by documenting:

- Completed Total Maximum Daily Loads (TMDLs), which re-categorize impairments from Category 5[1] (impaired and needs a TMDL: aka the "list of impaired waters") to Category 4a (TMDL completed, but still impaired).
- Analyses of new water quality data that shows previously impaired areas are attaining standards. This can result from remediation, changes in water quality standards, or improved monitoring and/or data analysis.
- Assessment methodologies and watershed segmentation that enhance the use of available data and provide more consistency with management and implementation strategies. Three examples for 2010 include the listing methodology for bacteria, for toxics in fish tissue, and the addition of a stressor identification component to Maryland's biological listing methodology.
- Statewide water quality statistics for Maryland's surface waters.

The 2010 IR incorporates a few changes this year which include: additional database reformatting to aid in querying function, implementation of revised listing methodologies for bacteria, toxics, and biology, as well as better integration of the CWA sections 305(b) and 303(d). These changes are part of an on-going effort to improve Maryland's reporting and assessment activities required under the CWA. Further, Maryland continues to work closely with EPA's Chesapeake Bay Program (CBP) and other state partners (VA, PA, D.C., NY, and DE) on the assessment process for the Chesapeake Bay water quality criteria. Maryland has adopted an assessment process that has been created and agreed upon by the partner states and the CBP. This agreement has resulted in 53 Chesapeake Bay segments based on a change in assessment methodology. The current Chesapeake Bay assessments will continue to evolve as new assessment methodologies are developed and as additional data are collected. More details on the Chesapeake Bay assessments can be found at:
http://www.chesapeakebay.net/waterquality.aspx?menuitem=13945.

There are 38 additions to the list of Category 5 waters in 2010. Fourteen of these new Category 5 waterbody-pollutant combinations (also referred to as listings) resulted from MDE's Biological Stressor Identification Analyses. The purpose of these analyses, as discussed in section C.2 of this report, is to identify the primary pollutants that are responsible for impairing watershed biological integrity. Of these 14 new 'biostressor' listings, eight are for chlorides, five are for sulfates, and one is listed for ammonia. There are seven new total suspended solids listings as the result of Chesapeake Bay submerged aquatic vegetation assessments. In addition, there are six fecal coliform listings in shellfish harvesting waters, five Chesapeake Bay segment listings as a result of bioassessments, two new mercury

[1] The Integrated Report places all waters of the State into one of five "categories": Category 1 indicates that a water body is meeting all standards, Category 2 means it is meeting some but not all standards, Category 3 indicates that there is insufficient data to determine whether standards are being met, Category 4a means that water quality standards are not being met but a TMDL is not needed, either because it has already been completed, other more immediate fixes are available, or the impairment is not load related, and finally, Category 5 indicates that a water body is impaired and a TMDL is needed.

listings for fish tissue, two listings for zinc, one listing for lead, and one listing for enterococcus in the Baltimore Harbor area.

Table 1: Category 5 Listing Status From 2006 to 2008

IR Year/Status	Category 5 Listings
2008 Total Category 5 Listings	**393**
2010 New Category 5 Listings	38
2010 New Delistings (Category 5 to Category 2 or 3) *(See Table 2)*	-37
Additional Category 5 listings caused by spatially splitting a previous listing	1
Category 5 Listings removed due to spatial aggregation	-3
Approved TMDLs (since the 2008 IR)	-33*
2010 Grand Total Category 5 Listings	**359**

*Six additional TMDLs were completed during this time but they were for waterbody-pollutant combinations that were either on Category 3 (insufficient information) or were nonexistent on the 2008 IR List.

Thirty-seven waterbody-pollutant combinations were removed or revised from the list of impaired waters ("delistings") in 2010. Eight biological listings without a specified impairing substance have been replaced by specific pollutant listings enumerated by the Biological Stressor Identification analyses. Another six have been delisted as a result of mercury or PCB levels that are now supporting the fishing designated use. Four delistings were for waters that are no longer recognized as beaches. The remaining nineteen delistings are a combination of waters that meet aquatic life standards for metals (six delistings), total phosphorus (nine delistings), and sediment-related parameters (four delistings). Since early listings were based on limited data (especially from 1996 and 1998), in many cases, it is not possible to attribute the reasons these waters now meet standards to a particular restoration action. It is possible that the extensive restoration practices that have been applied statewide might be playing a contributory role but it may also be true that these listings were made based upon insufficient data. Table 2 shows the specific water body-pollutant combinations that have been delisted.

Table 2: 2010 Delistings (water body-pollutant combinations removed from Category 5 (impaired status)

Type of Impairment Listing	Number of Listings Removed from Category 5
Generic Biological Listings – specific pollutant now specified	8
Mercury and PCB listings - Fish Tissue Concentrations now meeting fishing designated use	6
Areas no longer considered beaches	4
Metals – now meeting aquatic life designated use	6
Total Phosphorus – now meeting standards	9
Sediments – now meeting aquatic life designated use	4
2010 Total Number of Delistings	37

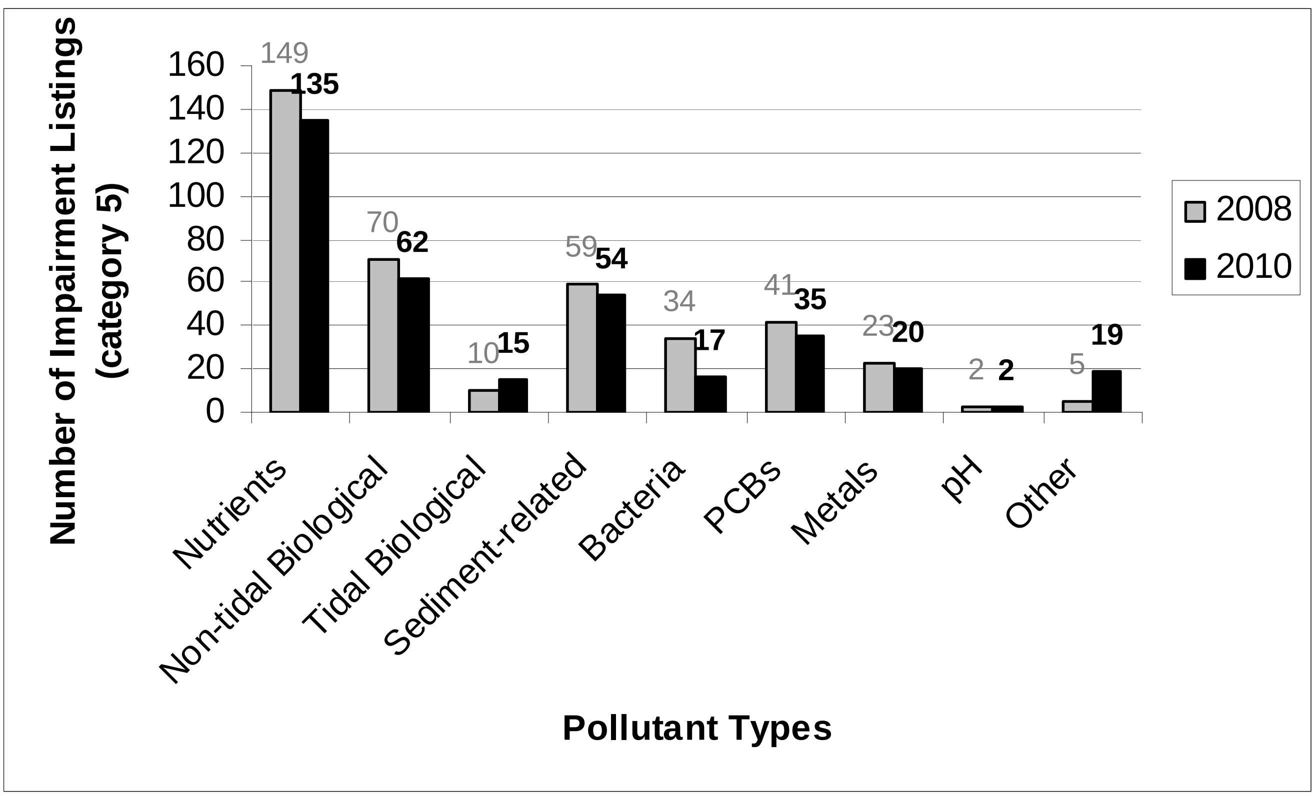


Figure 1: Comparison of the Number of Impaired Listings (Category 5) Between 2008 and 2010 Integrated Reporting Cycles per Pollutant Group.

There have been some notable developments in Maryland's water programs since the last IR reporting cycle in 2008. Maryland completed a total of 50 Total Maximum Daily Loads and Water Quality

Analyses in 2008 and 2009.[2] Twenty-nine of the 50 meet specific requirements of the memorandum of understanding (MOU) with EPA that sets TMDL production schedules for Maryland. In addition, in December 2009, MDE and DNR completed a strategic overhaul of Maryland's comprehensive water monitoring strategy to align monitoring programs with current priorities and goals.

Other notable new restoration programs or actions taken by the State include:

- Implementation of the new general permit for stormwater associated with construction activity;
- Passage of HB1305 to require the development of regulations to address the beneficial use and transportation of coal combustion by-products.
- Promulgation of Maryland's new stormwater management regulations that require the use of Environmental Site Design (ESD) principles for all new development and redevelopment projects to the maximum extent practicable.
- The development of the draft "Standards and Specifications for Soil Erosion and Sediment Control" to update the previous stormwater manual.
- Implementation of the new Concentrated Animal Feeding Operation (CAFO) and Maryland Animal Feeding Operation (MAFO) regulations and issuance of the General Discharge Permit for Animal Feeding Operations.

In addition to Maryland's efforts to improve water quality throughout the state, in May of 2009 President Obama signed an Executive Order that charges the federal government with renewing the effort to restore and protect the Chesapeake Bay estuary. This executive order created a federal leadership committee to oversee the restoration activities of both state and federal agencies to ensure progress is made and funding is allocated appropriately. Every year, starting with 2010, this committee will produce a Chesapeake Bay Action Plan that will detail how funding will be allocated towards Chesapeake Bay restoration in the coming year. The Executive Order also requires development of two-year milestones designed to set interim water quality goals that will increase the pace of current nutrient reductions within the Chesapeake Bay watershed.

[2] Of the 50 TMDLs and WQAs completed in 2008 and 2009, only 40 (30 TMDLs, 10 WQAs) of these resulted in delistings (category 5 to category 2 or 4a) in the 2010 IR. All other TMDLs and WQAs were accounted for previously in the 2008 Integrated List.

PREFACE

Maryland's Integrated Report, when approved by the US Environmental Protection Agency, will satisfy Sections 303(d), 305(b) and 314 of the federal Clean Water Act (CWA). The following lists the requirements of these sections.

Clean Water Act §303(d) (Impaired waters) Requirements

- A list of water quality-limited (impaired) waters still requiring TMDL(s), pollutants causing the impairment and priority ranking for TMDL development (including waters targeted for TMDL development within the next two years).
- A description of the listing methodologies used to develop the list.
- A description of the data and information used to identify waters, including a description of the existing and readily available data and information used.
- A rationale for any decision to not use any existing and readily available data and information.
- Other reasonable information such as demonstrating good cause for not including waters on the list.

Clean Water Act §305(b) (Water quality inventory) Requirements

- A description of the quality of all waters in the State and the extent to which the quality of waters provides for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allows recreational activities in and on the water.
- An estimate of the extent to which control programs have or will improve water quality, and recommendations for future actions necessary and identification of waters needing action.
- An estimate of the environmental, economic and social costs and benefits needed to achieve the objectives of the CWA and an estimate of the date of such achievement.
- A description of the nature and extent of nonpoint source pollution and recommendations of programs needed to control each category of nonpoint sources, including an estimate of implementation costs.
- An assessment of water quality of all publicly owned lakes as specified in §314(a)(1).

Clean Water Act §314 (Clean Lakes) Requirements

- An identification and classification according to eutrophic condition of all publicly owned lakes.
- A description of procedures, processes, and methods (including land use requirements), to control sources of pollution of such lakes.
- A description of methods and procedures, in conjunction with appropriate federal agencies, to restore the quality of such lakes.
- 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.
- A list and description of those publicly owned lakes for which uses are known to be impaired and those in which water quality has deteriorated as a result of high acidity that may be due to acid deposition.
- An assessment of the status and trends of water quality in lakes, including but not limited to, the nature and extent of pollution loading from point and nonpoint sources and the extent to which the use of lakes is impaired as a result of such pollution, particularly with respect to toxic pollution.

PART A: Introduction

In Maryland, the Departments of Natural Resources (DNR) and the Environment (MDE) are the two principal agencies responsible for water resources monitoring, assessment and protection. DNR is the primary agency responsible for ambient water monitoring and assessment. MDE sets water quality standards, regulates discharges to Maryland waters through multiple permits, enforcement and compliance activities, and develops Total Maximum Daily Loads (TMDLs) for impaired waters. Historically, DNR reported water quality monitoring and assessment results via annual §305(b) reports and updates mandated by the federal Clean Water Act (CWA), while MDE reported polluted waters using the CWA's biennial §303(d) List. Since 2002 and in compliance with Environmental Protection Agency guidance on 303(d) listing and 305(b) reporting, these formerly independent responsibilities have evolved into a combined reporting structure called the Integrated Report (IR).

The IR utilizes five reporting categories that not only include impaired waters requiring TMDLs, but also waters that are clean or need additional monitoring data to make an assessment. These categories are:

I. **Category 1:** water bodies that meet all water quality standards and no use is threatened;

II. **Category 2:** water bodies meeting some water quality standards but with insufficient data and information to determine if other water quality standards are being met;

III. **Category 3:** Insufficient data and information are available to determine if any water quality standard is being attained. This can be related to having an insufficient quantity of data and/or an insufficient quality of data to properly evaluate a water body's attainment status.

IV. **Category 4:** one or more water quality standards are impaired or threatened but a TMDL is not required or has already been established. The following subcategories are included in Category 4:
- **Subcategory 4a:** TMDL already approved or established by EPA;
- **Subcategory 4b:** Other pollution control requirements (*i.e.*, permits, consent decrees, etc.) are expected to attain water quality standards; and,
- **Subcategory 4c:** Water body impairment is not caused by a pollutant.

V. **Category 5:** Water body is impaired, does not attain the water quality standard, and a TMDL or other acceptable pollution abatement initiative is required. This is the part of the List historically known as the 303(d) List.

A.1 Data Sources and Minimum Requirements

Section 130.7(B)(5) of the Clean Water Act requires that states "assemble and evaluate all existing and readily available water quality-related data and information" when compiling their Integrated Report. This includes but is not limited to the following:

(i) Waters identified by the State in its most recent Section 305(b) Report as "partially meeting" or "not meeting" designated uses;

(ii) Waters for which dilution calculations or predictive models indicate non-attainment of applicable water quality standards;

(iii) Waters for which water quality problems have been reported by local, state, or federal agencies; members of the public or academic institutions; and,

(iv) Waters identified by the State as impaired in a nonpoint source assessment submitted to EPA under section 319 of the CWA or in any updates of the assessment.

With the integration of sections 305(b) and 303(d) of the Clean Water Act and the adoption of a multi-category reporting structure, Maryland has developed a two-tiered approach to data quality. Tier 1 data are used to determine impaired waters (*e.g.*, Category 5 waters or the traditional 303(d) List) and are subject to the highest data quality standards. Maryland waters identified as impaired using Tier 1 data may require a TMDL or other regulatory actions. These data should be accompanied by a Quality Assurance Project Plan (QAPP) consistent with EPA data guidance specified in *Guidance for Quality Assurance Project Plans. Dec 2002. EPA /240/R-02/009* available at http://www.epa.gov/quality/qs-docs/g5-final.pdf. Tier 1 data analysis must also be consistent with Maryland's Listing Methodologies (see section C.2).

Tier 2 data are used to assess the general condition of surface waters in Maryland and may include volunteer monitoring, land use data, visual observations of water quality condition, or data not consistent with Maryland's Listing Methodologies. Such data may not have a QAPP or may have one that is not consistent with EPA guidance. Waters with this level of data may be placed in Categories 2 or 3 of the List, denoting that water quality is generally good or that there are insufficient data to make an assessment, respectively. However, Tier 2 data alone are not used to make impairment decisions (*i.e.*, Category 5 listings requiring a TMDL) because the data are of insufficient quantity and/or quality for regulatory decision-making. Table 3 below identifies the organizations and/or programs that submitted data to MDE for the 2010 IR.

Table 3: Organizations/Programs that submitted water quality data for consideration in the 2010 IR.

Data Provider	Data Description	Parameter Measured	Data Tier	Notes
Harford County	NPDES MS4 report	pH, temperature, nutrients, metals, etc	1	
USGS	Referred MDE to USGS Web site	Stream flow	1	
Coastal Bays	Nutrient Data	Several nitrogen and phosphorus species, dissolved oxygen	1	Do not yet have nutrient criteria, Data may be used for TMDL development
Baltimore County	Biological	Non-tidal benthic biotic integrity	2	Taxa identified to family only
Friends of Deep Creek Lake	Photos and maps	N/A	2	No water quality data provided
Center for Biological Diversity	PDF with lots of citations and some pH and CO2 data from Hawaii, Bermuda and Europe	Carbon dioxide and pH	2	No site-specific data for Maryland waters.
Montgomery County	Biological Monitoring Data	Non-tidal biological integrity (fish and benthos)	1	Data could not be combined with DNR data
Baltimore Harbor Waterkeeper	3 MS Excel Files and a Powerpoint file depicting station locations	Enterococcus and E. coli	1	Data submitted during the public comment period
MDE	Bureau of Mines	pH, Fe, Mn, conductivity, sulfate, Zn, etc	2	Errors were found in the most recent data record
MDE	CSO/SSO	# of incidences of sewage overflows of 30,000 gallons or more	1	
MDE	Fish Tissue	PCBs and mercury levels in fish tissue	1	
MDE	Beaches	Enterococcus levels	1	
MDE	Shellfish	Fecal coliform levels	1	
MDE	TMDL	Multiple pollutant levels depending on the previously listed impairment	1	
DNR	CORE/TREND	DO, temperature, pH, nutrients, turbidity, etc	1	
DNR	MBSS	Non-tidal biological integrity (fish and benthics)	1	

Data Provider	Data Description	Parameter Measured	Data Tier	Notes
DNR and the Chesapeake Bay Program	Chesapeake Bay and Tidal Tributary Monitoring	Dissolved oxygen, SAV and water clarity, Tidal benthic biotic integrity	1	

MDE supports the use of computer models and other innovative approaches to water quality monitoring and assessment. Maryland and the Bay partners have also relied heavily on the Chesapeake Bay model to develop loading allocations, assess the effectiveness of best management practices, and guide implementation efforts. Several different modeling approaches have also been used in TMDL development. With the growing number of biological impairments in Category 5 of the List, Maryland will be relying more heavily on land use analyses, GIS modeling, data mining, and other innovative approaches to identify stressors, define ecological processes, and develop TMDLs.

Maryland has increased its efforts to make Integrated Reporting data available to the public in a real-time, user-friendly environment. To accomplish this goal, Maryland created a searchable IR database and clickable map to make it easier to find water quality assessments for a particular geographic area. This application is available online at http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Maryland%20303%20dlist/2008_303d_search/index.asp. In addition, Maryland has also created pre-made PDF maps, by county, of water quality impairments for the 2008 IR. These maps are also available online at http://www.mde.state.md.us/Water/HB1141/Water_Quality_Maps.asp, These materials will all be updated with 2010 information following EPA approval of Maryland's 2010 IR.

A.1.1 Quality control of water quality datasets

Data quality in Maryland's water monitoring programs is defined through implementation of the agency's quality control program (e.g., DNR's and MDE's Quality Management Plan), Quality Assurance Project Plan (QAPP) for each monitoring program, and field and laboratory Standard Operating Procedures (SOP). Water monitoring programs conducted under contract to the US Environmental Protection Agency (EPA) must have QAPPs approved by the EPA Regional or Chesapeake Bay Program QA Officer prior to initiating monitoring activities.

Details in each program's QAPP define data quality indicators by establishing quality control and measurement performance criteria as part of the program's planning and development. Such measures help ensure there is a well-defined system in place to assess and ensure the data quality.

Water monitoring programs conducted by a local agency, educational institution, consultant or citizen group may not have a QAPP. Unless there are contractual requirements, water monitoring QAPPs for these groups are not reviewed or approved by the State. While it is recommended that a QAPP or equivalent planning document be developed, some water quality monitoring programs may have no QAPP or documentation on quality control. For State analysts to review these contributed data with any confidence the quantitative aspects of these data need to be defined.

Some of the data quality aspects that need to be considered include:

- **Precision** - How reproducible are the data? Are sample collection, handling and analytical work done consistently each time samples are collected and processed?
- **Accuracy/Bias** - How well do the measurements reflect what is actually in the sample? How far away are results from the "true" value, and are the measures consistently above or below this value?
- **Representativeness** - How well do the sample data characterize ambient environmental conditions?
- **Comparability** – How similar are results from other studies or from similar locations of the same study, or from different times of the year, etc.? Are similar sampling and analytical methods followed to ensure comparability? Do observations of field conditions support or explain poor comparability?
- **Completeness** – Is the quality and amount of data collected sufficient to assess water quality conditions or can these data be appended to other, existing data collected at the same site or nearby to provide enough information to make an assessment decision?
- **Sensitivity -** Are the field and/or laboratory methods sensitive enough to quantify parameters at or below the regulatory standards and at what threshold can an analytical measure maintain confidence in results?

QAPPs will likely not address all of these issues and there are often no quantitative tests or insufficient QC data available to do so. In these instances, best professional judgement may be required as these aspects can be difficult to address, even if there is a monitoring QAPP. For some issues, there is no quantitative test and often little, if any, quality assurance data are provided with contributed data. In most instances, an analyst's review of available monitoring program documentation and data are subjective. Once data quality is considered acceptable (or at least not objectionable), the dataset review process moves to a more quantitative review stage.

A.1.1.1 Water quality data review

The designated uses defined in the Code of Maryland Regulations are assessed by relatively few field and analytical measures. Water temperature, dissolved oxygen, pH, turbidity, water clarity (Secchi depth or light extinction), acres of estuarine grasses, ammonium, biological integrity and certain bacteria levels define the principal data used to assess criteria attainment. Various measures of nitrogen and phosphorus as nutrients have not been defined in terms of criteria, although exceedance of oxygen criteria or nuisance levels of algae are attributed to high nutrients levels. Except for special studies or as a discharge permit requirement, metals, inorganic and organic parameters defined as criteria are not routinely measured due to the high cost of analysis and because few of these substances are found in ambient waters at levels exceeding criteria. Specific toxics known to be directly related to human health (i.e., mercury and PCBs) are assessed through MDE's fish and shellfish monitoring programs.

Water quality datasets reviewed for assessing use support are first examined in terms of QAPP or other reports that define monitoring objectives and quality control. For selected parameters, the data are reviewed for sufficient sample size, data distribution (type and outliers/errors) and spatial and temporal distribution in the field. Censored data and field comments are examined for unusual events that may affect data quality (e.g., storm event). Data are examined for seasonality and known correlations (e.g., conductivity and salinity) are reviewed. Censored data are noted and may be excluded from the analysis.

Not all water quality criteria are assessed using this approach. Some assessments are conducted by other State programs using peer-reviewed or defined methods (e.g., Maryland's listing methodologies) and are not re-evaluated using other approaches. Examples include; assessment of algal samples, the State's statistical non-tidal living resource survey (MD Biological Stream Survey), fish kill and bacterial assessments, bathing and shellfish harvesting restrictions, and toxic contaminants in fish tissue, shellstock and sediments.

Some criteria assessments are conducted externally. In these circumstances, the assessment methods are peer reviewed and results are provided to the State. Criteria assessed in this manner are not re-evaluated. Examples include, for Maryland's Chesapeake Bay and tidal tributaries, benthic community criteria (Versar, Inc. and Old Dominion University), aquatic grass coverage (VA Institute of Marine Science), water clarity (MD DNR), and dissolved oxygen (US Environmental Protection Agency's Chesapeake Bay Program).

PART B: Background

B.1 Total Waters

Maryland is fortunate to have an incredible diversity of aquatic resources. The low-lying, coastal plain region in the eastern part of the State includes the oceanic zone as well as the estuarine waters of both the Coastal and Chesapeake Bays. Moving further west and up through the rolling hills of the Piedmont region, the tidal influences give way to flowing streams and the Liberty, Loch Raven and Prettyboy reservoir systems. Along the western borders of the State is the Highland region where resides the State's highest peaks, and which includes three distinct geological provinces (the Blue Ridge, the Ridge and Valley province, and the Appalachian Plateaus). Estimates of Maryland's total surface waters across these regions are given in Table 4.

Table 4: Scope of Maryland's Surface Waters.

	Value	Scale	Source
State population	5,633,597	N/A	MD Dept. Planning, 2008
Surface area - land (mi^2) **- total ($mi_{2)}$**	9,844 12,193	Unknown	MD Dept. Natl. Res., 2001
Rivers and streams (mi)	10,820	1:100,000 NHD Coverage	MDE, 2008
Lakes, reservoirs (number / acres) **- all lakes/reservoir** **- significant, publicly-owned**	 947 lakes (77,965) 60 lakes (21,168)	 1:100,000 (RF3) Unknown	 US EPA, 1991 MDE, 2003; 2005
Estuaries/bays (mi^2)	2,522	Unknown	Cronin, 1971 / estimate
Ocean coast (mi^2)	109	1:100,000 NHD Coverage	MDE, 2008
Wetlands - freshwater (acres) **- tidal (acres)**	346,135 252,273	Unknown Unknown	Tiner and Burke, 1995 Tiner and Burke, 1995

B.1.1 Water Quality Standards

A water body is considered "impaired" when it does not support its designated uses [see Code of Maryland Regulations §26.08.02 at http://www.dsd.state.md.us/comar/subtitle_chapters/26_Chapters.aspx#Subtitle08]. Maryland's Water Quality Standards (WQS) assign one of eight designated use classes to each body of water. The following is a generalized list of these designated use classes.

1. **Use I waters:** Water contact recreation, and protection of nontidal warmwater aquatic life;
2. **Use II waters:** Support of estuarine and marine aquatic life and shellfish harvesting;
3. **Use III waters:** Nontidal cold water; and,
4. **Use IV waters:** Recreational trout waters.

Each designated use class then has an appropriate subset of specific designated uses. Water bodies assigned a use class are expected to support the entire subset of designated uses for that class. Table 5 illustrates the specific designated uses that apply to each use class. This table shows all possible use classes in the column headings.

Table 5: Specific Designated Uses that Apply to each use class.

Specific Designated Uses	Designated Use Classes							
	I	I-P	II	II-P	III	III-P	IV	IV-P
Water Contact Sports	✓	✓	✓	✓	✓	✓	✓	✓
Leisure activities involving direct contact with surface water	✓	✓	✓	✓	✓	✓	✓	✓
Fishing	✓	✓	✓	✓	✓	✓	✓	✓
Growth and Propagation of fish (not trout), other aquatic life and wildlife	✓	✓	✓	✓	✓	✓	✓	✓
Agricultural Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Industrial Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Propagation and Harvesting of Shellfish			✓	✓				
Seasonal Migratory Fish Spawning and Nursery Use*			✓	✓				
Seasonal Shallow-Water Submerged Aquatic Vegetation Use*			✓	✓				
Open-Water Fish and Shellfish Use*			✓	✓				
Seasonal Deep-Water Fish and Shellfish Use*			✓	✓				
Seasonal Deep-Channel Refuge Use*			✓	✓				
Growth and Propagation of Trout					✓	✓		
Capable of Supporting Adult Trout for a Put and Take Fishery							✓	✓
Public Water Supply		✓		✓		✓		✓

*These particular designated uses apply only to the Chesapeake Bay and its tidal tributaries. They are discussed in more detail in Section B.1.1.1.

Each of the designated uses has associated water quality criteria that are then used to determine if the use is being supported. Such criteria can be narrative or numeric. Numeric Water Quality Criteria establish threshold values, usually based upon risk analyses or dose-response curves, for the protection of human health and aquatic life. These apply to pollutants that can be monitored and quantified to known levels of precision and accuracy, such as toxics concentrations, pH, and nutrients. Narrative criteria are less quantitative in nature but generally prohibit any undesirable water quality conditions that would preclude a water body from supporting a designated use.

The Federal Clean Water Act and its amendments require that States update their water quality standards every three years, subject to review and approval by the US Environmental Protection Agency (http://www.mde.maryland.gov/Programs/WaterPrograms/TMDL/wqstandards/index.asp). Water quality standards are updated through changes to the regulatory language in COMAR and go through a public review process.

B.1.1.1 Water Quality Standards for Chesapeake Bay and its Tidal Tributaries

Maryland has detailed water quality standards for Chesapeake Bay and its tidal tributaries to protect both aquatic resources and to provide for safe consumption of shellfish. The recently revised aquatic resource protection standards are subcategories under Use II waters and establish five designated uses (see Figure 3), including:

1. **Seasonal Migratory Fish Spawning and Nursery Designated Use** - includes waters of the Chesapeake Bay and its tidal tributaries that have the potential for or are supporting the survival, growth, and propagation of balanced populations of ecologically, recreationally, and commercially important anadromous, semi-anadromous and tidal-fresh resident fish species from February 1 through May 31.
2. **Seasonal Shallow-Water Submerged Aquatic Vegetation Designated Use** –includes tidal fresh, oligohaline and mesohaline waters of the Chesapeake Bay and its tributaries that have the potential for or are supporting the survival, growth, and propagation of rooted, underwater bay grasses in tidally influenced waters between April 1 and October 1.
3. **Open-Water Fish and Shellfish Designated Use** - includes waters of the Chesapeake Bay and its tidal tributaries that have the potential for or are supporting the survival, growth, and propagation of balanced, indigenous populations of ecologically, recreationally, and commercially important fish and shellfish species. This subcategory applies to two distinct periods: summer (June 1 to September 30) and October 1 through May 31. In summer, the open-water designated use in tidally influenced waters extends from shoreline to adjacent shoreline, and from the surface to the bottom or, if a pycnocline exists (preventing oxygen replenishment), to the upper measured boundary of the pycnocline. October 1 through May 31, the boundaries of this use include all tidally influenced waters from the shoreline to adjacent shoreline and down to the bottom, except when the migratory spawning and nursery designation (MSN) applies.
   NOTE: If a pycnocline exists but other physical circulation patterns, such as the inflow of oxygen-rich oceanic bottom waters, provide oxygen replenishment to the deep waters, this use extends to the bottom. This is mostly prevalent in the Virginia portion of the Bay.
4. **Seasonal Deep-Water Fish and Shellfish Designated Use -** includes waters of the Chesapeake Bay and its tidal tributaries that have the potential for or are supporting the survival, growth, and propagation of balanced, indigenous populations of important fish and shellfish species inhabiting deep-water habitats from June 1 through September 30:
   NOTE 1: In tidally influenced waters located between the measured depths of the upper and lower boundaries of the pycnocline, where a pycnocline is present and presents a barrier to oxygen replenishment; or
   NOTE 2: From the upper boundary of the pycnocline down to the sediment/water interface at the bottom, where a lower boundary of the pycnocline cannot be calculated due to the depth of the water column.
   NOTE 3: From October 1 to May 31, criteria for *Open Water Fish and Shellfish Subcategory* apply.
5. **Seasonal Deep-Channel Refuge Designated Use** - includes waters of the Chesapeake Bay and its tidal tributaries that have the potential for or are supporting the survival of balanced, indigenous populations of ecologically important benthic infaunal and epifaunal worms and clams, which provide food for bottom-feeding fish and crabs. This subcategory applies from

June 1 through September 30 in tidally influenced waters where a measured pycnocline is present and presents a barrier to oxygen replenishment. Located below the measured lower boundary of the pycnocline to the bottom.
NOTE: From October 1 to May 31, criteria for *Open Water Fish and Shellfish Subcategory* apply.

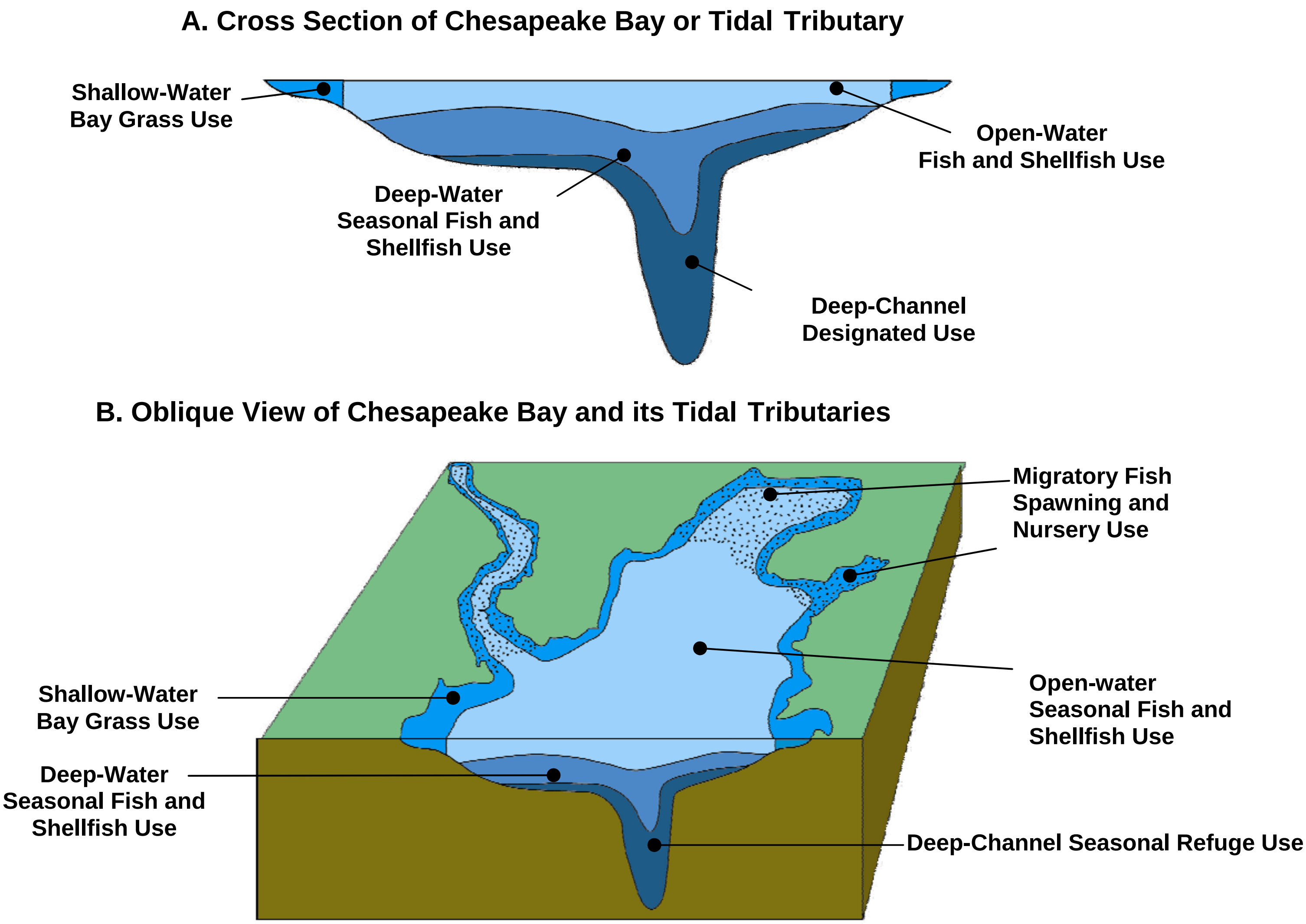


Figure 2: Illustration of the designated uses for Chesapeake Bay (Chesapeake Bay Program, 1998). Uses are both overlapping and three-dimensional.

B.2 Water Pollution Control Programs

Maryland implements a host of water pollution control programs to ensure that water quality standards are attained, many of which are funded by federal dollars under the Clean Water Act. Some programs are administered by different state agencies within Maryland or by local jurisdictions. Some of the programs administered by MDE are briefly cited below and web links are provided for access to more detailed information.

B.2.1 Permits

MDE is responsible for administering several permit programs to reduce the impacts of surface water and groundwater discharges to state waters. More detailed information on the state's water permits is available at http://www.mde.maryland.gov/Permits/WaterManagementPermits/index.asp.

B.2.2 Tier II Waters and Antidegradation

Recently, Maryland implemented antidegradation regulations to better protect state waters where data indicate that water quality is significantly better than required to support the applicable designated uses (COMAR 26.08.02.04). MDE is also developing detailed implementation guidance to help regulated entities better understand and implement these regulations. This important program aims to protect high quality waters by requiring more rigorous permit application reviews and by restricting the amount of buffering capacity (i.e., assimilative capacity) that can be used by a discharger. More information on Tier 2 can be found at
http://www.mde.state.md.us/ResearchCenter/Data/waterQualityStandards/Antidegradation/index.asp

B.2.3 Grant Programs

A number of financial assistance programs are offered and/or facilitated by the Maryland Department of the Environment. Funding may be in the form of grants, low interest loans, or direct payments for specific projects. More detailed information on the range of programs administered by the Department can be found at http://www.mde.maryland.gov/AboutMDE/grants/index.asp

B.2.4 Total Maximum Daily Loads (TMDLs)

Waters listed on Category 5 of this Integrated Report may require a Total Maximum Daily Load or TMDL. A TMDL is an estimate of the amount or load of a particular pollutant that a water body can assimilate and still meet water quality standards. After a total load has been developed, upstream discharges will be further regulated to ensure the prescribed loading amounts are attained. More information on Maryland's TMDL program can be found at
http://www.mde.maryland.gov/Programs/WaterPrograms/TMDL/index.asp

B.2.5 Drinking Water Supply and Protection

MDE is charged with ensuring that all Marylanders have a safe and adequate supply of drinking water. The Department has programs to oversee both public water supplies, which serve about 84 percent of the population's residential needs, and individual water supply wells, which serve citizens in most rural areas of the State. More information on Maryland's Water Supply Programs can be found at (http://www.mde.state.md.us/Programs/WaterPrograms/Water_Supply/index.asp)

B.2.6 Corsica River Targeted Watershed

The Corsica River Watershed Project is a pilot program designed to demonstrate that a tidal tributary of Chesapeake Bay can be successfully restored. The goal of this targeted watershed restoration is to remove the Corsica River from the Impaired Waters List. For more information, go to http://www.dnr.state.md.us/watersheds/tw/corsica/.

B.2.7 Program Coordination

State agency staff participate in many work groups, committees, task forces, and other forums to coordinate and communicate state efforts with interested stakeholders. Coordination with the Chesapeake Bay Program and participation by state staff in the associated subcommittees continues to be a nexus for Maryland's water quality restoration activities. The Interagency TMDL Workgroup, chaired by MDE, and which includes the Departments of Natural Resources, Agriculture, Planning and Transportation and the University of Maryland, addresses needs for enhanced coordination between agencies (i.e., Data-sharing, TMDL project selection and review, and TMDL implementation planning, etc.) stemming from the accelerated TMDL production schedule, as well as for federal (Section 319) funding guidance for watershed restoration plans that can be used to develop TMDL implementation plans. State staff also meet regularly with other groups, such as the State Water Quality Advisory Committee and the Maryland Water Monitoring Council, to ensure program coordination with local and federal government agencies, as well as the private sector, academia, and Maryland's citizens.

Recently, in 2009, MDE and DNR completed the latest update to Maryland's Water Monitoring Strategy. During this process both agencies took the opportunity to reevaluate current monitoring goals and objectives to determine if monitoring programs are still meeting state needs. This process also helped to document data gaps that the State hopes to fill before the next updates are made to the strategy.

B.3 Cost/Benefit Assessment

One specific reporting requirement of the Clean Water Act under §305(b), is a cost-benefit analysis of water pollution control efforts to ensure that the benefits of these programs are worth the costs. Economists have defined various ways to measure water quality benefits (e.g., Smith and Desvousges, 1986) and a number of agencies have produced estimates of water quality values based on uses (e.g., flood control value of wetlands – Leschine et al., 1997) or specific activities (e.g., recreational fishing - US Fish and Wildlife Service, 1998). Data for these efforts often are difficult to obtain, the results are complex or often address only a single use, and comparability between States or regions can be impossible.

B.3.1 Program costs

A substantial level of federal funding for water pollution control efforts comes from some agencies (US Environmental Protection Agency) while funding for aquatic resource protection and restoration may be substantially provided by other federal agencies (e.g., US Fish and Wildlife Service). Funds usually are transferred to States through a variety of appropriations – for example, certain provisions of the federal Water Pollution Control Act and its amendments provide for grants to States, including Sections 104(b)

(NPDES), 106 (surface- and ground water monitoring and permitting), 117 (Chesapeake Bay Program), 319 (nonpoint source pollution control), and 604(b) (water quality planning). These funds often provide seed money or low-interest loans that must be matched by State or local funds or documented in-kind efforts used on the project. A summary of federal water quality/aquatic resource-related grants to State agencies is shown in Figure 3.

While some new water programs are occasionally initiated, overall, there has been a general decline of federal funding available to States for various water quality-related programs. The figure below shows a summary of EPA budget data from traditional water grants (Clean Water Act §106, §319, §104b planning, wetlands, targeted watersheds (including Chesapeake Bay), public water supply, beach monitoring and wastewater operator training). The USGS water program summary includes the federal share of joint funding agreements with State/local agencies and other entities.

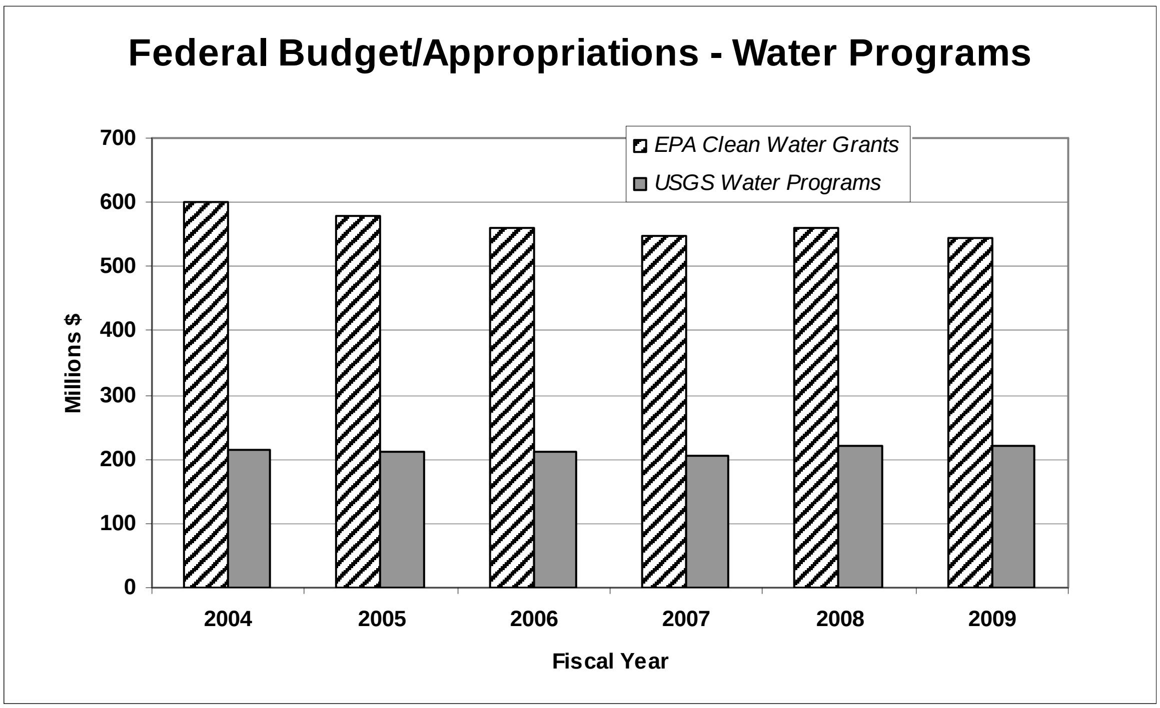
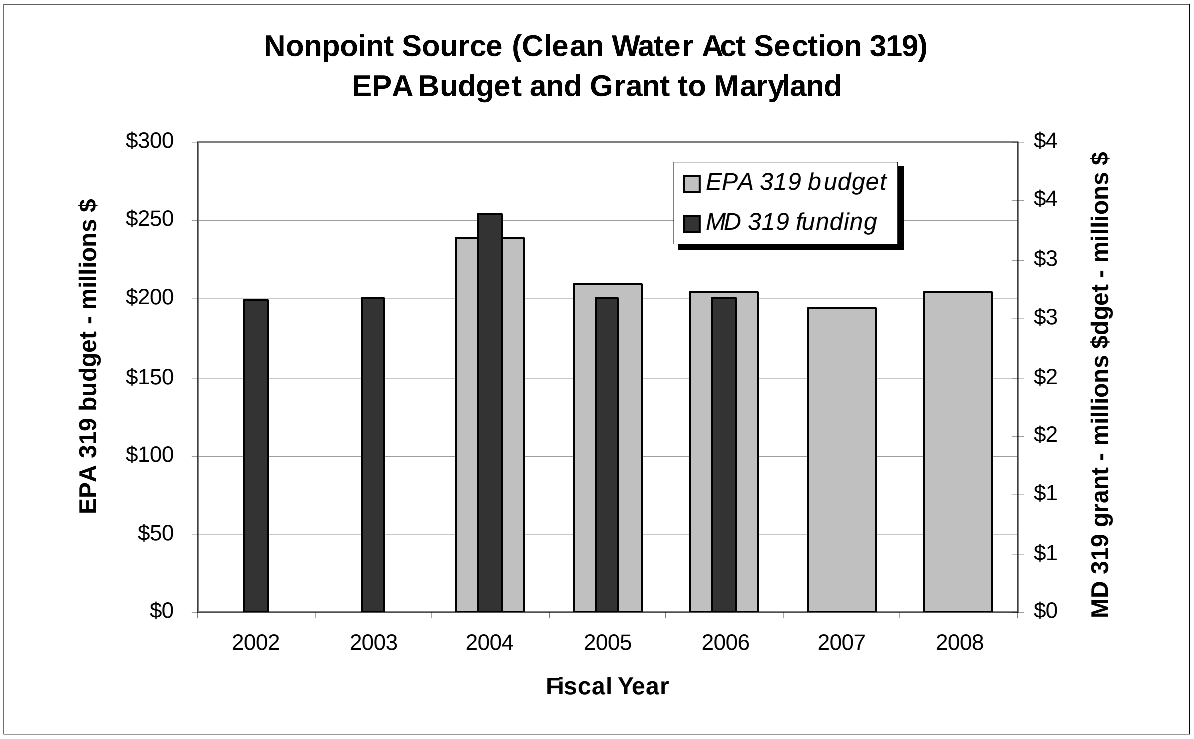


Figure 3: Federal Budget Appropriations to Water Programs (2004-2009)
Source: Association of State and Interstate Water Pollution Control Administrators, 2004, 2009, see http://www.asiwpca.org/home/docs/FINAL09Approp.pdf

Although the changes appear gradual, the loss for State programs is increased when programs that require matching funds are reduced. An example of the impact of national funding variance in §319 funding appropriation and what Maryland received is shown in Figure 4.



Source: Association of State and Interstate Water Pollution Control Administrators, 2005, 2008; MD Dept. Emvironment, 2006, 2007

Figure 4: Federal non-point source total budget allocation including the Maryland grant amount.

As the federal funding for water programs vary and program costs increase annually, maintenance of nearly every water program activity requires either an increased share from State/local budgets or reductions in program function.

B.3.2 Program benefits

Clean water offers many valuable uses to individuals and communities as direct and indirect economic benefits. Beautiful beaches, whitewater rivers, and calm, cool lakes add to aesthetic appeal and contribute to a recreation and tourism industry. A plentiful supply and good quality drinking water encourages economic growth and development, increased waterfront property values, and water-based recreational opportunities and commerce. But while environmental quality ranks high in the public's perception of livable communities, an economic valuation of each of these benefits is difficult to develop.

Most often, economic benefits are determined for single uses (e.g., fishing). For example, more than 500,000 Maryland residents are anglers (about one in 10) and residents comprise 70 percent of the State's anglers. In 1996, these anglers spent $475 million in the State on fishing expenses - an average of $664 per angler per year. Most of these expenses (56 percent) were trip-related (food, lodging, transportation, equipment rental). Equipment costs accounted for another large portion (39 percent) and other items (membership dues, magazines, permits, stamps and leases) amounted to $27 million (US Fish and Wildlife Service, 1998).

B.3.3 Summary

Water pollution control efforts are very costly. Much of the federal funds provided to the State and cost-shared with additional State and local funds are used to implement local pollution control and/or restoration programs. On an annual basis, the funds available are but a fraction of the estimated cost.

EPA needs to clearly define meaningful, accessible, available and comparable cost and benefit information that would meet Congress' intent in assessing value of the Clean Water Act's §305(b). A pilot State or regional program or a national study with recognized economists and federal and State participation could help simplify the complexities of this economic analysis.

B.4 Special State Concerns and Recommendations

Chesapeake Bay touches virtually every watershed within Maryland's borders and continues to be the focal point for water quality planning and restoration efforts across the State. On May 12, 2009, Governor O'Malley joined Virginia's Governor Kaine, Washington D.C Mayor Fenty, EPA Administrator Jackson, and representatives of Pennsylvania, Delaware, West Virginia, and New York in announcing significant acceleration of our collective Chesapeake Bay restoration actions over the next 2 years. Maryland's suite of actions represent a 138% increase in our rate of nitrogen reduction and an over 500% increase in our rate of phosphorus reduction, and put Maryland on a pace to meet our Bay Restoration Goals by 2020.[3]

In addition to the Bay work, Maryland is increasingly engaged in protecting its high quality waters. Over the past year, MDE has continued its outreach to local governments by identifying high quality waters in their jurisdictions needing special protection (COMAR 26.08.02.04) and raising awareness on the need for antidegradation reviews. Maryland has also started to screen water permits for potential impacts to Tier II waters as well as begun implementing special permit conditions necessary to protect high quality waters. These efforts have been a part of a larger State strategy (House Bill 1141) requiring local governments to include both water quantity and quality considerations in their comprehensive planning. Maryland also continues its targeted watershed work in the Corsica River to better understand how watersheds respond to restoration and determine recovery lag times between restoration activities and statistically valid water quality improvements. More targeted watershed restoration projects will occur as funding becomes available.

Maryland faces many emerging issues in the effort to reduce the amount of pollutants entering the Bay. Due to military Base Re-alignment and Closure (BRAC) initiated by the federal government, more people are expected to move into the Bay watershed with expansion of Aberdeen Proving Grounds and Fort Meade. Proactive planning efforts between the State and local jurisdictions are required to address the infrastructure needs to accommodate BRAC associated population growth. Several successes have already been realized in keeping BRAC zones out of Maryland's high quality watersheds. Another emerging issue of state concern is detection of endocrine disrupting chemicals in Maryland waters. These chemicals are being studied for effects on fish reproduction and, in some cases, have been linked to low reproductive success. These substances will be increasingly investigated to determine the magnitude of their effect on fish stocks and whether it is feasible to control them at the source. Also, Maryland is developing a regulatory framework to deal with discharge issues associated with mining the Marcellus Shale formation and looking at the experiences in Pennsylvania to inform regulatory decision-making on this topic.

[3] From Maryland BayStat web site at http://www.baystat.maryland.gov/

Maryland continues to meet its commitments to EPA and other stakeholders in developing Total Maximum Daily Loads for restoring impaired waters. However, to achieve its water quality goals, Maryland will have to find more effective ways to ramp up both restoration and protection efforts. The limiting factors for restoration activities continue to be funding constraints, as well as decentralization of water quality programs. The State's efforts to increase environmental funding as well as current efforts to better align monitoring and assessment programs through a coordinated state monitoring strategy will help to address these limiting factors. However, increased funding from the federal side as well as a more coordinated, centralized authority accountable to project successes and failures are necessary for continued progress. On the protection side, the State must continue to implement its antidegradation policy for high quality waters as well as develop clarifying guidance and regulations consistent with both water quality goals and the State's Smart Growth Initiative. To do this effectively, Maryland will have to work more closely with local jurisdictions and the public and be willing to face any associated legal challenges.

PART C: Surface Water Monitoring and Assessment

C.1 Monitoring Program

In September 2004, Maryland completed the last update of its comprehensive water monitoring strategy (http://www.mde.state.md.us/assets/document/water/WQPlanning_MonitoringStrategy_Sep04.pdf). Maryland's water quality monitoring programs are designed to support State Water Quality Standards (Code of Maryland Regulations Title 26, Subtitle 08) for the protection of both human health and aquatic life. This strategy identifies the programs, processes and procedures that have been institutionalized to ensure State monitoring activities continue to meet defined programmatic goals and objectives. The strategy also discusses current data management and quality assurance/quality control procedures implemented across the State to preserve data integrity and guarantee that data are of sufficient quality and quantity to meet the intended use.

In the Fall of 2007, MDE initiated monitoring strategy discussions with the Department of Natural Resources in anticipation of a revised strategy for 2009-2010. By starting this conversation well in advance of the reporting deadline, the State has built plenty of time into the process to allow a hard look at its current strategy, revisit programmatic goals and assumptions, and work towards developing a revised monitoring strategy that can effectively measure program effectiveness in meeting clearly defined goals. This draft 2009 Strategy has been submitted to EPA for review.

C.2 Listing Methodologies

Starting in 2002, Maryland developed and solicited public review of the listing methodologies used to document the State's assessment of its water quality standards (WQS) and which establish statistically based approaches for determining water body impairment. These methodologies are designed to provide consistency and transparency in Integrated Reporting so that the public and other interested stakeholders understand why listing decisions are made and can independently verify listing decisions. The assessment methodologies are living documents that can be revised as new statistical approaches, technologies, or other improved methods are identified. When changes are proposed to the methodologies, Maryland allows for public review and comment via the biennial Integrated Report.

For this 2010 reporting cycle, several listing methodologies (bacteria, toxics and the biological) have been revised and are open for public review and comment. These revised methodologies and/or language are provided below for stakeholder review and comment. All listing methodologies includibng those under review during this reporting cycle are available on MDE's Web site at http://www.mde.maryland.gov/Programs/WaterPrograms/TMDL/Maryland%20303%20dlist/IR_Listing_Methodologies.asp .

C.2.1 Bacterial Listing Methodology

The major change to the bacterial assessment methodology this cycle concerns how impaired waters listings are made for recreational waters (see Section C.2.1.3). In all cases, waters showing signs of bacterial contamination will require a sanitary survey before an impairment decision is made. Sanitary surveys can often find and fix the source of the bacterial problem, thus obviating the need for a TMDL.

C.2.1.1 Introduction

The rules used by MDE to interpret data and apply the water quality standards are discussed below in three sections. Each of those sections describes the application to a distinct water use: shellfish harvesting; recreational waters; and beaches. Although in each case a bacteriological indicator applies, the criterion and in some cases the indicator itself differs according to the requirements of the National Shellfish Sanitation Program (NSSP), water quality standards, or public health requirements. Data collected and analyzed using approved methods and in accordance with strict QA/QC guidelines may be utilized for decision making with respect to designated use support status. All available data will be considered but may be used for prioritization, additional study, or revised monitoring.

C.2.1.2 Interpretation of Fecal Coliform Data in Use II, Shellfish Harvesting Areas

(1) RESTRICTED:
Those areas restricted to shellfish harvesting because they do not meet water quality standards for Use II waters are listed in Category 4 or 5 (depending on whether a TMDL was completed or not) of the Integrated Report (IR). MDE uses routine bacteria water quality sampling to determine the presence and extent of shellfish harvesting restrictions. In order to support the shellfish harvesting designated use, the measured level of fecal coliform (expressed as MPN/100 ml) must have a median of less than 14 and a 90^{th} percentile of less than 49, for a minimum of 30 samples.
(1A)
Those areas restricted to shellfish harvesting because they are located in the vicinity of a wastewater treatment plant (WWTP) outfall but where there is no evidence of actual bacteriological impairment are **NOT** listed as impaired (in Category 4 or 5) in the IR. This restriction is an important application of the principals and practices of public health protection and is required under the NSSP. MDE also evaluates treatment plant performance and its impact to shellfish harvesting waters. These administrative closures are not based on water quality criteria but are designed to be protective buffer areas in case of a system failure. These areas meet the bacteriological portion of the standard.
(1B)
The upper Chesapeake Bay is restricted to shellfish harvesting for administrative reasons and is not listed as impaired (Category 4 or 5 of the IR). This area is designated as Use II waters; however there is insufficient shellfish resource for harvesting due to the fresh water input from the Susquehanna River. Since there are no oysters or clams to harvest and the NSSP requirements for sanitary survey are not met, the area is classified as restricted. In order to protect shellfish waters directly below this area, the shellfish harvesting water designation is a valuable protective measure. Water quality is routinely monitored in this area for fecal coliform and meets the bacteriological portion of the standard. If the collected data shows violations with State standards (notwithstanding the fact that the area is under an administrative closure or restriction) it will be listed appropriately.

(2) CONDITIONALLY APPROVED WATERS:
Before being opened for conditional harvesting, areas need to meet the stringent shellfish bacteriological standards. However, those areas classified as conditionally approved are closed to harvesting for three days following a rainfall event of greater than or equal to one inch in twenty-four hours. This occurs an average of 10 - 15 times per year when it is not completely certain that bacterial levels are not elevated in response to rain. The rest of the time, these areas meet the water quality standards for Use II waters

and are determined to support the designated use. These areas are not listed as impaired (Category 4 or 5) in the IR.

(3)APPROVED WATERS:
Areas classified as approved for harvesting meet the water quality standards for Use II waters and are placed in Category 1 or 2 (meeting water quality standards) of the IR.

C.2.1.3 Interpretation of Bacteria Data for General Recreational Use

Maryland has implemented the EPA recommended enterococcus (marine or freshwater) and *E. coli* (freshwater only) standards for all waters except shellfish harvesting waters, where the more stringent FDA standard must be met.

According to EPA's *Ambient Water Quality Criteria for Bacteria -1986*, the indicators E. coli and enterococcus have been found through epidemiological studies to have the best quantifiable relationship between the density of an indicator in the water and the potential human health risks associated with swimming in sewage contaminated waters. "Indicator organisms are a fundamental monitoring tool used to measure both changes in environmental (water) quality or conditions and the potential of hard-to-detect pathogenic organisms. An indicator organism provides evidence of the potential presence or absence of a pathogenic organism that survives under similar physical, chemical, and nutrient conditions (EPA Beach Guidance, June 2002).

Maryland's bacteria indicator criterion is a conservative measure, which protects the public from the potential risks associated with swimming and other primary contact recreation activities. A few high values of the indicators may or may not be indicative of impairment. Therefore, it is necessary to evaluate the results from indicator organisms from multiple sampling events over time to adequately quantify water quality conditions.

C.2.1.3.1 Recreational Waters

Step 1 - A steady state geometric mean will be calculated with available data from the previous year where there are at least 5 representative sampling events. The data shall be from samples collected during steady state, dry weather conditions and during the beach season (Memorial Day through Labor Day) to be representative of the critical condition (highest use). If the resulting steady state geometric mean is greater than 35 cfu/100 ml enterococci in marine/estuarine waters, 33 cfu/100 ml enterococci in freshwater or 126 cfu/100 ml *E. coli* in freshwater, the water body will be included for further assessment. If fewer than 5 representative sampling events for an area being assessed are available, data from the previous two years will be evaluated.

Step 2 – Once a preliminary list is assembled, a steady state geometric mean will be calculated with available data from the previous two (2) to five (5) years. The data shall be from samples collected during steady state, dry weather conditions and during the beach season (Memorial Day through Labor Day) to be representative of the critical condition (highest use). If the resulting geometric mean is greater than 35 cfu/100 ml enterococci in marine/estuarine waters, 33 cfu/100 ml enterococci in freshwater or 126 cfu/100 ml *E. coli* in freshwater, the water body will be listed on Category 3 (insufficient information) of the IR as requiring more data.

Category 3 of the Integrated Report
When waters are listed on Category 3 of the IR, a sanitary survey must be conducted to identify potential sources of pathogenic bacteria. If the sanitary survey identifies significant sources of pathogenic bacteria and they are not corrected before the end of the next listing cycle, the waters will be moved to Category 5 of the IR (impaired, TMDL required). If the sanitary survey is conducted and all potential sources of pathogenic bacteria are remedied, the waters will be moved from Category 3 to Category 2 (meeting this particular water quality criterion) of the IR. If a sanitary survey is not conducted before the next listing cycle, the waters will be moved from Category 3 to Category 5.

Category 5 of the Integrated Report
For waters listed under Category 5 of the IR, a sanitary survey must be conducted if it was not conducted before or after the waters were listed on Category 3 of the IR. A water body can be removed from Category 5 of the IR and placed in Category 2 (A) if it meets the steady state geometric mean standard referenced in Step 1 and (B) if a sanitary survey is conducted at the water body and there are no sources of pathogenic bacteria found, or if sources of pathogenic bacteria are remedied.

C.2.1.3.2 Beaches

Beaches are designated as "Beaches" from Memorial Day through Labor Day (Beach Season). During this period, beaches are monitored closely using a tiered approach based on risk to human health since these are places identified as areas where people are likely to swim. High, Medium, and Low priority beaches are monitored weekly, biweekly, and monthly, respectively. Low priority beaches will be re-evaluated regularly to determine if they should be prioritized higher or removed from the list of beaches. This will mean that eventually, all beaches will have more than the necessary number of sampling events performed to adequately assess them.

MDE has delegated the authority for designating beaches, monitoring beaches, and notifying the public regarding beach water quality conditions to local health departments. Thus, local health departments can make administrative decisions to add or remove beaches based on the level of use. They must submit correspondence (form) to MDE when they elect to administratively add or remove beaches from MDE's list of beaches. When a local health department removes a beach from the list of beaches, it also effectively removes the beach from Category 4 or 5 of the IR, if the beach was previously listed as impaired. This is done to avoid having to monitor a water body for contact recreation support when, in reality, the water body is not used for such activity.

MDE's role in this process is to assure that beaches state-wide are managed uniformly. MDE maintains a database of all beaches in Maryland including latitude and longitude coordinates of the endpoints identifying the beach segment, sanitary survey information provided by the local health departments, and monitoring results (all beach monitoring samples are submitted to DHMH for laboratory analysis). These data, along with all other available data will be used to determine which areas are to be listed as impaired.

The listing methodology for all general recreational use also applies to beaches (Section 4.4.3). The single sample maximum criteria applies only to beaches and is to be used for closure and advisory decisions based on short term exceedences of the geometric mean portion of the standard.

C.2.1.4 Discussion

It is critical that the sampling be carried out in a way that is representative of conditions in time and space. Per EPA's *Ambient Water Quality for Bacteria - 1986* , the calculated "densities are for steady state dry weather conditions." A sampling event means samples taken at a beach, or other water body to characterize bacterial concentrations with the number and placement of sampling stations sufficient to characterize conditions in the full extent of the beach area or water body. High spatial and temporal variability suggest that infrequent or moderately elevated bacteriological levels alone do not necessarily represent a human health risk or impairment. The bacteriological standard is descriptive and includes numerical criteria. The intent of the criteria is to allow the 'number' to be judged in conjunction with the sanitary survey that identifies probable sources of bacteria and allows regulators to assess the probability of human health risk. The standard recognizes the inherent variability of the bacterial measurement and recognizes the inadequacies of indicator organisms. The Most Probable Number (MPN) or Colony Forming Units (CFU) test used to determine the level of bacteria is not a direct count but a statistical estimation subject to a high degree of variability.

C.2.2 Toxics Assessment Methodology

Changes to the Toxics Assessment Methodology were relatively minor for this cycle. The most important changes involved slight refinements/clarifications in the fish tissue portion of the methodology. Specific language was added to more clearly define what size of fish and what parts of the fish are to be used in the analysis.

C.2.2.1 Background

The designated uses define the water quality goals of a water body. At a minimum, the Maryland Department of the Environment (MDE) must provide water quality for the protection and propagation of fish, shellfish, and wildlife, and provide for recreation in and on the water, where attainable (CWA Section 101(a)(2)). The MDE is required to adopt water quality criteria that protect designated uses. Such criteria must be based on sound scientific rationale, must contain sufficient parameters to protect the designated uses, and can be expressed in either numeric or narrative form. Narrative criteria are descriptions of the conditions necessary for a water body to attain its designated use, while numeric criteria are concentration values deemed necessary to protect designated uses. Narrative criteria can be used to assess water quality, and also to establish pollutant-specific discharge limits where there are no numeric criteria or where such criteria are not sufficient to protect the designated use.

Although several approaches exist to assess water quality (e.g. numeric criteria, whole effluent toxicity (WET), etc.), few approaches exist to assess sediment quality due to its complexities. Nevertheless, sediments are an integral component of aquatic ecosystems, providing habitat, feeding, spawning, and rearing areas for many aquatic organisms and are, therefore, protected under the narrative criteria. Furthermore, sediment quality can affect whether or not waters are attaining designated uses. Consequently, it is necessary and appropriate to assess and protect sediment quality, as an essential component of the total aquatic environment, to achieve and maintain designated uses. The difficulty lies in implementing the narrative criteria, which is qualitative in nature. To circumvent this obstacle, MDE is implementing an approach to quantitatively interpret narrative criteria statements, and determine water quality standard violations from contaminated sediments.

C.2.2.2 Introduction

Under Section 303(d)(1) of the federal Clean Water Act (CWA), the MDE is required to establish Total Maximum Daily Loads (TMDLs) for those water body segments that do not meet applicable water quality standards and are therefore considered "impaired". To achieve this, MDE is required to consider all existing and readily available water quality data and information, and develop methods to interpret this data for each potential impairing substance (e.g., pH, nutrient, fecal coliform, etc.).

EPA does not provide guidance for interpreting water quality data for the purposes of developing the 303(d) List. However, EPA does provide guidance on making "use support determinations" for the State Water Quality Assessments (305(b) Report) (EPA 1997). In general, MDE adopted the 305(b) guidance for identifying water body segments impaired due to chemical contaminants. Even though the Department will adhere to these methods as closely as possible, there may be instances where our determinations may vary based on scientifically defensible decisions. It is important to note that there may be situations that do not support an impairment determination from chemical contaminants, but rather from another stressor (*e.g.* dissolved oxygen, biocriteria), and would therefore be addressed elsewhere. This document provides the specific methodology used by MDE for identifying water body segments impaired due to *chemical contaminants*.

It is not the intent of this methodology to include waters that do not meet water quality criteria solely due to natural conditions or physical alterations of the waterbody not related to anthropogenic pollutants. Similarly, it is not the intent of this chapter to include waters where designated uses are being met and where water quality criteria exceedances are limited to those parameters for which permitted mixing zones or other moderating provisions (such as site-specific alternative criteria) are in effect. The Department will examine these situations on a case-by-case basis, and evaluate the context under which the exceedance exists. Determination of compliance with water quality criteria may be facilitated through special analyses (e.g. normalization of metals to common reference element to determine anthropogenic influences), or monitoring (e.g. compliance monitoring for mixing zones).

MDE considers all existing readily available chemical, toxicological, and biological data from water column, sediments, and fish tissue in determining if a water body segment should be classified as impaired due to chemical contaminants and listed on Category 5 of the Integrated Report. As a result, MDE has divided the impairment evaluation process into three media categories (Water Column, Sediment, and Fish Tissue). The Department will evaluate the Monitoring Plans, Quality Assurance, and Quality Control programs of data providers, and will use best professional judgment to include/exclude data where documentation does not exist.

C.2.2.3 Water Column

Ambient water column contaminant data are screened against numerical ambient water quality criteria if available. These water quality criteria are utilized because they represent science-based threshold effect values and are an integral part of the Maryland's water quality standards program. These criteria are divided into the following categories that directly relate to Maryland's surface water use designation classification (COMAR 26.08.02):

All surface waters of the State (USE DESIGNATIONS - I, II, III, & IV)

- *Criteria for the protection of aquatic life*
  - *Fresh water (Chronic & Acute)*
  - *Saltwater (Chronic & Acute)*
- *Criteria for the protection of human health from fish tissue consumption (Organism Only)*

Surface waters used for public water supply (USE DESIGNATION - P)

- *Criteria for the protection of human health from fish tissue consumption & drinking water (Water + Organism)*
- *Drinking water only (Maximum Contaminant Levels-MCLs)*

EPA does not provide guidance in interpreting water column data for the purposes of developing the 303(d) list but does for the development of the 305(b) report (Maryland's Water Quality Inventory). The 305(b) guidance states that, with a minimum of 10 samples over a three-year period, the designated use is not supported if >10 percent (i.e. 2 out of 10) of the samples exceed the appropriate benchmark (EPA 1997). MDE had adopted this rule to identify waterbodies impaired by chemical contaminants. In other words, with a minimum of 10 samples over a three-year period, an impairment would exist if >10 percent of the samples exceed the criteria. An appropriate statistical procedure (e.g. confidence interval approach) will be applied if sample size for a segment is deemed adequate. If there are less than 10 samples for a given area, MDE interprets the available data on a case-by-case basis and determines if an impairment exists. In such cases, a number of factors are considered such as:

- *The magnitude of the criteria exceedance for any one contaminant,*
- *The number of criteria exceeded,*
- *Water column bioassay (toxicity) data indicating toxicity to test organisms.*
- *Data Quality*

If it is determined that a potential impairment exists, but there is insufficient data to make an impairment determination, the segment will be placed in Category 3 (Insufficient data), or Category 4 (Impaired/Threatened but TMDL not required due to forthcoming compliance or previous completion of a TMDL). Segment will then be prioritized for additional monitoring. In these instances, the Department will use its best professional judgment based on the available data to make its determination.

In the case that no criteria are available for a particular contaminant or no criteria are exceeded, other impairment indicators (*e.g.,* ambient water column toxicity data) will be evaluated using best professional judgment. During this evaluation process, if toxicity is indicated, a Toxicity Identification Evaluation (TIE) maybe considered to further identify the possible contaminant source(s) causing toxicity. A TIE is a comprehensive approach used in the Whole Effluent Toxicity (WET) Program to identify possible causes of toxicity. When warranted, MDE will also utilize spatial and temporal trend analyses as an additional evaluation tool for making impairment determinations.

As mentioned previously, MDE considers all existing and readily available data, including independent studies conducted by sources external to MDE. These ambient water column data are screened to determine if they are of acceptable quality (i.e., documented methods and an acceptable QA/QC plan). If the data are unacceptable (i.e., poor or no QA/QC) but suggest an exceedance of the appropriate criteria, the segment is targeted for additional monitoring, and evaluated using other approaches.

In many cases, there may be no ambient water quality data (chemical or toxicity) available for an impairment evaluation. In such cases, MDE will apply a weight-of-evidence approach using other data as described below.

C.2.2.4 Sediment

Protecting sediment quality is an important part of restoring and maintaining the biological integrity of our State's waters. Sediment is an integral component of aquatic ecosystems, providing habitat, feeding, spawning, and rearing areas for many aquatic organisms. Sediment also serves as a reservoir for chemical contaminants and therefore a source of chemical contaminants to the water column and organisms. Chemicals that do not easily degrade can accumulate in sediments at much higher levels than those found in the water column.

Contaminated sediments can cause adverse effects in benthic or other sediment-associated organisms through exposure to pore water or direct ingestion of sediments or contaminated food. In addition, natural and human disturbances can release chemical contaminants to the overlying water, where water column organisms can be exposed. Sediment contaminants can reduce or eliminate species of recreational, commercial, or ecological importance, either through direct effects or by affecting the food supply that sustainable populations require. Furthermore, some chemical contaminants can bioaccumulate through the food chain and pose human health risks even when sediment-dwelling organisms are not themselves impacted. This specific pathway will be addressed later in the fish tissue approach.

MDE is using the following comprehensive weight-of-evidence approach in making impairment determinations. This approach, also referred to as the Sediment Quality Triad, consists of three components (Chapman, 1992):

- Ambient Sediment bioassays - to measure toxicity
- *In situ* biological variables - to measure alteration of resident biota (*e.g.,* change in benthic community structure)
- Ambient Sediment chemistry - to measure chemical contamination

These components provide complementary data to each other, that when combined, may provide an efficient tool in determining an impairment. However, each component has its limitations, which necessitates a sound scientific interpretation of the data and best professional judgment on a case-by-case basis. The scientific community, in fact, has previously indicated that sediment assessments are strongest when the three data components are used in combination to balance their relative strengths and weaknesses (Chapman 1992, Long et al. 2000, Anderson et al. 2001, Ingersoll et al. 1997, EPA 1997).

C.2.2.4.1 Ambient Sediment Bioassay Data

Ambient sediment bioassays are a type of biological data, in which test organisms are exposed under controlled conditions to the field collected sediment sample. Although we have confidence in this type of data because of the controlled conditions, it can be inconsistent, especially where toxicity is minimal or subtle. Laboratory artifacts, although generally controlled, can produce false results. For this reason, at least two or more non-microbial tests are required to exhibit toxicity to determine that the potential for adverse effects from contaminated sediment is high.

This type of data is essential in assessing sediment contaminants. If toxicity is exhibited to the tested benthic/epibenthic organisms, it is generally considered indicative of water quality that is incapable of supporting aquatic life, which is in violation of our State's water quality standards. Furthermore, it also suggests that the adverse effects observed in the toxicity tests may be related to chemical contaminants because other non-contaminant related causes (e.g. dissolved oxygen, pH, temperature) are controlled in the laboratory setting. In addition, the information from this data component is quantitative and can be correlated to the toxicity of other sediments or chemicals to the test species. For this reason, the greatest weight is given to toxicity test data among the three data components.

However, a limitation of this data is that it does not identify the causative pollutant, which necessitates the need for sediment chemistry data. The sediment chemistry data provides the best link for establishing an impairment determination resulting from contaminant exposure, which is the basis of this document. Additionally, the laboratory conditions under which bioassays are conducted may not accurately reflect field conditions of exposure to toxic chemicals, and thus introduces uncertainties when extrapolating to population dynamics. This point is important to understand because while attempting to control for non-contaminant related stressors (e.g., dissolved oxygen, pH, temperature), contaminants in the sediments may be rendered toxic to the test organisms that would not be toxic under field conditions, thus providing a false positive result (e.g., sulfide and ammonia in sediments, pH shift for metals).

C.2.2.4.2 Sediment Chemistry Data

Although EPA has been working on sediment quality criteria (SQC) for many years, no final numeric water quality criteria have been published. This is due to the difficulty in determining the fraction of the chemical contaminant that is biologically available to exert its toxic effect on the exposed population and in establishing a criteria derivation process that could be shown to be consistent with other evaluative tools. In fact, the EPA has redirected their efforts to derive equilibrium sediment guidelines (ESGs), rather than criteria, for the following five substances; acenaphthene (EPA 1993a), fluoranthene (EPA 1993b), phenanthrene (EPA 1993c), dieldrin (EPA 1993d), and endrin (EPA 1993e).

In the absence of such guidelines, a set of screening values devised by National Oceanic and Atmospheric Administration (NOAA) has been generally accepted as a screening tool to evaluate the likelihood of adverse effects (Long and Morgan, 1990/NOAA, 1991; Long *et al*., 1995). The Effects Range-Median (ER-M) values are defined as the median (50^{th} percentile) of the distributions of the effects data for a particular contaminant. However, these values should only be used to screen sediments for levels of possible concern, and should not be construed to indicate an adverse effect in the absence of additional corroborative data (Long and MacDonald, 1998). In their development of a classification scheme for the National Sediment Quality Inventory, EPA also recognized the limitations of the ER-Ms by requiring that the bulk sediment chemistry data exceed two separate sediment benchmarks in classifying sediments as Tier I (probable adverse effects to aquatic life and human health) (EPA 1996).

In the absence of EPA ESGs and NOAA ER-M values, sediment quality benchmarks (SQBs) were derived by MDE for non-ionic organic substances using the EPA-recommended equilibrium partitioning approach, (*e.g.***,** alpha-BHC, beta-BHC, lindane, chlordane, chlorpyrifos, heptachlor, etc.) see Table 8. This is also consistent with EPA's National Sediment Quality Inventory. MDE will compare sediment chemistry data according to the described thresholds in the following order:

a) EPA ESGs,
b) NOAA ER-M values,
c) MDE derived SQBs, and
d) Other toxicological sediment benchmarks (*i.e.,* toxicity data)

Both the quality of sediment chemistry data and associated screening thresholds are considered when conducting an evaluation. Once the quality of data has been established, the potential for adverse effect from contaminated sediment is said to be high if either of the following conditions are met:

1. The sediment chemistry data exceeded the EPA ESG, or

2. The sediment chemistry data exceeded the ER-Ms or other screening values by a factor of two[4] for any one contaminant, or

3. The mean ER-M quotient[5] is greater than 0.5 (Long et al. 2000 & Anderson et al. 2001), or

4. The sediment chemistry data exceeded more than 5 ER-Ms[6] (Long et al. 2000 & Anderson et al. 2001).

Furthermore, various environmental conditions in the sediment can have a profound effect on the availability and toxicity of the sediments to aquatic environment (e.g., AVS for metals, organic carbon for organics, etc.). If data on these parameters are available, MDE will use best professional judgment to interpret the effects of these parameters on the sediment chemistry data.

When the measured chemical exceeds the appropriate sediment threshold, any observed adverse effects to the test species may be due to the measured chemical with the likelihood increasing as the chemical concentration increases. When a chemical is measured at a level below the threshold, any observed adverse effects are not likely to be due to the measured chemical. It is recognized, however, that sediments are rarely, if ever contaminated by a single chemical. Therefore, in cases where a chemical is

[4] The factor of two was derived as the geometric mean of the ratios for those substances for which ER-Ms and SQCs were available; acenaphthene (ER-M/SQC ratio=4.6), fluoranthene (ER-M/ESG ratio=0.6), and phenanthrene (ER-M/ESG ratio=1.6). Although it was possible to calculate a ratio for dieldrin (ER-M/ESG ratio=25), it was not considered because the ratio was greater than 5 times the highest of the other three ratios. This condition serves the purpose of confirming the severity of contamination for any one contaminant above background concentrations, and therefore demonstrating the potential for impairing that segment.
[5] An ER-M quotient is calculated as the ambient sample concentration over the ER-M (toxicity weighted average).
[6] Long et al., (2000) showed that there is a much higher probability (>48%) that samples would be toxic in which six or more ERM values are exceeded or in which mean ERM quotients exceed 0.5.

measured at a level below a threshold, the sediment may still cause adverse effects. Such cases could include, for example, contaminated sediments where chemicals not covered by a threshold are creating or contributing to toxicity, or where bioaccumulation or biomagnification up the food chain is a concern (EPA 2000).

The mere exceedence(s) of a sediment threshold, however, does not in itself establish an adverse effect from toxicity, but helps to identify the chemical that might be responsible for any observed adverse effects from toxicity. Given these limitations, MDE does not believe that the exceedence(s) of sediment thresholds are appropriate as sole indicators of use attainment. Instead, we recommend using all three data components as a basis for interpreting narrative criteria and developing pollutant reduction strategies.

C.2.2.4.3 Biological Benthic Assessment Data

In freshwater, MDE currently uses biological community data independently in making an impairment determination. The methodology dealing with biological assessments is addressed elsewhere under the biocriteria framework. This type of data is generally considered a good water quality indicator, because it measures a community (population) response to water quality and integrates through time and cumulative impacts. To determine toxicity for parameters without a water or sediment quality criterion, if these assessment data or other types of assessment data (e.g. Chesapeake Bay restoration goals) do not indicate an alteration (or degradation) of the biological benthic community, the water body may not be considered for an impairment determination despite data from the other components because:

1. It is supportive of aquatic life (at a community level), and thus meets its designated use,
2. The biological assessment component is a more rigorous method of assessing water quality than chemical and bioassay data which may be highly dependent on uncontrollable variables
3. It measures a community response to water quality rather than subjective endpoints from the other components (e.g. ER-M, significant level of toxicity, toxicity to one species)
4. It is consistent with the biological assessments method developed elsewhere

It is more likely to observe an alteration of the biological community where none should be present (false positive) than not to observe alteration of the biological community where one should present (false negative). Anderson et al., 2001 found that laboratory toxicity tests were indicative of benthic impacts in Los Angeles and Long Beach Harbor stations in California. Single and multivariate correlations showed significant positive relationships between amphipod survival in laboratory toxicity tests and measured benthic community structure in field samples. For this reason, MDE would further investigate the chemistry and toxicity data where an alteration of the biological community has been observed. These data would be used to confirm that the community effect is due to exposure to contaminants and to identify the probable contaminant of concern. However, although biological assessment data alone could indicate an impairment, it would not necessarily result in a “toxics” impairment determination. This is because non-contaminant effects (e.g., competition, predation, sediment type, salinity, temperature, recent dredging) may confound interpretation of this data with respect to chemical contamination by toxics (Anderson et al., 2001).

C.2.2.4.4 Weight-of-Evidence Approach (Sediment Quality Triad)

A comprehensive approach using multiple assessment methods helps eliminate false conclusions brought about by relying solely on one method of evaluation. Consequently, MDE would assess sediment quality, and thus an impairment determination, using a weight-of-evidence approach (Winger, et al., 2001). Biological assessments could be used to supplement findings of impaired waters, or as a prioritization tool to determine where additional testing should be performed. These components provide complementary data to each other, which when combined may provide an efficient tool in determining an impairment. However, each component has its limitations, which necessitates a sound scientific interpretation of the data and best professional judgment on a case-by-case basis. Consequently, the individual use of these data components as sole indicators of use attainment is inappropriate. Instead, we recommend using all three data components as a basis for interpreting narrative criteria and developing pollutant reduction strategies.

Sediment chemistry data provide information on contamination, and when used with sediment thresholds or other indicators, also provide insight into potential biological effects. However, they provide little insight on the bioavailability of the contaminant unless data on other mitigating factors (e.g. AVS for metals, organic carbon for organic contaminants) are collected simultaneously. Sediment bioassays are an important component of sediment assessment because they provide direct evidence of sediment toxicity. However, they do not identify the causative pollutant. Additionally, the laboratory conditions under which bioassays are conducted may not accurately reflect field conditions of exposure to toxic chemicals. *In situ* biological studies (such as benthic community composition analyses) are useful because they account for field conditions. However, interpretation with respect to chemical contamination may be confounded by non-contaminant effects. Because each component alone has limitations, the Triad approach uses all three sets of measurements to assess sediment contamination. Table 6 lists possible conclusions that can be drawn from various sets of test results, followed by possible listing decisions.

Table 6: Possible Conclusions Provided by Using the Sediment Quality Triad Approach (Chapman, 1992).

Scenario	Toxicity	Chemistry	Community Alteration	Possible Conclusions	Listing Decision
1	+	+	+	Strong evidence for chemical contaminant-induced degradation.	**List (Category 5)**
2	-	-	-	Strong evidence for absence of chemical contaminant-induced degradation.	**Do not list for toxics**
3	-	+	-	Chemical contaminants are not bioavailable.	**Do not list for toxics**
4	+	-	-	Unmeasured chemical contaminants or conditions may exist that have the potential to cause degradation.	**Do not list for toxics Additional monitoring**
5	-	-	+	Alteration is probably not due to chemical contaminants.	**Do not list for toxics**
6	+	+	-	Chemical contaminants are likely stressing the system.	**List (Category 3) Additional**

Scenario	Toxicity	Chemistry	Community Alteration	Possible Conclusions	Listing Decision
					monitoring
7	+	-	+	Unmeasured chemical contaminants are causing degradation.	**List (Category 3) Additional monitoring**
8	-	+	+	Chemical contaminants are not bioavailable or alteration is not due to contaminants.	**Do not list for toxics Additional monitoring**

"+" Indicates measured difference between test and control or reference conditions.
"–" Indicates no measurable difference between test and control or reference conditions.

As indicated in Table 6, there may be scenarios where sediment chemistry data, sediment bioassays, and benthic community analyses produce conflicting results. In these scenarios, the interpretation becomes more complex, but it does not necessarily indicate that any of the data sets are "wrong", although this possibility should not be ruled out without sound evidence.

Scenario #1: This decision is due to the overwhelming evidence of impairment from all three data components.

Scenario #2: This decision is based on the overwhelming lack of evidence from all three data components.

Scenario #3: Without evidence of toxicity or a degraded biological community, the most likely conclusion is that the chemical contaminants, although elevated, are not bioavailable. If the biological community data shows no adverse effect, the water quality is deemed to be supportive of aquatic life and its designated use is fully supported.

Scenario #4: The basis for this decision is due to the biological community response, and is supported by sediment chemistry. The clear results from the healthy biological community and the lack of chemical concentrations consistent with toxic impacts suggest that the toxicity test results may be anomalous, due to artifacts and not to chemical contaminants. It is possible that there are unmeasured contaminants, but the impact is not sufficient to impair the designated use, as demonstrated by the biological community. However, if the magnitude of the effect observed in the bioassays were severe (e.g. <50 percent survival), the Department may re-evaluate its listing decision. Nevertheless, additional monitoring would be required to confirm the findings of the Triad, and to determine if further actions are required.

Scenario #5: Without evidence of toxicity or elevated chemical concentrations, the most likely conclusion is that the degraded biological community is not due to chemical contaminants. This scenario, however, will be captured by other decision rules.

Scenario #6: Where a good tool exists for evaluating the biological community, it is usually a good indicator of water quality in general and is very sensitive because it integrates impacts from different stressors as well as impacts through time. Practical experience has shown that where "IBI"-type indicators are considered, they indicated impairments not supported by the other data components (i.e., toxicity and chemistry). Therefore, where biological community data of this type exist showing non-degraded biological communities, it will be considered as sufficient evidence of a supported designated use, despite the implications of toxicity and chemistry.

However, where no such data exists or where those indicators are not applicable, the Department will apply its best professional judgment, but will likely determine that the designated use is not supported.

Scenario #7: The basis for this decision is the adverse response observed from the toxicity and biological community data. In this scenario, the water quality is not supportive of aquatic life and is likely due to a chemical contaminant(s) with no applicable chemical threshold or some unmeasured chemical contaminant. This scenario would require listing in Category 3 of the Integrated Report. Additional monitoring would be required to determine the impairing substance(s).

Scenario #8: The basis of this decision is the absence of effect in the bioassays. Although the biological community show adverse effects, the lack of toxicity in the tests are indicative that the adverse effect is not due to chemical contaminants, or that they are not bioavailable. If chemical contaminants were truly affecting the designated use, the impacts of those contaminants should have been observed in the bioassay. These bioassays control for confounding factors such as low D.O., or habitat impacts. This scenario, however, will be captured by other decision rules.

The scientific community has indicated that in order to obtain a reliable and consistent assessment, data from all three components (i.e., toxicity, chemistry, and biological community) are required (Chapman 1992, Ingersoll et al. 1997, Long et al. 1998, Long et al. 2000 and Anderson et al. 2001). However, if data are not available for all three components, the Department will use its discretion but will consider an impairment determination if;

a) the magnitude of any single indicator is overwhelmingly suggesting an impairment determination,
b) a toxicity test shows toxicity and is confirmed either by chemistry data or a degraded biological community, its designated use is not likely supported and an impairment determination will likely be concluded.
c) All other cases are considered to present insufficient evidence of impairment and will be prioritized for additional monitoring as resources become available.

Under the Triad approach, MDE would evaluate appropriate lethal and sublethal sediment bioassays. A finding of toxicity may trigger a sediment chemistry analysis, if one has not already been performed. Sediment chemistry data would be used to support an impairment determination. The chemical analysis should be performed on samples originating from the same composited homogenate used for the bioassays, so that paired data can be obtained (Chapman, 1992). The chemistry data can be compared to sediment thresholds to help determine which chemicals may be causing toxicity. If no sediment thresholds are exceeded, sediment Toxicity Identification Evaluation (TIE) should be performed to determine a chemical cause if possible.

Chemistry data themselves are useful in determining sediment contamination trends, and may also help identify areas that may have the potential for adverse impacts. MDE uses sediment chemistry data, as an effective prioritization tool to help determine which sediments should be targeted for additional monitoring. That is, other factors being equal, sediments with chemical concentrations exceeding sediment thresholds would have higher priority for further testing compared with sediments that meet the sediment thresholds. Chemical concentrations exceeding these thresholds could also indicate the need to monitor and assess water column concentrations for those chemicals. Sediment chemistry alone should not, however, be used to make an impairment determination.

C.2.2.5 Fish Tissue

Section 101(a)(2) of the Clean Water Act established as a national goal the attainment of "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water." This is commonly referred to as the "fishable/swimmable" goal of the Act. Additionally, Section 303(c)(2)(A) requires water quality standards to protect the public health and welfare, enhance the quality of water, and serve the purposes of the Act. Environmental Protection Agency (EPA), along with Maryland Department of the Environment (MDE), interprets these regulations to mean that not only should waters of the State support thriving and diverse fish and shellfish populations, but they should also support fish and shellfish which, when caught, are safe to consume by humans.

Some of the contaminants found in Maryland waters (mainly mercury and PCBs) tend to bioaccumulate to elevated levels in the tissues of gamefish (e.g. largemouth bass) and bottom-feeders (e.g. catfish). When tissue levels of a specific contaminant are elevated to increase the risk of chronic health effects, the State has the responsibility to issue a fish consumption advisory. *Fish consumption advisories* are designed to protect the general as well as sensitive populations (i.e., young children; women who are or may become pregnant). In addition to such advisories, which stop at 4 meals per month, the Department provides *fish consumption recommendations*, which stop at 8 meals per month. These additional recommendations are issued in order to protect the frequent fish consumers.

It has been accepted that when a fish consumption advisory (not a recommendation) is issued for a waterbody, the designated use of that waterbody is not being supported. This usually results in listing a waterbody as impaired for the specific contaminant. To determine if a waterbody is impaired, a median of the contaminant level in the edible portion of the common recreational fish species is compared to the established threshold/criterion. If the threshold/criterion is exceeded, the waterbody's designated use is not met, and the waterbody is listed as impaired. The existing fish tissue criteria are used as the listing thresholds (e.g. methylmercury fish tissue criterion: 300 ppb). For the contaminants that do not have an existing criterion (e.g. PCBs), MDE has defined "fishable" as the ability to consume AT LEAST 4 meals per month of common recreational fish species by a 76 kg individual. In such cases, the fish tissue concentration threshold used for impairment listing is the concentration that results in 4 meals per month advisory (see Contaminant Thresholds Section).

C.2.2.5.1 Data Requirements

Data requirements for listing a waterbody as impaired are similar to the data requirements for issuing a fish consumption advisory. These include:

1. All available data should be reviewed when making impairment decisions.
2. Only data results taken from the part of the fish or shellfish typically consumed will be used for assessment purposes. Maryland publishes advisories based on concentrations found in fillets only; therefore, only data on fillets are to be considered for making impairment decisions. For shellfish, only the soft tissue portion will be considered.
3. The data needs to be collected from the specific waterbody in question.
4. The size of the fish sampled should be within the legal slot limit. If no slot limit exists for a specific species, best professional judgment for a minimum size of a given species will be applied.
5. Minimum data requirement: 5 fish (individual or composite of the same resident species) for a given waterbody. At times, in order to protect more sensitive populations MDE might issue an advisory that is based on an incomplete dataset (less than 5 fish of the same species), existence of such an advisory does not automatically result in an impairment listing. In other words, the minimum data requirement needs to be met in order to list a waterbody as impaired.
6. All fish that comprise a composite sample must be within the same size class, i.e., the smallest fish must be within seventy-five percent of the total length of the largest fish.
7. Species used to determine impairment should be representative of the waterbody. Migratory and transient species may be used if they are the dominant recreational species, but should only be used in conjunction with resident species, especially in the case of tidal rivers of the Chesapeake Bay.
8. To ensure that the impairment is temporally relevant, impairments based on the minimum required samples should be re-sampled prior to TMDL development.

C.2.2.5.2 Contaminant Thresholds

The acceptable contaminant thresholds are based on a risk assessment calculation that incorporates numerous risk parameters such as contaminant concentration, reference dose/cancer slope factor, exposure duration, lifetime span, and for some contaminants, cooking loss.

Table 7: Concentration thresholds/criterion for the contaminants of concern.

Contaminant	Threshold/Criterion	Basis	Group
Mercury[7]	300 ppb (ng/g – wet weight)	EPA/MDE Fish Tissue Human Health Consumption Criteria	76 kg Individual
PCBs	39.0 ppb (ng/g – wet weight)	4 meals/month concentration level	76 kg Individual

[7] Per EPA recommendation, total mercury concentrations, as opposed to methylmercury, will be used in MDE fish consumption risk-calculation. This approach is deemed to be most protective of human health and most cost-effective.

Over time, advances in science may require changes in risk assessment parameters that may increase or decrease the currently used contaminant thresholds, and consequently the levels at which impairment decisions are made. When this happens, waterbodies that were listed as impaired may no longer be considered impaired, or new waterbodies may need to be listed.

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Table 8: Table of Sediment Screening Values.

Contaminant	*Sediment Screening Values (ppb)*		
	EPA SQCs	**NOAA ERMs**	**MDE SQBs**
α-BHC			4,357
Acenaphthylene		640	
Acenaphthene	2,300	500	
Anthracene		1,100	
Arsenic		70,000	
β-BHC			9,406
Benz(a)anthracene		1,600	
Benzo(a)pyrene		1,600	
Cadmium		9,600	
Chlordane		6	51
Chlorpyrifos			4,214
Chromium		370,000	
Chrysene		2,800	
Copper		270,000	
DDT Sum		46	
Dibenz(a,h)anthracene		260	
Dieldrin	200	8	3,616
Endrin	7.6		7,368
Fluoranthene	3,000	5,100	
Fluorene		540	
Heptachlor			1,433
Heptachlor epoxide			1,433
Hexachlorobenzene			6,114,892
Lead		218,000	
Mercury		710	
Methyl naphthalene, 2-		670	
Naphthalene		2,100	
Nickel		51,600	
p,p-DDD (TDE)		20	
p,p-DDE		27	
p,p-DDT		7	
PAHs (High MW)		9,600	
PAHs (Low MW)		3,160	
PAHs (Total)		44,792	
PCB (Polychlorinated Biphenyl)		180	
Phenanthrene	2,400	1,500	
Pyrene		2,600	
Silver		3,700	
Zinc		410,000	

C.2.3 Biological Listing Methodology and the Biological Stressor Identification Process

The latest Biological Listing Methodology is posted at: http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Maryland%20303%20dlist/IR_Listing_Methodologies.asp. This methodology went largely unchanged between the 2008 and 2010 IR cycles with the exception of the incorporation of the biological stressor identification analysis (BSID) and the changing of the impairment 'cause' from "Combination Benthic/Fishes Bioassessments" to "Cause Unknown". The impairment cause was changed to better reflect the actual cause/pollutant impairing the watershed. Those watersheds that do not have the stressor identification process completed will remain as "Cause Unknown" until stressors are identified. As a result, a watershed may be listed in Category 5 (impaired) with an unknown cause of impairment. However, it will be shown for such a listing, that the indicator of impairment was benthic and fish IBIs.

The 2008 Maryland Integrated Report contained seventy Category 5 and thirty-nine Category 3 listings for biological/cause unknown impairments. The current Category 5 listings for biological/cause unknown impairments represent degraded biological conditions for which the stressors, or causes, are unknown. The MDE Science Services Administration has developed a biological stressor identification (BSID) analysis that uses a case-control, risk-based approach to systematically and objectively determine the predominant cause of reduced biological conditions, which will enable the Department to update current Integrated Report listings. The BSID analysis and process can be reviewed in more detail in the report entitled *Maryland Biological Stressor Identification Process (http://www.mde.state.md.us/assets/document/BSID_Methodology_Final_03-12-09.pdf).*

In effect, the BSID process links potential causes/stressors identified by the analysis with general causal scenarios and concludes with a review for ecological plausibility by State scientists. Once the BSID process is completed, one or several stressors (pollutants) may be identified as probable causes of the poor biological conditions within the Maryland 8-digit watershed.[8] MDE will use identified stressor(s) (e.g., sediment, chlorides, and nutrients) to support current pollutant listings, add new pollutant listings, and/or change the category listing for a pollutant on the Integrated Report. As a result, when stressor(s)/pollutant(s) are identified for a biologically-impaired watershed, the biological listing will be removed from Category 5 and will be replaced by the appropriate pollutant listing(s) (in Category 5). An example of this is illustrated below.

Table 9: Example of a 2008 Biological Listing

AU-ID	Basin Name	Category	Cause	Indicator
MD-02130906	Patapsco Lower North Branch	5	Combination Benthic/Fishes Bioassessments	N/A

[8] These probable causes each have an associated 'percent attributable risk' value which is essentially an estimate of what proportion of the watershed impairment can be attributed to the specified pollutant/cause.

Table 10: 2010 Listings Resulting from the BSID Analysis. These three listings essentially take the place of the previous biological listing (combination benthic/fishes bioassessments) for MD-02130906.

Cycle First Listed	AU-ID	Basin Name	Category	Cause	Indicator	Notes
1996	MD-02130906	Patapsco Lower North Branch	5	Total Suspended Solids (TSS)	Fish and Benthic IBIs	This pollutant listing existed previous to the BSID analysis. The BSID confirmed that this pollutant was impairing the watershed.
2010	MD-02130906	Patapsco Lower North Branch	5	Chlorides	Fish and Benthic IBIs	Newly identified stressor/cause
2010	MD-02130906	Patapsco Lower North Branch	5	Sulfates	Fish and Benthic IBIs	Newly identified stressor/cause

C.3 Assessment Results

There are 38 additions to the list of Category 5 waters in 2010. Fourteen of these new Category 5 waterbody-pollutant combinations resulted from MDE's Biostressor Analyses. Of these 14 new 'biostressor' listings, eight are for chlorides, five are for sulfates, and one is listed for ammonia. There are seven new total suspended solids listings that are the result of Chesapeake Bay submerged aquatic vegetation assessments. In addition, there are six fecal coliform listings in shellfish harvesting harvesting waters, 5 Chesapeake Bay segment listings as a result of bioassessments, two new listings for mercury levels in fish tissue, two listings for zinc, one listing for lead, and one listing for enterococcus in the Baltimore Harbor area. Table 11 below provides detailed information regarding these new listings.

Table 11: New Impairment (Category 5 only) listings for 2010.

AU_ID	Basin_Name	Water_Type_Detail	Designated_Use	Cause
MD-02130904	Jones Falls	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Chlorides
MD-02130904	Jones Falls	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Sulfates
MD-02130905	Gwynns Falls	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Chlorides
MD-02130906	Patapsco River Lower North Branch	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Chlorides
MD-02130906	Patapsco River Lower North Branch	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Sulfates
MD-021311070941-Rocky_Gorge_Reservoir	Rocky Gorge Dam	Impoundments	Fishing	Mercury in Fish Tissue
MD-02140207	Cabin John Creek	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Chlorides
MD-02140207	Cabin John Creek	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Sulfates
MD-02140208	Seneca Creek	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Chlorides
MD-02140208	Seneca Creek	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Ammonia (Total)
MD-02141002	Evitts Creek	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Chlorides
MD-02141002	Evitts Creek	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Sulfates
MD-02141003	Wills Creek	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Chlorides
MD-02141003	Wills Creek	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Sulfates
MD-05020201-Youghiogheny_River_Lake	Youghiogheny River	Impoundments	Fishing	Mercury in Fish Tissue
MD-05020204	Casselman River	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Chlorides
MD-CB2OH	CB2OH - Northern Chesapeake Bay Oligohaline	Chesapeake Bay segment	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)

AU_ID	Basin_Name	Water_Type_Detail	Designated_Use	Cause
MD-CB5MH-ST_JEROMES_CREEK	CB5MH - Chesapeake Bay 5 Mesohaline	Tidal Shellfish Area	Shellfishing	Fecal Coliform
MD-CHOMH1	CHOMH1 - Choptank River Mesohaline mouth 1	Chesapeake Bay segment	Aquatic Life and Wildlife	Cause Unknown/Estuarine Bioassessments
MD-CHOMH2	CHOMH2 - Choptank River Mesohaline mouth 2	Chesapeake Bay segment	Aquatic Life and Wildlife	Cause Unknown/Estuarine Bioassessments
MD-CHOMH2-LOWER_CHOPTANK_RIVER_MAINSTEM2	CHOMH2 - Choptank River Mesohaline mouth 2	Tidal Shellfish Area	Shellfishing	Fecal Coliform
MD-CHSOH	CHSOH - Middle Chester River Oligohaline	Chesapeake Bay segment	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)
MD-EASMH-Hunting_Creek	Miles River	Tidal Shellfish Area	Shellfishing	Fecal Coliform
MD-ELKOH	ELKOH - Elk River Oligohaline	Chesapeake Bay segment	Aquatic Life and Wildlife	Cause Unknown/Estuarine Bioassessments
MD-GUNOH	GUNOH - Gunpowder River Oligohaline	Chesapeake Bay segment	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)
MD-PATMH-MiddleBranch_NorthwestHarbor	PATMH - Patapsco River Mesohaline	Tidal subsegment	Water Contact Recreation	Enterococcus
MD-PATMH-BEAR_CREEK	PATMH - Patapsco River Mesohaline	Tidal subsegment	Aquatic Life and Wildlife	Zinc - sediments
MD-PATMH-NORTHWEST_BRANCH	PATMH - Patapsco River Mesohaline	Tidal subsegment	Aquatic Life and Wildlife	Zinc - sediments
MD-PATMH-NORTHWEST_BRANCH	PATMH - Patapsco River Mesohaline	Tidal subsegment	Aquatic Life and Wildlife	Lead - sediments
MD-PAXMH-BATTLE_CREEK	PAXMH - Lower Patuxent River Mesohaline	Tidal Shellfish Area	Shellfishing	Fecal Coliform
MD-PAXMH-WELLS_COVE	PAXMH - Lower Patuxent River Mesohaline	Tidal Shellfish Area	Shellfishing	Fecal Coliform
MD-PAXOH	PAXOH - Middle Patuxent River Oligohaline	Chesapeake Bay segment	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)

AU_ID	Basin_Name	Water_Type_Detail	Designated_Use	Cause
MD-PAXOH	PAXOH - Middle Patuxent River Oligohaline	Chesapeake Bay segment	Aquatic Life and Wildlife	Cause Unknown/Estuarine Bioassessments
MD-PAXTF	PAXTF - Upper Patuxent River Tidal Fresh	Chesapeake Bay segment	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)
MD-POTOH	POTOH - Lower Potomac River Oligohaline	Chesapeake Bay segment	Aquatic Life and Wildlife	Cause Unknown/Estuarine Bioassessments
MD-SASOH	SASOH - Sassafras River Oligohaline	Chesapeake Bay segment	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)
MD-SEVMH	SEVMH - Severn River Mesohaline	Chesapeake Bay segment	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)
MD-WICMH-WICOMICO_RIVER_2	WICMH - Wicomico River Mesohaline	Tidal Shellfish Area	Shellfishing	Fecal Coliform

Based on Maryland's listing methodology for combined sewer overflows (CSO) and sanitary sewer overflows (SSO), if any water body segment has received more than two spills greater than 30,000 gallons over a 12-month period that water body will be considered impaired. This is applied only in the absence of bacterial monitoring data; if such monitoring data are available, the decision methodology for bacteria will apply. Table 12 and 13 describe the pertinent overflow events. Though not all of these bacterial impairments are captured in the IR database, these tables serve as record of their impairment.

Table 12: Summary of combined sewer overflows that occurred 3 or more times over the past 5 years.

Receiving Waters	NPDES Permit	# Exceedences (≥30,000 gallons) from 2005 thru 2009	City/County	Consent Decree	IR Status for Bacteria
Evitts Creek	MD0021598	22	City of Cumberland/Allegany County	✓	Not listed
North Branch Potomac River	MD0021598	410	City of Cumberland/Allegany County	✓	Not listed
Wills Creek	MD0021598	150	City of Cumberland/Allegany	✓	Listed and TMDL complete

Receiving Waters	NPDES Permit	# Exceedences (≥30,000 gallons) from 2005 thru 2009	City/County	Consent Decree	IR Status for Bacteria
			County		
Choptank River	MD0021636	273	City of Cambridge/Dorchester	✓	Multiple shellfish areas listed with TMDLs complete
Braddock Run	MD0067547	123	La Vale/Allegany	✓	Listed – tributary to Wills Creek
George's Creek	MD0067384	34	Westernport/Allegany	✓	Listed and TMDL complete
George's Creek	MD0067407	119	Dept. Public Works/Allegany	✓	Listed and TMDL complete
George's Creek	MD0067423	44	Frostburg/Allegany	✓	Listed and TMDL complete
Jenning's Run	MD0067423	8	Frostburg/Allegany	✓	Listed under Wills Cr. and TMDL complete

Table 13: Summary of sanitary sewer overflows that occurred 3 or more times over the past 5 years resulting from the same facility or occurring within the same jurisdiction.

Receiving Waters	Owner of Collection System	# Exceedences (≥30,000 gallons) from 2005 thru 2009	City/County	Consent Decree	IR Status for Bacteria
Anacostia River	Washington Suburban Sanitation Commission	6	Prince George's County	✓	Listed and TMDL complete
Broad Creek	Washington Suburban Sanitation Commission	17	Prince George's County	✓	Not listed
C&D Canal	Chesapeake City	4	Cecil County/Chesapeake City		Not listed
Chesapeake Bay	Calvert County DPW	7	Calvert County/Chesapeake Beach		Not listed

Receiving Waters	Owner of Collection System	# Exceedences (≥30,000 gallons) from 2005 thru 2009	City/County	Consent Decree	IR Status for Bacteria
Evitts Creek	Allegany County	8	City of Cumberland/Allegany County	✓	Not listed
Falls Creek	Washington County	3	Washington County		Listed and TMDL complete
Flat Run	City of Emmitsburg WWTP	6	City of Emmitsburg/Frederick County	✓	Tributary to Upper Monocacy, which has TMDL
George's Creek	Allegany County	29	Allegany County	✓	Listed and TMDL complete
Gwynns Falls	Baltimore City	77	Baltimore City	✓	Listed and TMDL complete
Herring Run	Baltimore City	26	Baltimore City	✓	Listed and TMDL complete
Jennings Run	Allegany County	37	Allegany County	✓	Listed under Wills Cr. and TMDL complete
Jones Falls	Baltimore City	17	Baltimore City	✓	Listed and TMDL complete
Maiden Choice Creek	Baltimore County	41	Baltimore County	✓	Listed and TMDL Complete
Moores Run	Baltimore County	4	Baltimore City	✓	Tributary to Back River
North Branch Potomac River	Allegany County (Cresaptown Pumping Station)	43	Allegany County	✓	Not listed
Northeast Creek	Baltimore County	16	Baltimore County	✓	Not listed
Pea Vine Run	Allegany County (Mill Run Pump Station)	25	City of Cumberland/Allegany County	✓	Not listed
Piscataway Creek	Washington Suburban	5	Prince George' County	✓	Listed and TMDL

Receiving Waters	Owner of Collection System	# Exceedences (≥30,000 gallons) from 2005 thru 2009	City/County	Consent Decree	IR Status for Bacteria
	Sanitation Commission				complete
Port Tobacco River	Town of La Plata	7	Town of La Plata/Charles County	✓	Listed on Category 5
Swan Creek	City of Aberdeen	6	City of Aberdeen/Harford County		Not listed
Warrior Run	Allegany County	21	Allegany County	✓	Listed in Category 3
West Branch	Baltimore County	6	Baltimore County	✓	Listed and TMDL complete
Western Branch	Washington Suburban Sanitation Commission	3	Prince George's County	✓	Not listed
Wills Creek	Allegany County	27	Allegany County	✓	Listed and TMDL complete

There were a total of 37 delistings during this cycle, primarily on the basis of new assessments/data or water quality analyses (WQAs), Table 14. Water quality analyses are completed when State scientists collect detailed information for a listed water body in anticipation of a TMDL and find that the water body is not impaired. New assessments are simply a reanalysis of more recent water quality data collected by ongoing monitoring and assessment programs.

Of the delistings that were not based on WQAs or reassessments, three delistings occurred because of changes in beach designation. Local health departments originally characterized these areas as beaches, but after follow-up monitoring discerned that swimming was not occurring at these locations. These areas are no longer recognized by the counties as public bathing beaches and, as a result, are no longer monitored for primary contact recreation. Another listing, the Middle Chester River PCB listing, has also been removed from Category 5 after an error was found in the data used for assessment. In this case, Lower Chester River data was inadvertently used for the Middle Chester River assessment. The Choptank River PCB assessment was also erroneously listed as impaired, having been based on fish ovary concentrations, something that does not satisfy the fish tissue listing methodology. Lastly, the PCB listing for Jennings Randolph Lake was incorrectly computed and after recalculation is shown to be supporting the fishing designated use.

Table 14: New Delistings for 2010 (removed from Category 5). This list does not include waterbody-pollutant combinations for which a TMDL was established.

ID	AU ID	Basin Name	BasinCode	Water Type	Designated Use	Cause	Summary Rationale for Delisting of Segment/Pollutant Combinations*
147	MD-02130704	Bynum Run	02130704	RIVER	Fishing	PCB in Fish Tissue	1
164	MD-02130804	Little Gunpowder Falls	02130804	RIVER	Aquatic Life and Wildlife	Phosphorus (Total)	1
216	MD-02130904	Jones Falls	02130904	RIVER	Aquatic Life and Wildlife	Combination Benthic/Fishes Bioassessments	5
175	MD-02130904	Jones Falls	02130904	RIVER	Aquatic Life and Wildlife	Phosphorus (Total)	1
220	MD-02130905	Gwynns Falls	02130905	RIVER	Aquatic Life and Wildlife	Combination Benthic/Fishes Bioassessments	5
181	MD-02130905	Gwynns Falls	02130905	RIVER	Aquatic Life and Wildlife	Phosphorus (Total)	1
274	MD-02130906	Patapsco Lower North Branch	02130906	RIVER	Aquatic Life and Wildlife	Combination Benthic/Fishes Bioassessments	5
272	MD-02130906	Patapsco Lower North Branch	02130906	RIVER	Aquatic Life and Wildlife	Phosphorus (Total)	1
765	MD-02131105	Little Patuxent River	02131105	RIVER	Aquatic Life and Wildlife	Cadmium	1
217	MD-02131105	Little Patuxent River	02131105	RIVER	Aquatic Life and Wildlife	Phosphorus (Total)	1
683	MD-02131106	Middle Patuxent River	02131106	RIVER	Aquatic Life and Wildlife	Zinc	1
1286	MD-02140207	Cabin John Creek	02140207	RIVER	Aquatic Life and Wildlife	Combination Benthic/Fishes Bioassessments	5
1219	MD-02140207	Cabin John Creek	02140207	RIVER	Aquatic Life and Wildlife	Phosphorus (Total)	1
577	MD-02140208	Seneca Creek	02140208	RIVER	Aquatic Life and Wildlife	Combination Benthic/Fishes Bioassessments	5
801	MD-02140208	Seneca Creek	02140208	RIVER	Aquatic Life and Wildlife	Phosphorus (Total)	1
437	MD-02140501	Potomac River WA County	02140501	IMPOUND MENT	Fishing	Mercury in Fish Tissue	1
168	MD-02141001	Lower North Branch Potomac River	02141001	RIVER	Fishing	Mercury in Fish Tissue	1

ID	AU ID	Basin Name	BasinCode	Water Type	Designated Use	Cause	Summary Rationale for Delisting of Segment/Pollutant Combinations*
397	MD-02141002	Evitts Creek	02141002	RIVER	Aquatic Life and Wildlife	Combination Benthic/Fishes Bioassessments	5
303	MD-02141002	Evitts Creek	02141002	RIVER	Aquatic Life and Wildlife	Phosphorus (Total)	1
478	MD-02141003	Wills Creek	02141003	RIVER	Aquatic Life and Wildlife	Combination Benthic/Fishes Bioassessments	5
308	MD-02141003	Wills Creek	02141003	RIVER	Aquatic Life and Wildlife	Phosphorus (Total)	1
428	MD-02141005-JENNINGS_RANDOLPH_RESERVOIR	Upper North Branch Potomac River	02141005	IMPOUNDMENT	Fishing	PCB in Fish Tissue	2
431	MD-05020204	Casselman River	05020204	RIVER	Aquatic Life and Wildlife	Combination Benthic/Fishes Bioassessments	5
2034	MD-CB1TF	CB1TF – Chesapeake Bay 1 Tidal Fresh	02139996, 02120201, 02130609, 02130706, 02130705,	ESTUARY	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)	1
4	MD-CB1TF-02120201	Tidal L Susquehanna River	02120201	ESTUARY	Aquatic Life and Wildlife	Cadmium	1
1710	MD-CB3MH-Bay_Country_Campground_Beach	Lower Chester River	02130505	ESTUARY	Water Contact Sports	Enterococcus	2
1713	MD-CB3MH-Rockhall_Beach	Lower Chester River	02130505	ESTUARY	Water Contact Sports	Enterococcus	1, 2
2027	MD-CHOOH-02130404	Upper Choptank River	02130404	ESTUARY	Fishing	PCB in Fish Tissue	2
769	MD-CHSOH-02130509	Middle Chester River	02130509	ESTUARY	Fishing	PCB in Fish Tissue	2
116	MD-ELKOH	ELKOH – Elk River Oligohaline	02130601, 02130603, 02130605	ESTUARY	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)	1
1718	MD-NANTF-CHERRY_BEACH	Nanticoke River	02130305	ESTUARY	Water Contact Sports	Enterococcus	1, 2

ID	AU ID	Basin Name	BasinCode	Water Type	Designated Use	Cause	Summary Rationale for Delisting of Segment/Pollutant Combinations*
1727	MD-NORTF	NORTF - Northeast River Tidal Fresh	02130608	ESTUARY	Aquatic Life and Wildlife	Lead	1
183	MD-PATMH-Bodkin_Creek	Bodkin Creek	02130902	ESTUARY	Aquatic Life and Wildlife	Lead	1
163	MD-PATMH-Bodkin_Creek	Bodkin Creek	02130902	ESTUARY	Aquatic Life and Wildlife	Zinc	1
1313	MD-POTTF	POTTF – Potomac River Tidal Fresh	02140102, 02140201, 02140202, 02140204	ESTUARY	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)	1
1362	MD-WICMH	WICMH – Wicomico River Mesohaline	02130301, 02130302, 02130303	ESTUARY	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)	1
1719	MD-WICMH-SCHUMAKER_POND_BEACH	Lower Wicomico River	02130301	ESTUARY	Water Contact Sports	Enterococcus	2

Table 15: Key for the last column in Table 14.

*Summary Rationale for Delisting of Segment/Pollutant Combinations	Explanation
1	State determines water quality standard is being met
2	Flaws in original listing
3	Other point source or nonpoint source controls are expected to meet water quality standards
4	Impairment due to non-pollutant
5	Original listing was based on a bioassessment, specific pollutants are now identified in place of biological listing

C.3.1 Total Maximum Daily Loads

Maryland continues to make progress completing TMDLs for waters listed as impaired on Category 5 if the IR. Total Maximum Daily Loads determine the sources of pollution for an identified impairment as well as the estimated reductions necessary to bring the waterbody back into compliance with Water Quality Standards. Table 16 lists the waterbodies with TMDLs completed since the last IR cycle while Table 17 and 18 lists those waters for which TMDLs will likely be initiated over the next two years.

Table 16: Recently Approved TMDLs in Category 4a of the IR. This does not include TMDLs completed for only a portion of a Bay segment. TMDLs completed for parts of Bay segments are identified in the notes for Category 4a listings (see Section F.4). This also does not include TMDLs that were captured on the 2008 IR.

Cycle First Listed	Assessment Unit ID	Basin /Subasin Name	Water Type Detail	Designated Use	Cause	Sources
1998	MD-NANMH-NANTICOKE_RIVER	NANMH - Lower Nanticoke River Mesohaline	Tidal Shellfish Area	Shellfishing	Fecal Coliform	Livestock (Grazing or Feeding Operations)
1996	MD-02130204	Dividing Creek	River Mainstem	Water Contact Sports	Fecal Coliform	Source Unknown
1998	MD-021311080966-Triadelphia_Reservoir	Brighton Dam	Impoundments	Aquatic Life and Wildlife	Sedimentation/siltation	Source Unknown
2002	MD-02140504	Conococheague Creek	River Mainstem	Water Contact Sports	Fecal Coliform	Source Unknown
1998	MD-021311080966-Triadelphia_Reservoir	Brighton Dam	Impoundments	Aquatic Life and Wildlife	Phosphorus (Total)	Source Unknown
1996	MD-WICMH-WICOMICO_RIVER	WICMH - Wicomico River Mesohaline	Tidal Shellfish Area	Shellfishing	Fecal Coliform	Natural Sources
1998	MD-021311070941-Rocky_Gorge_Reservoir	Rocky Gorge Dam	Impoundments	Aquatic Life and Wildlife	Phosphorus (Total)	Source Unknown
1996	MD-02140502	Antietam Creek	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Total Suspended Solids (TSS)	Source Unknown
1996	MD-ANATF	ANATF - Anacostia River Tidal Fresh	Chesapeake Bay segment	Seasonal Migratory Fish Spawning and Nursery Subcategory.	Nitrogen (Total)	Discharges from Municipal Separate Storm Sewer Systems (MS4)
1996	MD-ANATF	ANATF - Anacostia River Tidal Fresh	Chesapeake Bay segment	Open-Water Fish and Shellfish Subcategory	Nitrogen (Total)	Discharges from Municipal Separate Storm Sewer Systems (MS4)
1996	MD-ANATF	ANATF - Anacostia River Tidal Fresh	Chesapeake Bay segment	Open-Water Fish and Shellfish Subcategory	Phosphorus (Total)	Discharges from Municipal Separate Storm Sewer Systems (MS4)

Cycle First Listed	Assessment Unit ID	Basin /Subasin Name	Water Type Detail	Designated Use	Cause	Sources
1996	MD-ANATF	ANATF - Anacostia River Tidal Fresh	Chesapeake Bay segment	Seasonal Migratory Fish Spawning and Nursery Subcategory.	Phosphorus (Total)	Discharges from Municipal Separate Storm Sewer Systems (MS4)
1996	MD-02140302	Lower Monocacy River	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Total Suspended Solids (TSS)	Source Unknown
1996	MD-CHSOH-Chester_River	Southeast Creek	Tidal Shellfish Area	Shellfishing	Fecal Coliform	Livestock (Grazing or Feeding Operations)
1996	MD-02140205	Anacostia River	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Phosphorus (Total)	Discharges from Municipal Separate Storm Sewer Systems (MS4)
1996	MD-02140205	Anacostia River	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	BOD, Biochemical oxygen demand	Discharges from Municipal Separate Storm Sewer Systems (MS4)
1996	MD-02140205	Anacostia River	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Nitrogen (Total)	Discharges from Municipal Separate Storm Sewer Systems (MS4)
1996	MD-02140304	Double Pipe Creek	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Total Suspended Solids (TSS)	Agriculture
1996	MD-CHSOH-Chester_River	Middle Chester River	Tidal Shellfish Area	Shellfishing	Fecal Coliform	Livestock (Grazing or Feeding Operations)
1996	MD-ANATF	ANATF - Anacostia River Tidal Fresh	Chesapeake Bay segment	Open-Water Fish and Shellfish Subcategory	BOD, Biochemical oxygen demand	Discharges from Municipal Separate Storm Sewer Systems (MS4)
1996	MD-ANATF	ANATF - Anacostia River Tidal Fresh	Chesapeake Bay segment	Seasonal Migratory Fish Spawning and Nursery Subcategory.	BOD, Biochemical oxygen demand	Discharges from Municipal Separate Storm Sewer Systems (MS4)
1996	MD-CHSOH-Chester_River	Lower Chester River	Tidal Shellfish Area	Shellfishing	Fecal Coliform	Livestock (Grazing or Feeding Operations)
1996	MD-02140504	Conococheague Creek	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Total Suspended Solids (TSS)	Source Unknown
2002	MD-02130907	Liberty Reservoir	River Mainstem	Water Contact Sports	Fecal Coliform	Source Unknown
2002	MD-05020202	Little Youghiogheny River	River Mainstem	Water Contact Sports	Fecal Coliform	Source Unknown
2002	MD-02140303	Upper Monocacy River	River Mainstem	Water Contact Sports	Fecal Coliform	Source Unknown
2008	MD-02130805	Loch Raven Reservoir	River Mainstem	Water Contact Sports	Fecal Coliform	Source Unknown

Cycle First Listed	Assessment Unit ID	Basin /Subasin Name	Water Type Detail	Designated Use	Cause	Sources
2002	MD-02140502	Antietam Creek	River Mainstem	Water Contact Sports	Fecal Coliform	Source Unknown
2008	MD-05020201-CHERRY_CREEK	Youghiogheny River	Non-tidal Segment(s)	Water Contact Sports	Fecal Coliform	Source Unknown
2002	MD-02130806	Prettyboy Reservoir	River Mainstem	Water Contact Sports	Fecal Coliform	Source Unknown
1998	MD-PAXMH-MILL_CREEK	PAXMH - Lower Patuxent River Mesohaline	Tidal Shellfish Area	Shellfishing	Fecal Coliform	Non-Point Source
1996	MD-02140305	Catoctin Creek	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Total Suspended Solids (TSS)	Crop Production (Crop Land or Dry Land)
2002	MD-02140304	Double Pipe Creek	River Mainstem	Water Contact Sports	Fecal Coliform	Source Unknown
2008	MD-02130906	Patapsco River Lower North Branch	River Mainstem	Water Contact Sports	Fecal Coliform	Source Unknown
2002	MD-02140302	Lower Monocacy River	River Mainstem	Water Contact Sports	Fecal Coliform	Source Unknown
1996	MD-02140303	Upper Monocacy River	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Total Suspended Solids (TSS)	Agriculture
1996	MD-02130905	Gwynns Falls	Non-tidal 8-digit watershed	Aquatic Life and Wildlife	Total Suspended Solids (TSS)	Urban Runoff/Storm Sewers
1998	MD-POCMH-OH-02130201	Pocomoke Sound	Tidal Shellfish Area	Shellfishing	Fecal Coliform	Manure Runoff
1996	MD-POCOH-02130202	Lower Pocomoke River	Tidal Shellfish Area	Shellfishing	Fecal Coliform	Manure Runoff

Table 17: Anticipated Submissions to Address Category 5 Integrated Report Listings FFY 2010.

Listing Year	Listed Waterbody	Cause	1998 MOU Count	2008 Integrated Report Count
1996	Assawoman Bay	Nutrients	1	2
1996	Assawoman Bay, Greys Creek	Nutrients		2
1996	Isle of Wight Bay (open water)	Nutrients	1	2
1996	Isle of Wight Bay, Manklin Creek	Nutrients		2
1996	Sinepuxent Bay	Nutrients	1	2
1996	Newport Bay, Marshall Creek	Nutrients		2
1996	Chincoteague Bay	Nutrients	1	2
1996	Bynum Run	Sediments	1	1
2006	Fishing Bay (Tedious Creek)	Bacteria		1
1996	Little Patuxent River (Little Patuxent River/Dorsey Run E of Rt. 1)	Sediments	1	1
1996	Middle Patuxent River	Sediments	1	1
1996	Patuxent River/Rocky Gorge Dam to Rt. 214	Sediments	1	1
1996	Rock Creek	Sediments	1	1
1996	Seneca Creek	Sediments	1	1
2002	Anacostia River (Non-tidal NEBF & Non-tidal NWBF)	PCBs – water column		1
2006	Anacostia River, Non-tidal and Tidal Fresh	Trash/Debris		2
1996	Cabin John Creek	Sediments	1	1
2006	Monie Bay	Shellfish Area Bacteria		2
1998	Marley Creek and Furnace Creek (Baltimore Harbor)	Recreational Area Bacteria	2	2
2008	Patuxent River Upper	Non-tidal Bacteria		1
2004	Cash Lake	Mercury		1
2004	Millington Wildlife Area, Impoundments	Mercury		1
Total for 1998 MOU			13	
Total Addressed from 2008 Integrated Report				32

Table 18: Anticipated Submissions to Address Category 5 Integrated Report Listings FFY 2011.

Listing Year	Listed Waterbody	Cause	1998 MOU Count	2008 Integrated Report Count
1996	Lower Monocacy River	Nutrients	1	1
1996	Upper Monocacy River	Nutrients	1	1
1996	Double Pipe Creek	Nutrients	1	1
1996	Antietam Creek	Nutrients	1	1
1996	Catoctin Creek	Nutrients	1	1
1996	Liberty Reservoir	Nutrients and Sediments	2	2
1998	Back River	PCBs - sediment	1	1
1998	Baltimore Harbor	PCBs - fish tissue and sediment	1	1
1998	Bear Creek	PCBs - fish tissue and sediment	1	1
1998	Curtis Bay/Curtis Creek	Zinc	1	1
1998	Middle Harbor	Zinc	1	1
1996	Potomac River/Washington County	Nutrients	1	1
2002	Anacostia River (Non-tidal)	Heptachlor Epoxide		1
1996	Rock Creek	Nutrients	1	1
1996	Deep Creek (Non-tidal)	Nutrients	1	1
1996	Lower North Branch of Potomac River	Nutrients and Sediments	2	2
1998	Deep Creek Lake, Impoundment	Nutrients	1	1
1996	Lower Gunpowder Falls	Nutrients	1	1
1996	Potomac River/Monocacy River to Chain Bridge	Nutrients and Sediments	2	2
1996	Potomac River/Washington County	Sediments	1	1
1996	Susquehanna River/Conowingo Dam	Nutrients and Sediments	2	2
1996	Upper Pocomoke River	Sediments	1	1
1996	Bodkin Creek	Copper	1	1
1996	Aberdeen Proving Ground	Toxics	1	1
1996	Upper Pocomoke River	Nutrients	1	1
1996	Atkisson Reservoir	Nutrients and Sediments	2	2
1996	Patapsco River Mesohaline	Nutrients		2
1998	Curtis Bay/Creek	PCBs - fish tissue and sediment	1	1
Total for 1998 MOU			**31**	
Total Addressed from 2008 Integrated Report				**34**
Grand Total for FFY 2010 and 2011			**44**	**66**

C.3.2 Assessment Summary

The summary tables provided in this section are submitted for consistency with EPA guidance and to help EPA fulfill its mandate to provide nationwide assessment results. To some degree, these tables can be used for tracking statewide progress with respect to water quality. However, one should be cautious in placing too much emphasis on these numbers. In many cases, the water body size reported in Category 1 or 2 (unimpaired status) can increase or decrease cycle to cycle simply because assessments were corrected or made with better data and instrumentation. Other useful water quality tracking information can be found at Maryland's BayStat Program website (http://www.baystat.maryland.gov/) which provides information not only for water quality tracking but also information and progress related to water quality implementation.

Table 19: Size of Surface Waters Assigned to Reporting Categories. Maryland utilizes a multi-category report structure for the IR which can potentially report a single water body in multiple listing categories. For the purposes of this table, water body sizes were not double-counted as they were in 2008. If a water body was listed in Category 5 for one pollutant and Category 2 for another, the water body size was assigned to Category 5 to represent a worst-case scenario.

Waterbody Type	Category							Total in State	Total Assessed
	1	2	3	4a	4b	4c	5		
River/stream miles	0	3,490.73	554.79	614.98	0	0	5,279.83	10,820.00	9,940.33
Lake/pond acres	0	2,225.83	302.00	6,130.23	0	0	11,729.40	21,168.00	20,387.46
Estuarine square miles	0	4.18	38.35	36.38	0	0	2,377.04	2,522.40	2,455.96
Ocean square miles	0	92.81	0	0	0	0	0	92.81	92.81
Freshwater wetland	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tidal wetland acres	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

C.3.3 Split Water Body Segments

The State has split water bodies or assessment units where data and information are supportive. For example, a listing originally may have been made for a large watershed and more detailed information is now available demonstrating that the watershed is comprised of smaller, hydrologically distinct subwatersheds. In these cases, the State will split this watershed into several subwatershed scale listings that better align with TMDL development. A summary of the assessment units that were split during the 2010 cycle is included in Table 20.

Table 20: Summary of Newly Split Assessment Units in the 2010 IR.

Former AU ID (2008 IR)	Water Body Names	Pollutant(s)	New (2010) Split AU IDs	Rationale
MD-POCMH-OH-POCOMOKE_SOUND-RIVER	Pocomoke Sound	Fecal Coliform	MD-POCMH-OH-02130201	This listing was split out for TMDL accounting purposes. The area impaired for fecal coliform is in two 8-digit watersheds, the default largest listing scale for bacteria impairments.
	Pocomoke River		MD-POCOH-02130202	

C.3.4 Estuarine Assessments

This section provides assessment results and water quality summaries for Maryland's estuarine systems that include both the Chesapeake and Coastal Bays. The Chesapeake Bay assessments continue to evolve as new criteria and assessment methodologies are implemented and as Maryland utilizes the newer salinity-based segmentation. Comparatively, the Coastal Bays fall behind the Chesapeake in terms of public awareness and resource allocation for monitoring and assessment activities. For additional details on Chesapeake Bay assessments, please see http://www.mde.maryland.gov/assets/document/2008%20Ambient%20Water%20Criteria.pdf

Table 21 and 22 show the size of estuarine waters assigned to each category for each pollutant. For the 2010 cycle, these numbers were calculated differently for the total phosphorus (TP) and total nitrogen (TN) pollutants. For the 2008 cycle, Maryland used the percentage of failure from each water body segment's cumulative frequency diagram (CFD) as a surrogate for the percent-area-impaired by nutrients. The problem with this method is that the CFD represents both area and time, a dimension not easily accounted for in the IR. [For an explanation on what a CFD is and how it is calculated go to http://www.mde.state.md.us/assets/document/2008%20Ambient%20Water%20Criteria.pdf.] Thus, after careful consideration, this method of calculation was abandoned in favor of the more binary method used in 2010. The new method reports the entire Chesapeake Bay segment in one category. In other words, regardless of the magnitude of impairment implied by the CFD, a segment's whole size will be reported in Category 5 for nutrients (TP or TN) if any percentage of its CFD fails to meet the applicable water quality criterion.

Table 21: Size of Estuarine Waters per Category According to Pollutant.

Cause	Category on the Integrated List						
	Cat. 1	Cat. 2	Cat. 3	Cat. 4a	Cat. 4b	Cat. 4c	Cat. 5
Arsenic		0.964					
BOD, Biochemical oxygen demand				31.37			
Cadmium		32.18					
Chlordane				41.36			
Chlorpyrifos		48.72					
Chromium		20.66					2.90
Copper		40.30			Point*		1.03
Cyanide					Point*		
Debris/Floatables/Trash							0.09
Cause Unknown/Estuarine Bioassessments		915.13	315.76				1,107.80
Enterococcus							4.88
Fecal coliform		132.86		54.63			25.52
Lead		34.09					1.30
Mercury					Point*		
Mercury in Fish Tissue		201.17	84.13				
Nickel		6.26			Point*		
Nitrogen (Total)			82.24	99.61			2259.231
Oil spill - PAHs					0.33		
PCBs		87.94	87.53	356.92			265.54
Phosphorus (Total)			82.24	76.99			2259.231
Selenium		0.03					
Silver		0.96					
Total Suspended Solids (TSS)**		224.5374	21.33	0.09			436.99
Toxics							2.00
Zinc		13.42					7.40

Point* - These listings are remnants of the 304(L) list and were originally listed due to the presence of point sources. Thus these listings have no associated sizes.

**The total size of areas assessed for TSS do not total the area assessed for the Shallow Water designated use (DU) due to TSS listings for the aquatic life DU.

Table 22: Size of Estuarine Waters in Linear Distance per Category According to Pollutant

	Category on the Integrated List						
Cause	**Cat. 1**	**Cat. 2**	**Cat. 3**	**Cat. 4a**	**Cat. 4b**	**Cat. 4c**	**Cat. 5**
Debris/Floatables/Trash							9.50
Enterococcus		1.13	0.41				0.22
Fecal coliform		0.15					

Table 23 depicts the status of estuarine waters with respect to different designated uses. Similar to Table 21, the numbers provided for the open water, deep water, and deep channel designated uses were calculated differently in 2010 using a binary method. Instead of calculating the percent-area-impaired using the CFD surrogate, Maryland used the 'impaired or not' approach to determine the column in which a water-segment's size should be placed.

Table 23: Designated Use Support Summary for Maryland's Estuarine Waters.

Designated Use		Size of Estuarine Waters (square miles)				
		State Total	Total Assessed	Supporting - Attaining WQ Standards	Not Supporting - Not Attaining WQ Standards	Insufficient Data and Information
Aquatic Life and Wildlife		2,522.4	2,173.6	914.9	1,258.6	348.8
Fishing		2,522.4	710.4	87.9	622.5	1,812.0
Water Contact Recreation	General Recreational Waters	2,522.4	6.4	1.4	4.963	2,516.0
	Public Beaches*	164.0	164.0	163.0	1.0	0
Shellfish Harvesting		2,136.2	2,136.2	2,056.1	80.1	0
Migratory Spawning and Nursery**		1,334.8	97.1	0.0	98.1	1,236.7
Shallow Water SAV**		667.6	646.3	224.5	421.7	21.3
Open Water**		2,337.8	2,255.6	0	2,255.6	82.2
Deep Water**		1,369.7	1,369.7	0	1,369.7	0.0
Deep Channel**		1,297.5	1,297.5	0	1,297.5	0.0

*Public Beach results are reported as the number of beaches, not as surface area or linear extent of water affected.
**Chesapeake Bay specific uses. Note: Areas are based on total segment surface area. Surface area sizes for each specific designated use have not been defined.

Table 24: Size of Estuarine Waters Impaired by Various Sources.

Waterbody Type - Estuary	
Sources	**Water Size in Square Miles**
Agriculture	481.91
Channel Erosion/Incision from Upstream Hydromodifications	0.09
Contaminated Sediments	238.10
Discharges from Municipal Separate Storm Sewer Systems (MS4)	0.09
Industrial Point Source Discharge	2.95
Livestock (Grazing or Feeding Operations)	9.59
Manure Runoff	17.64
Municipal Point Source Discharges	41.41
Natural Sources	1.95
Nonpoint Source	0.004
Pipeline Breaks	0.33
Source Unknown	2,255.23
Upstream Source	356.92
Urban Runoff/Storm Sewers	23.87
Wastes from Pets	20.21
Wildlife Other than Waterfowl	5.24

Table 25: Attainment Results for the Chesapeake Bay Calculated Using a Probabilistic Monitoring Design.

Project Name	Chesapeake Bay Benthic Assessment
Owner of Data	Chesapeake Bay Program and Versar Inc.
Target Population	Tidal waters of the Chesapeake Bay (reporting only the MD portion)
Type of Waterbody	Chesapeake Bay Estuary
Size of Target Population	2338.7 (only the MD portion)
Units of Measurement	Square Miles
Designated use	Aquatic Life
Percent Attaining	21.2%
Percent Not-Attaining	47.4%
Percent Nonresponse	31.5%
Indicator	Biology - Estuarine Benthic macroinvertebrate IBI
Assessment Date	4/1/2010
Precision	unknown

C.3.4.1 The Coastal Bays

Maryland's Coastal Bays, the shallow lagoons nestled behind Ocean City and Assateague Island, comprise a complex ecosystem. Like many estuaries, Maryland's Coastal Bays display differences in water quality ranging from generally degraded conditions within or close to tributaries to better conditions in the more open, well-flushed bay regions. Showing the strain of nutrient enrichment, the Coastal Bays exhibit high nitrate levels in the freshwater reaches of streams, excess algae, chronic brown tide blooms, macroalgae blooms, and incidents of low dissolved oxygen. Although seagrass coverage has leveled off over the past three years, large increases in seagrass area have taken place since the 1980s.

Like water quality, the status of Coastal Bays living resources is mixed. While the Bays still support diverse and abundant populations of fish and shellfish, human activities are affecting their numbers. Forage fish, the major prey item for gamefish, have been in steady decline since the 1980s and reports of fish kills, usually the result of low oxygen levels, are increasing. Hard clam densities are lower than historic levels but have been generally stable over the past 10 years. Blue crab populations are fluctuating but do not appear to be in decline, despite a relatively new parasite causing summer mortality in some areas. Oysters, which were historically abundant in the Coastal Bays, remain only as small, relict populations. Bay scallops have recently returned after being absent for many decades and are now found throughout the Bays, although numbers are low.

In terms of overall water quality, living resources, and habitat conditions, the Bays were given the following ranking from best to worst: Sinepuxent Bay, Chincoteague Bay, Assawoman Bay, Isle of Wight Bay, Newport Bay, and St. Martin River. For more information, refer to the 2004 State of the Coastal Bays Report (http://dnrweb.dnr.state.md.us/pressroom/MCB.pdf). The Department of the Environment is scheduled to submit nutrient TMDLs for the Coastal Bays to EPA by the end of federal fiscal year 2011.

C.3.4.2 2007 National Estuary Program Coastal Condition Report

In spring of 2007, the US Environmental Protection Agency (EPA) released its third in a series of coastal environmental assessments which focused on conditions in the 28 National Estuary Program (NEP) estuaries (online at: www.epa.gov/owow/oceans/nepccr). In this Coastal Condition Report (CCR), four estuarine condition indicators were rated for individual estuaries:

• water quality (e.g., dissolved inorganic nitrogen, dissolved inorganic phosphorus, chlorophyll a, water clarity, and dissolved oxygen);
• sediment quality (e.g., sediment toxicity, sediment contaminants, and sediment total organic carbon);
• benthic index and;
• fish tissue contaminants index

For each of these four key indicators, a score of good, fair, or poor was assigned to each estuary which were then averaged to create overall regional and national scores. Based on these calculations, the overall condition of the nation's NEP estuaries as generally fair. Estuaries in the

Northeast Coast region where Maryland's two NEP estuaries are located (Coastal Bays; Chesapeake Bay), the water quality index was rated as fair; sediment quality, benthic, and fish tissue contaminants indices were poor and overall condition estuaries were rated poor. Altogether, NEP estuaries showed the same or better estuarine condition than US coastal waters overall.

The report describes a number of major environmental concerns that affect some or all of the nation's 28 NEP estuaries. The goal of this report is to provide a benchmark for analyzing the progress and changing conditions of the NEPs over time. The top three issues, which also affect Maryland's estuaries include:

• Habitat loss and alteration (including dredging and dredge-disposal activities; construction of groins, seawalls, and other hardened structures; and hydrologic modifications);
• Declines in fish and wildlife populations (associated with habitat loss, fragmentation or alteration, water pollution from toxic chemicals and nutrients, overexploitation of natural resources, and introduction of invasive species); and
• Excessive nutrients (nitrogen and phosphorus runoff from agriculturally and residentially applied fertilizers and animal wastes, discharges from wastewater treatment plants, leaching from malfunctioning septic systems, and discharges of sanitary wastes from recreational boats).

C.3.5 Lakes Assessment - Clean Water Act §314 (Clean Lakes) Report

In the federal Clean Water Act (CWA), §314 addresses the Clean Lakes program, which was designed to identify publicly owned lakes, assess their water quality condition, implement in-lake and watershed restoration activities and develop programs to protect restored conditions. This section also requires regular reporting of State efforts and results.
In Maryland, all significant (> 5 acres surface area), publicly-owned lakes are man-made impoundments. A number of specific assessment, planning and restoration activities in Maryland were funded by §314 as early as 1980 until Congress rescinded Clean Lakes funding in 1996. The US Environmental Protection Agency encouraged States to use funds in the §319 (Nonpoint Source Program) to address Clean Lakes priorities; however, no Clean Lake projects have been funded in Maryland through this program because of limited funding and higher priorities (e.g., Chesapeake Bay restoration, Total Maximum Daily Loads).

C.3.5.1 Trophic status

One measure of lake water quality is through classification by overall level of productivity ("trophic condition"). This measure often is based on relative nutrient levels which can affect not only biological community structure, but also certain physical characteristics of lakes:

- **oligotrophic lakes** - usually deep, with low levels of nutrients, plankton and low production rates - often serve well as drinking water sources or as lakes for boating or swimming, but having limited gamefish populations.
- **eutrophic lakes** - generally shallow, with high plankton levels and production rates - often supporting sportfishing for some species, but oxygen may be depleted below the thermocline and during periods of ice cover and may result in fish kills. Diurnal oxygen and pH levels may vary widely. Sportfishing for some fish species may be excellent, but water clarity will be reduced.

- **mesotrophic lakes** - have moderate productivity levels between the above two classifications and serve well as recreational lakes for fishing, boating and swimming activities.

Two other lake trophic classes not found in Maryland include: **dystrophic** or "bog" lakes characterized as having low nutrient levels, but very high color from humic materials and often acidified, and **hypereutrophic** lakes characterized by extremely high nutrient/productivity levels.

The most recent Statewide trophic survey of Maryland's significant, publicly-owned lakes was conducted in 1991 and 1993. For this survey, 58 lakes were identified as meeting the definition of significant, publicly-owned lakes. Since then, two other lakes have been added to this listing:

1. Big Piney Reservoir (*Allegany Co.; Casselman River segment)* - 110 ac. Frostburg water supply reservoir that was being rebuilt during this survey when public access was restricted, and
2. Lake Artemesia (*Prince George's Co.; Anacostia River segment*) - a recreational lake created from Metro construction.

In addition to publicly-owned lakes, water quality issues at a number of privately-owned lakes have been evaluated and water quality determined to be impaired and either needing a TMDL or just having had a TMDL completed and approved. These include: LaTrappe Pond, Lake Linganore, Lake Lariat, Atkisson Reservoir, and Millington Wildlife Ponds. Trophic condition has not been determined for these lakes.

The State's 60 significant, publicly-owned lakes, surface area, owners and trophic status, and a summary of the trophic status of privately owned lakes are provided in Tables 26 and 27, respectively.

Table 26: Trophic status Maryland's significant, publicly-owned lakes

BASIN	LAKE NAME	SIZE (acres)	OWNER/MANAGER	TROPHIC ASSESSMENT
02120204	Conowingo Pool	2,936.0	Exelon Generation Co.	Meso/Eutrophic
02130103	Bishopville Pond	5.7	Worcester Co.	Eutrophic
02130106	Big Mill Pond	60.2	Worcester Co.	Eutrophic
02130203	Adkins Pond	17.2	MD State Hwy/Wicomico Co.	Eutrophic
02130301	Coulbourn Pond	8.6	Wicomico Co.	Meso/Eutrophic
02130301	Mitchell Pond #2	8.6	City of Salisbury	Eutrophic
02130301	Mitchell Pond #3	5.8	City of Salisbury	Eutrophic
02130301	Schumaker Pond	48.6	City of Salisbury	Meso/Eutrophic
02130301	TonyTank Lake	42.0	Wicomico Co.	Eutrophic
02130301	TonyTank Pond	41.3	MD State Hwy Admin.	Eutrophic
02130303	Allen Pond	35.8	Somerset/Wicomico Co.	Meso/Eutrophic
02130304	Johnson Pond	104.0	City of Salisbury	Eutrophic
02130304	Leonards Mill Pond	45.9	Wicomico Co.	Eutrophic
02130306	Chambers Lake	9.4	Town of Federalsburg	Meso/Eutrophic
02130306	Smithville Lake	40.0	MD DNR	Meso/Eutrophic
02130405	Tuckahoe Lake	86.0	MD DNR	Eutrophic
02130503	Wye Mills Community Lake	61.5	MD DNR	Eutrophic
02130509	Urieville Community Lake	35.0	MD DNR	Meso/Eutrophic
02130510	Unicorn Mill Pond	48.0	MD DNR	Meso/Eutrophic
02130702	Edgewater Village	7.2	Harford Co.	Eutrophic
02130805	Loch Raven Reservoir	2,400.0	Baltimore City	Mesotrophic
02130806	Prettyboy Reservoir	1,500.0	Baltimore City	Mesotrophic
02130904	Lake Roland	100.0	Baltimore City	Eutrophic
02130907	Liberty Reservoir	3,106.0	Baltimore City	Mesotrophic
02130908	Piney Run Reservoir	298.0	Carroll Co.	Meso/Eutrophic
02131001	Lake Waterford	12.0	Anne Arundel Co.	Meso/Eutrophic
02131103	Allen Pond	9.5	City of Bowie	Eutrophic
02131104	Laurel Lake	12.0	City of Laurel	Meso/Eutrophic
02131105	Centennial Lake	50.0	Howard Co.	Eutrophic
02131105	Lake Elkhorn	49.0	Columbia Assn.	Eutrophic
02131105	Lake Kittamaqundi	107.0	Columbia Assn.	Eutrophic
02131105	Wilde Lake	23.0	Columbia Assn.	Eutrophic
02131107	Duckett Reservoir	773.0	Wash. Suburban Sanitary Comm.	Meso/Eutrophic
02131108	Triadelphia Reservoir	800.0	Wash. Suburban Sanitary Comm.	Mesotrophic
02140103	St. Mary's Lake	250.0	MD DNR	Meso/Eutrophic
02140107	Wheatley Lake	59.0	Charles Co.	Mesotrophic
02140111	Myrtle Grove Lake	23.0	MD DNR	Eutrophic
02140203	Cosca Lake	11.0	MD-NCPPC	Eutrophic
02140205	Greenbelt Lake	21.5	City of Greenbelt	Eutrophic
02140205	Pine Lake	5.0	MD-NCPPC	Meso/Eutrophic
02140205	Lake Artemesia	38.0	MD-NCPPC	Unknown
02140206	Lake Bernard Frank	56.0	MD-NCPPC	Eutrophic
02140206	Lake Needwood	74.0	MD-NCPPC	Eutrophic
02140208	Little Seneca Lake	505.0	Wash. Suburban Sanitary Comm.	Mesotrophic
02140208	Clopper Lake	90.0	MD DNR	Mesotrophic
02140303	Hunting Creek Lake	46.0	MD DNR	Mesotrophic
02140501	Big Pool (C&O Canal)	92.4	National Park Service	Meso/Eutrophic
02140502	City Park Lake	5.2	City of Hagerstown	Mesotrophic
02140502	Greenbrier Lake	27.0	MD DNR	Oligo/Mesotrophic
02140508	Blairs Valley Lake	32.2	MD DNR	Meso/Eutrophic
02141002	Lake Habeeb	208.5	MD DNR	Oligo/Mesotrophic
02141005	Wm. Jennings Randolph Reservoir	952.0	Army Corps of Engineers	Oligo/Mesotrophic
02141006	Savage River Reservoir	360.0	Upper Potomac River Assn.	Oligo/Mesotrophic
02141006	New Germany Lake	13.0	MD DNR	Meso/Eutrophic
05020201	Youghiogheny River Lake	593.0	Army Corps of Engineers	Meso/Eutrophic
05020201	Herrington Lake	41.5	MD DNR	Mesotrophic
05020202	Broadford Lake	138.0	Town of Oakland	Meso/Eutrophic
05020203	Deep Creek Lake	4,500.0	MD DNR	Oligo/Mesotrophic
05020204	Cunningham Lake	20.0	Univ. Maryland	Mesotrophic
05020204	Big Piney Reservoir	110.0	City of Frostburg	Unknown

Source: MD Department of the Environment, 1993; 1995

Table 27: Trophic status summary of Maryland's significant, publicly-owned lakes

	Number of lakes	Lake size (acres)
Total lakes	60	21,167.6
Lakes assessed	58	21,009.6
Dystrophic	0	0.0
Oligotrophic	0	0.0
Oligotrophic-Mesotrophic	5	6,047.5
Mesotrophic	11	8,572.7
Mesotrophic-Eutrophic	19	5,380.0
Eutrophic	23	1,009.4
Hypereutrophic	0	0.0
Unknown	2	158.0

Source: MD Department of the Environment, 1993; 1995

C.3.5.2 Pollution control programs

Various existing point and nonpoint source management programs described in this report can be effective in managing pollutant inputs directly to lakes and to lake watersheds. Unlike other water types, lakes have features that complicate the water management process, but also provide more options than other water body types. These factors include "residence time" - the time it takes a water parcel to pass through the lake, seasonal stratification and ability of some lake managers to control water levels or to selectively bypass certain layers or water masses.

Unless the impoundment is a run-of-the-river system, lakes (and estuaries) have a longer residence time than free-flowing streams, allowing organic and inorganic substances in the water more time to interact with the biota (primary producers) and sediments. If the lakes are large enough to develop seasonal stratification, new water masses develop, in-lake residence time is modified, and water movements altered. The ability to manage water levels and withdrawals provides management options, but adds to the complexity of managing lake waters for the best possible uses.

Most lakes in Maryland do not have comprehensive lake or watershed management plans that address point and nonpoint source pollution, land cover, or management options that would address pollution control in-lake or in the lake watershed. In most instances, pollutant sources are not a result of direct waste discharges to a lake or its immediate watershed, but are in the watershed upstream of the lake. While large water supply systems invest in lake management plans, often their effectiveness in addressing pollution sources in the watershed varies as the watershed areas often are not controlled by the lake owners. Effective lake management plans require a cooperative relationship with land managers (public agencies and private land owners) in upstream watershed areas to develop cooperative agreements addressing land use, pollution control and funding priorities to protect lake resources.

C.3.5.3 Lake Restoration Programs

One aspect of the now un-funded §314 Clean Lakes Program was to provide funding for lake restoration activities. After the Clean Lakes Program was de-authorized in 1996, restoration funding for lakes was added to the §319 Nonpoint Source Program as a fundable activity. Grant requirements, priorities and limited funding in this program, however, do not allow for much needed in-lake reclamation activities (e.g., removal/dredging of excess sediments and nutrients, aquatic vegetation control, aquatic and wildlife habitat enhancement, and shoreline stabilization).

Without a directed management program and federal funding support and with comparatively low priority for accessing State water management funding, current lake restoration activities generally are initiated by lake managers (often the owners). With few lake management plans in place, there is often little planning activity or actual effort to address lake water issues until they become severe (and more difficult and costly to address). Lake managers can take advantage of expert resources available from various State agencies (DNR, MDA, MDE), federal agencies (EPA, US Dept. Agriculture) and non-governmental organizations (e.g, North American Lake Management Society; regional lake management organizations in PA and VA) to assist in developing lake management plans and finding available funding sources.

C.3.5.4 Acidification of lakes

Poorly buffered lakes or lakes in mining areas are subject to acidification due to atmospheric deposition or through acid mine drainage. Although several of Maryland's significant, publicly-owned lakes receive acid mine drainage or naturally acidic drainage through free-flowing tributaries (Deep Creek Lake, Jennings Randolph Reservoir), dilution and natural buffering prevent these lakes from becoming acidified.

The MD Bureau of Mines has worked with the US Department of Interior's Office of Surface Mining Reclamation and Enforcement which has partially funded several projects in Cherry Creek (*Garrett Co.*), a major tributary to Deep Creek Lake that is impacted by high acidity from acid mine drainage (AMD) from abandoned mines and low-lying wetlands/bogs. Completion of these AMD projects has measurably reduced mineral acidity, though natural organic acidity from the wetlands remain. Studies of the lake have shown that acidic inflow to Deep Creek Lake, even before AMD projects were installed, is quickly buffered by a natural limestone layer such that water quality of Cherry Creek is not a threat to water quality of the lake.

Wm. Jennings Randolph Reservoir (*Garrett Co.; Upper North Branch Potomac River segment*) receives acid mine drainage from numerous tributaries directly to the lake and to the upstream river from both Maryland and West Virginia. Constructed primarily to manage flows for downstream water quality, the lake volume varies considerably. Although the lake was designed to manage an expected acidic layer, data show that acidic stratification did not occur. The lowest pH levels in the lake rarely were acidic and water quality below the dam was good enough to support a trout hatchery in the tailwaters of the dam. As AMD is managed upstream of the lake, pH levels, even in the river above the lake rarely are acidic and, with gradually increasing productivity, the lake supports an excellent sportfishery.

Information about acidification in small lakes and privately-owned lakes is not widely known, but water quality impacts can be significant and restoration can be successful. Lake Louise (Garrett Co.; Casselman River segment), a privately-owned, 30-acre lake, had a renowned trout fishery. In the 1970's, sulphide-bearing fill material was used in the construction of Interstate 68 through the upper lake watershed. Acidic leachate from this material entered tributaries to the lake, which suffered severe degradation of the ecosystem and loss of the sport fishery within a two-year period. In the 1990's, the State Highway Administration installed a passive treatment system in the upper lake watershed in an effort to reduce the acidic runoff. In 1999, following restoration of water quality in the lake, an aquatic resource restoration program was implemented to re-establish the aquatic community and sport fishery (http://www.al.umces.edu/Research%20Aquatic%20Ecology/projlakelouise.htm).

C.3.5.5 Lake Status and Trends

Maryland agencies do not include lakes in their ambient monitoring programs, although contaminants in selected fish species are tested in some reservoirs on a cyclical basis (MDE). Infrequent sampling is done to address fish kills and algal bloom complaints (DNR, MDE) and some water sampling is done to provide input for pollutant loading models (Total Maximum Daily Loads) (MDE). Some water supply reservoirs have routine water monitoring programs in their lakes (e.g., Baltimore City, Washington Suburban Sanitary Commission reservoirs) and, at times, some local agencies and citizen groups will establish monitoring programs in some lakes. Based on available data a summary of the status of Maryland lakes and reservoirs is given in Table 28.

Table 28: Designated use support summary: Maryland lakes and reservoirs (acres), 2010.

Designated Use		Size of Impoundments (acres)				
		Total Impoundment Acres	Total Assessed	Supporting - Attaining WQ Standards	Not Supporting - Not Attaining WQ Standards	Insufficient Data and Information
Aquatic Life and Wildlife		20,405.7	17,522.2	1,113.0	12,638.2	6,654.4
Fishing		20,405.7	19,613.5	3,343.1	16,176.4	886.1
Water Contact Recreation	General Recreational Waters	20,405.7	33.0	0	33.0	20,372.7
	Public Beaches*	26.0	26.0	26.0	0	0

*Public beaches were reported as the number of beaches in each category rather than providing a size.

C.3.5.5.1 Causes and sources of impairment

Primary causes for why lakes do not fully support their uses include toxic metals - primarily mercury which restricts fish consumption, and low oxygen conditions, which reduces available habitat for aquatic organisms. Low oxygen levels are a result of an accelerated eutrophication process caused by nutrients entering the lake or by nutrients being released from sediments. Other causes include pesticides (chlordane) in fish tissue causing a listing as a consumption advisory of selected species, low pH, excessive siltation and aquatic vegetation.

Table 29: Size of Impoundments per Category According to Pollutant.

Cause	Category on the Integrated List						
	Cat. 1	Cat. 2	Cat. 3	Cat. 4a	Cat. 4b	Cat. 4c	Cat. 5
Arsenic		3,708.0					
Cadmium		3,708.0					
Chlordane				98.0			
Chromium (total)		5,113.0					
Chromium, hexavalent		1,508.0					
Copper		3,708.0					
Lead		6,621.0					
Mercury in Fish Tissue		6,972.8	94.0	8,167.0			4,348.4
Nickel		3,708.0					
Nitrogen (Total)		27.0					
PCB in Fish Tissue		12,784.1	198.3				3,661.0
Phosphorus (Total)		1,113.0	3,771.0	6,005.2			6,633.0
Sedimentation/Siltation		298.0		3,502.0			2,946.0
Selenium		3,708.0					
Zinc		1,508.0					

As lake water quality is reflective of conditions in the watershed, there are numerous sources of pollutants that may keep a lake from meeting its intended use, Table 28. Overall, one of the principal lake problems is due to the accelerated eutrophication process that characterizes most reservoir systems. Nutrients and sediments from various natural and land use activities in the watershed upstream of these impoundments flow into the lake. Nutrients in lake sediments can be recycled into the water column under certain conditions and decomposition of organic material in the sediments can reduce oxygen levels in a stratified lake's deep layer (hypolimnion).

Metals (methylmercury) and PCBs from fish tissue samples in a number of publicly-owned and private lakes are found at levels that could affect human health if enough fish taken from these systems are consumed. The Department of the Environment identifies lakes and species of affected fish using suggested consumption limits for fish taken from these waters (http://www.mde.state.md.us/assets/document/Fish_Advisory_Table_2007.pdf#Recommended_Meals_Per_Year). Other sources of pollutants include natural conditions (including waterfowl, upstream sources), municipal waste discharges, and urban runoff.

Table 30: Source of impairment: Maryland lakes and reservoirs (acres), 2010.

Waterbody Type - Impoundment	
Sources	**Water Size in Acres**
Agriculture	4,126.0
Atmospheric Depositon - Toxics	11,860.4
Contaminated Sediments	3,661.0
Municipal Point Source Discharges	223.9
Non-Point Source	336.3
Source Unknown	8,082.0
Urban Runoff/Storm Sewers	2,331.0

In the Baltimore City water supply reservoirs (Loch Raven, Prettyboy, Liberty Reservoirs), historical trends from an extensive water quality monitoring effort show that total phosphorus concentrations in monitored streams and from wastewater treatment plants have been declining and algal levels in all three reservoirs have gradually improved during the past 15-18 years. Steadily increasing nitrate levels over this period appear to be leveling off. All three reservoirs are still in various states of eutrophication and need further improvement and continued protection. Sedimentation is monitored periodically to assess the practical storage capacity of these systems - last reported as: Loch Raven Reservoir losing about 11 percent of its original volume followed by Prettyboy Reservoir (losing 7.5 percent), and Liberty Reservoir (losing 3.3 percent) (Reservoir Technical Group, 2004).

C.3.5.5.2 National Lake Survey

As part of a national effort to assess the quality of the nation's waters in a statistically-valid manner, EPA used their water body database and randomly identified lakes in each state (stratified by State, EPA Region and ecological region). In Maryland, 40 lakes were targeted from which only four would be sampled. EPA requested that Maryland collect field water quality, sediment and habitat data from these sites using nationally-consistent sampling/recording protocols. DNR biologists were trained by EPA and the selected lakes were intensively sampled one time during the late summer 2007 (along with one lake sampled by EPA biologists as a reference lake and one additional lake sampled as a replicate for QC purposes). Water, sediment and biological samples were sent to national labs for analysis and field data were submitted to EPA. More information on the national survey can be found at http://www.epa.gov/owow/lakes/lakessurvey/.

C.3.5.5.3 Total Maximum Daily Loads for Lakes

Pollutant loading models and pollutant caps (Total Maximum Daily Loads - TMDLs) have been developed and approved by EPA for 21 public and privately-owned lakes in Maryland through 2009 for substances including: methylmercury, phosphorus, chlordane, and sediments (Section F.4). Another nine (9) lakes are identified as impaired and need TMDLs for pollutants including total phosphorus, sediments, mercury and PCBs. One lake (Edgewater Village Lake) which cannot meet water quality standards even under the most stringent of controls is being considered for a change in designated use (i.e., a Use Attainability Analysis).

C.3.6 Non-tidal Rivers and Streams Assessment

Maryland has two major monitoring programs for assessing non-tidal waters. One is the probabilistic Maryland Biological Stream Survey (MBSS) and the other is the CORE/TREND program for assessing water quality trends at fixed locations. The MBSS program uses fish and aquatic insects as indicators of aquatic health while the CORE/TREND program focuses on conventional water quality parameters (temperature, pH, etc.) as well as nutrient species. The following summaries highlight the results of these programs.

Table 31: Statewide results for the MBSS Program.

Project Name	Maryland Biological Stream Survey
Owner of Data	MD Dept. of Natural Resources (MANTA)
Target Population	All 1st through 4th order nontidal wadeable streams in MD
Type of Waterbody	1st through 4th Order Wadeable Streams
Size of Target Population	9,199.3
Units of Measurement	Miles
Designated use	Aquatic Life
Percent Attaining	19.0%
Percent Not-Attaining	38.0%
Percent Nonresponse	43.0%
Indicator	Biology - freshwater fish and benthic macroinvertebrate IBIs
Assessment Date	4/1/2008

C.3.6.1 Trend Monitoring

Various statistical approaches are used to define changes in water quality over time to document annual/seasonal variability and how water quality changes in response to water management programs. In the past, EPA has sought to incorporate trend results into the State's assessment methodology, however, an increasing or declining trend in water quality may not signify "improvement" or "degradation". Water quality trend results are not used in the State's water quality assessment or watershed listing process.

Ambient water quality data often do not support the statistical requirements for using parametric statistics. Data transformations (e.g., using statistically significant streamflow-concentration regression residuals) and non-parametric approaches, such as seasonal Kendall's tau (to address seasonality) and LOWESS smoothing (to adjust for serial correlation) may be necessary. Recently, as more data have been collected, some trend results are found to be better explained using a polynomial approach to document reversals in water quality trends (often explaining water quality improvements that are being surpassed by increased watershed development).

Maryland's baseline CORE monitoring program has collected water quality samples from significant non-tidal streams (fourth order and larger) in Maryland each month since the early 1980's. At some sites, samples have been collected regularly since the middle 1970's. Status and trends in water quality condition are determined annually at 54 locations for selected parameters. Trends based on CORE data are determined for a 20-year period (Calendar Year 1986-2006) using the Seasonal Kendall's tau, a statistical test that addresses seasonal variation. These data are not adjusted for streamflow.

The US Geological Survey (USGS) also conducts long-term sampling for nutrient species and sediments at four non-tidal River Input monitoring stations on Susquehanna River (Conowingo Dam), Potomac River (Little Falls), Patuxent River (Governor's Bridge Road) and Choptank River (Red Bridges Road). Regression trends based on USGS data are determined over a nearly similar 22-year period (Water Year 1984-2006). Results presented here are not adjusted for streamflow to provide a level of comparability.

In most instances, there are no statistically significant, long-term trends in water quality conditions. Where they occur, significant trends are summarized below:

- **Temperature** - significant increasing trends observed at four stations (Georges Creek, Susquehanna River, Potomac River at Little Falls, and Upper Patuxent River); significant decreasing trends in temperature were detected on the Lower Patapsco River (US Route 1).
- **pH** - Increasing trends were evident at 37 percent of the sites. Decreasing trends were observed on Catoctin Creek (MD route 464), Gunpowder River between Prettyboy and Loch Raven Reservoirs, and the Choptank River.
- **Conductivity** - Increasing trends were observed in two thirds (67 percent) of the stations; decreasing trends occurred at three sites; two located in the lower free-flowing Potomac River (Point of Rocks and Whites Ferry) and a third site located on the Lower Susquehanna River.
- **Suspended solids** - Decreasing trends observed at four stations (Gwynns and Jones Falls, Upper/Lower Patapsco River, and Upper/Middle/Lower Monocacy River); an increasing trend was observed on the lower Susquehanna River.
- **Turbidity** - Decreasing trends occurred at 65 percent of these stations; four sites in western Maryland (Braddock Run, Casselman River, Cherry Creek, and the Lower Youghiogheny River at Friendsville) were found to have increasing trends.
- **Total nitrogen** – Decreasing trends observed at 79 percent of the stations; with an increase observed on the Choptank River. The USGS analysis of results from the Patuxent River (near Bowie) showed a significant, declining trend.
- **Ammonium** – Decreasing trends were observed at 25 percent of all stations; an increasing trend was observed for the Choptank River - reflecting the increasing Total Nitrogen trend there.
- **Total phosphorus** – Twenty-four sites had decreasing trends - predominantly in the eastern Upper Potomac Basin and the urban/agricultural corridor north of Washington and Baltimore. On the Choptank River, analysis of both MD and USGS datasets showed increasing trends in overlapping, long-term datasets.

C.3.6.1.1 Overall Non-tidal River and Stream Assessment Results

Other monitoring projects initiated on an ad-hoc basis have helped to supplement the MBSS and Core Trend Monitoring programs and have helped to assess for other pollutants not captured by these assessments. Tables 32 – 34 provide statewide assessment data for non-tidal rivers and streams.

Table 32: Extent of River/Stream Miles per Category According to Pollutant.

Cause	Category on the Integrated List						
	Cat. 1	Cat. 2	Cat. 3	Cat. 4a	Cat. 4b	Cat. 4c	Cat. 5
Aluminum		121.53	15.32				10.89
Ammonia							195.76
Arsenic		424.59					
BOD, Biochemical oxygen demand		88.00		171.19			
BOD, carbonaceous		226.32		136.72			
BOD, nitrogenous		226.32		136.72			
Cadmium		803.87					
Chlorides							715.72
Chromium (total)		137.64					
Chromium, hexavalent		209.66					
Chromium, trivalent		225.03					
Cause Unknown/Combination Benthic/Fishes Bioassessments		4,771.82	646.94				3,094.88
Copper		454.10					
Cyanide		68.39					
Debris/Floatables/Trash							171.19
Enterococcus							17.80
Fecal coliform		291.14	78.50	439.40			8.83
Heptachlor Epoxide							171.19
Iron			121.53				26.21
Lead		516.02					
Manganese		106.58					41.16
Mercury		276.85					
Mercury in Fish Tissue		1,588.05	441.25				
Nickel		424.59					

Cause	Category on the Integrated List						
	Cat. 1	Cat. 2	Cat. 3	Cat. 4a	Cat. 4b	Cat. 4c	Cat. 5
Nitrogen (Total)		1,272.23	146.30	171.19			
PCB in Fish Tissue		855.78	534.86				1,133.29
PCBs - water							171.19
pH, High							88.00
pH, Low		435.07	6.14	795.73	5.10		14.35
Phosphorus (Total)		2,128.69	146.30	214.72			2370.56
Selenium		424.59					
Silver		147.74					
Sulfates							363.29
Total Suspended Solids (TSS)		258.22		2646.48			1692.52
Zinc		563.21					

Table 33: Designated Use Support Summary for Non-tidal Rivers and Streams.

Designated Use		Size of River/Stream Miles				
		Total River miles	Total Assessed	Supporting - Attaining WQ Standards	Not Supporting - Not Attaining WQ Standards	Insufficient Data and Information
Aquatic Life and Wildlife		9,940.3	9,889.0	3,466.8	5,836.4	637.1
Fishing		9,940.3	2,738.73	947.29	1,282.9	7,710.1
Water Contact Recreation	General Recreation Waters	9,940.3	900.6	285.3	615.3	9,039.7
	Public Beaches**	7	7	7	0	0
Agricultural Water Use		9,940.3	9,940.3	9,940.3	0	0
Industrial Water Use		9,940.3	9,940.3	9,940.3	0	0

Table 34: Summary of Sizes of Riverine Waters Impaired by Various Sources.

Waterbody Type - River	
Sources	**Water Size in Miles**
Acid Mine Drainage	800.13
Agriculture	697.09
Contaminated Sediments	1,133.29
Crop Production (Crop Land or Dry Land)	167.03
Discharges from Municipal Separate Storm Sewer Systems (MS4)	179.09
Livestock (Grazing or Feeding Operations)	596.07
Municipal Point Source Discharges	53.34
Non-Point Source	223.93
Source Unknown	4,798.19
Urban Runoff/Storm Sewers	1,123.11

C.3.7 Wetlands Program

MDE received a grant from the U.S. Environmental Protection Agency in 2005 to develop a statewide wetland monitoring and assessment strategy. The Maryland Department of Natural Resources (DNR) was a co-applicant for the grant but resigned from active participation under the grant in 2008. Both agencies participated in discussions and work groups for the Mid-Atlantic work group for wetland monitoring, as well as participated on a national advisory group. There are multiple objectives for Maryland's wetland monitoring and assessment program, which will be related to other regulatory and non-regulatory wetland management programs:

1) Meet 305(b) reporting requirements;
2) Improve existing wetland and waterway regulatory programs;
3) Provide additional information for targeting wetland/waterway restoration and protection efforts;
4) Comply with TMDL requirements, if applicable;
5) Develop use designations and water quality standards for wetlands;
6) Assist in evaluating the effectiveness of compensatory mitigation and voluntary restoration projects;
7) Improve our ability to comprehensively assess landscape and watershed function;
8) Develop the capability to study and assess the status of wetland condition over time; and,
9) Make wetland condition and functional value information available for use in federal, State, local and citizen group-driven natural resource conservation and restoration efforts (examples include Tributary Strategies, TMDL implementation plans, Green Infrastructure Assessment, Strategic Forest Lands Assessment, etc.).

Maryland has made some strides in the development of tools for the assessment of landscapes, including wetlands, for the condition of the habitats these landscapes provide. These tools may have a place in the development of wetland condition monitoring. Several pilot projects have taken place or are underway, including those in the Nanticoke and Patuxent watersheds; tidal wetlands of the Nanticoke watershed; and wetlands in the Piedmont region. A work group of State agency representatives has met several times to discuss goals for the strategy. There is a general consensus to monitor for both wetland condition and function. A draft system for classifying wetlands for monitoring purposes was prepared by MDE and DNR.

A larger work group of State, federal, and local agency representatives; researchers; and other stakeholders began meeting in September 2009 to review and make recommendations for the wetland strategy. Meetings will conclude in February 2010. An analysis of existing wetland methods for applicability in Maryland will continue. The final strategy will be completed in the fall of 2010. More details on Maryland's wetlands strategy can be found on MDE's web site at http://www.mde.state.md.us/Programs/WaterPrograms/Wetlands_Waterways/about_wetlands/monitoring.asp

C.3.8 Invasive aquatic species

'New' species of viruses, animals, and everything in-between (e.g., amphibians, reptiles, birds, insects, plants, fish, shellfish, even jellyfish) are being introduced at an increasing rate into Maryland. Since colonization, new species have been introduced through a variety of pathways, including ship ballast, in packing materials, and through deliberate import for various uses. While most of these introduced species are beneficial or benign, about 15 percent become invasive - showing a tremendous capacity for reproduction and distribution throughout its new environment. These invasive species can have a negative impact on environmental, economic, or public welfare priorities.

Many introduced species once thought to be beneficial (e.g., grass carp, mute swans, and nutria) have demonstrated invasive characteristics and are proving difficult to control - out-competing native species (species of plants and animals that have evolved in the State and have developed mutually-sustaining relationships to each other over geologic time) for food, shelter, water or other resources, as well as affecting economic interests and human welfare.

Some of the many aquatic invasive species that have recently consumed a significant level of State and federal agency resources include:

- mute swans *(Cygnus olor)*
- nutria *(Myocaster coypus)*
- zebra mussels *(Dreissena polymorpha)*
- Hydrilla (*Hydrilla verticillata*)
- water chestnut *(Trapa patens)*
- phragmites *(Phragmites australis)*
- purple loosestrife *(Lythrum salicaria)*
- wavyleaf basketgrass (*Oplismenus hirtellus* ssp. *undulatifolius*)
- Chinese mitten crab *(Eriocheir sinensis)*
- several species of crayfish
- snakehead *(Channa argus)*
- Didymo *(Didymosphenia Geminata)*

Information about these and other invasive species are available online from the Department of Natural Resources (http://www.dnr.state.md.us/invasives/), the Smithsonian Research Center, and the US Department of Interior's Fish and Wildlife Service and Geological Survey.

In 2007, the Department of Natural Resources created an Invasive Species Matrix Team to study and direct scientifically-based policy and management responses to the ecological, economic, and public health threats of invasive species in Maryland's native ecosystems (contact Jonathan McKnight at: 410-260-8539; mailto: jmcknight@dnr.state.md.us or Dr. Ron Klauda at: 410-260-8615; mailto: rklauda@dnr.state.md.us). Specific objectives of this intra-agency team are to:

- Provide recommendations to the Secretary of Natural Resources on invasive species policies and regulations.
- Develop a framework for surveillance and monitoring programs designed to detect invasive species introductions and track their dispersal.
- Coordinate rapid response efforts when new invasive species are detected.
- Recommend agency actions and public education programs to prevent new introductions and control the increase/spread of invasive species into non-infested landscapes/waters.
- Develop a list of non-native species introductions into Maryland.
- Share and interpret data, knowledge, and experience on invasive species within Maryland, as well as other state, local, interstate, and federal agencies.
- Develop an Invasive Species Management Plan for Maryland, in cooperation with other organizations, that provides a coordinated, multi-agency strategy to achieve the objectives listed above.

C.3.9 Public Health Issues

C.3.9.1 Waterborne Disease

In the *Surveillance for Waterborne Disease and Outbreaks Associated with Recreational Water - United States, 2003-2004* (US Centers for Disease Control, 2006), data was summarized from the Waterborne Disease and Outbreak Surveillance System, which tracks the occurrences and causes of waterborne disease and outbreaks associated with recreational waters (both natural and artificial (e.g., pool, spa) waters are included). During 2003 and 2004, waterborne disease and outbreaks associated with recreational water were reported by more than half of the States.

One bacterial outbreak of gastroenteritis in an unnamed lake in Maryland in July 2003 resulted in 65 people reporting an illness. In this case, both *Shigella* and *Plesiomonas* was determined to be the cause associated with fecal accidents (5 - 10 diapers were reportedly retrieved from the lake each week) and sewage contamination as the source of the bacterial contamination.

This report also identified illnesses due to the naturally-occurring aquatic bacteria, *Vibrio sp.* The cases are associated with recreational water (no evidence that contact with seafood or marine life might have caused infection) in 16 States. Five cases of illness were reported from *Vibrio sp.* infections with one death in Maryland waters in 2003-2004. These entailed three different *Vibrio* species isolated from these occurrences, including: *Vibrio alginolyticus* (2 cases, 1 death); *Vibrio parahaemolyticus* (1 case), *Vibrio vulnificus* (2 cases). In this report, nearly all *Vibrio* patients reported that they were exposed to coastal recreational water mostly during the summer and most frequently during July and August. Activities associated with *Vibrio* infections included swimming, diving, or wading in water, walking or falling on the shore or rocks and boating, skiing, or surfing.

C.3.9.1.1 Research Summary

In 2006, US Environmental Protection Agency's (EPA) Office of Research and Development and Office of Water published a series of papers summarizing the research conducted on waterborne disease in the last 10 years. The work includes research supported by EPA and others and is limited to gastrointestinal illness as the health effect of concern. The 1996 Safe Drinking Water Act Amendments mandated that EPA and the US Centers for Disease Control (CDC) and Prevention conduct five waterborne disease studies and develop a national estimate of waterborne disease. In response, EPA, CDC, and other authors produced a series of papers that reviews the state of the science, methods to make a national estimate of waterborne disease, models that estimate waterborne illness, and recommendations to fill existing data gaps. The papers represent the most comprehensive review conducted in the last 25 years and the first publication of modeling information that estimates waterborne illness on a national level. The papers have been published and are online at: http://www.epa.gov/nheerl/articles/2006/waterborne_disease.html.

C.3.9.2 Drinking Water

The Maryland Department of the Environment (MDE) is charged with ensuring that all Marylanders have a safe and adequate supply of drinking water. The Department has programs to oversee both public water supplies, which serve about 84 percent of the population's residential needs, and individual water supply wells, which serve citizens in most rural areas of the State. Marylanders use both surface water and ground water sources to obtain their water supplies. Surface water sources such as rivers, streams, and reservoirs serve approximately two-thirds of the State's 5.1 million citizens. The remaining one-third of the State's population obtains their water from underground sources. For more details on the State's drinking water programs, go to http://www.mde.state.md.us/Programs/WaterPrograms/Water_Supply/index.asp

C.3.9.3 Shellfish Harvesting Area Closures

Maryland's Chesapeake Bay waters have long been known for their plentiful shellfish. To protect this valuable resource and safeguard public health the Maryland Department of the Environment is responsible for regulating shellfish harvesting waters.

Shellfish include clams, oysters, and mussels. The term shellfish does not include crabs, lobsters, or shrimp. Shellfish are filter-feeding animals: they strain the surrounding water through their gills which trap and transfer food particles to their digestive tract. If the water is contaminated with disease-causing bacteria, the bacteria are also trapped and consumed as food. If shellfish are harvested from waters which the Department has restricted (closed) and eaten raw or partially cooked, they have the potential to cause illness. Therefore, it is mandatory for oysters and clams to be harvested from approved (open) shellfish waters only.

Shellfish harvesting waters which are open or approved for harvesting are those where harvesting is permitted anytime. Areas which are conditionally approved mean that shellfish harvesting is permitted except for the three days following a rain event of greater than one inch in a twenty-four hour period. Runoff from such a rainfall can carry bacteria into surface waters from adjacent land. Information about which areas have conditional closures is updated daily on the web and via a phone message. Click http://www.mde.state.md.us/CitizensInfoCenter/FishandShellfish/shellfish_advisory/ to find out which conditional closures are in effect or call 1-800-541-1210.

The Department of the Environment has also created maps that summarize oyster & clam harvesting waters as of June 1, 2009 (http://www.mde.state.md.us/CitizensInfoCenter/FishandShellfish/pop_up/shellfishmaps.asp). The maps depict the classification of shellfish growing waters of the State as restricted, conditionally approved, or approved.

Also shown in the maps are shellfish areas closed as reserves and sanctuaries by the Department of Natural Resources (DNR). Sanctuaries are areas which are closed to shellfish harvest and often contain oyster restoration projects to help enhance oyster populations for their environmental benefits. These areas are permanent closures. Reserves are areas which are restored, then opened for periodic harvest when certain criteria are met.

C.3.9.4 Toxic Contaminants Fish Consumption Advisories

The Maryland Department of the Environment (MDE) is responsible for monitoring and evaluating contaminant levels in fish, shellfish and crabs in Maryland waters. The tissues of interest for human health include the edible portions of fish (fillet), crab (crabmeat and "mustard"), and shellfish ("meats"). Such monitoring enables MDE to determine whether the specific contaminant levels in these species are within safe limits for human consumption. Results of such studies are used to issue consumption guidelines for recreationally caught fish, shellfish, and crab species in Maryland (see our http://www.mde.state.md.us/CitizensInfoCenter/FishandShellfish/). Additionally, since fish, shellfish, and crabs have the potential to accumulate inorganic and organic chemicals in their tissues (even when these materials are not detected in water), monitoring of these species becomes a valuable indicator of environmental pollution in a given waterbody.

C.3.9.4.1 Fish Tissue Monitoring

The Maryland Department of the Environment has monitored chemical contaminant levels in Maryland's fish since the early 1970s. The current regional watershed sampling areas divide the State waters into four watersheds:

- Western Maryland watershed,
- Chesapeake Bay tributary watershed,
- Coastal Bays watershed, and
- Baltimore/Washington urban watershed.

Maryland routinely monitors watersheds within these four zones on a 5-year cycle. When routine monitoring indicates potential hazards to the public and environment, additional monitoring of the affected area may be conducted to verify the initial findings and identify the appropriate species and size classes associated with harmful contaminant levels. Findings from such studies (See http://www.mde.state.md.us/CitizensInfoCenter/Fishandshellfish/risk/index.asp) are the basis for the fish consumption guidelines (find our guidelines at: http://www.mde.state.md.us/CitizensInfoCenter/FishandShellfish/index.asp#).

The types of fish sampled include important predatory game species (such as small mouth bass and striped bass), common recreational panfish species (white perch, bluegill, crappie) as well as bottom dwelling accumulator species with relatively high fat content (such as carp, catfish and American eel). Also, periodically, MDE conducts intensive surveys of contaminant levels in selected species in specific water bodies. Past targets of intensive surveys conducted in Patapsco River/Baltimore Harbor included: white perch, channel catfish, eel, and striped bass.

C.3.9.4.2 Shellfish Monitoring

Since the 1960's, the Maryland Department of the Environment has been surveying metal and pesticide levels in oysters and clams from the Chesapeake Bay and its tributaries. Prior to 1990, this effort was conducted every one or two years. In response to low levels of contaminants found and very little change from year to year, the bay-wide monitoring is conducted every three years. This allows MDE to devote its limited resources toward intensive surveys.

During the last monitoring season, MDE collected and tested 500 oysters from 20 locations within the Maryland portion of the Chesapeake Bay. While there were no chemical contaminants at levels of concern in any of the oysters sampled, recreational harvesters should still be aware of possible bacterial contamination and avoid shell-fishing in areas that are closed to commercial shellfish harvesting.

C.3.9.5 Harmful Algal Blooms

Algae are a natural and critical part of our Chesapeake and Coastal Bays ecosystems. Algae, like land plants, capture the sun's energy and support the larger food web that leads to fish and shellfish. They occur in a size range from tiny microscopic cells floating in the water column (phytoplankton) to large mats of visible "macroalgae" that grow on bottom sediments.

Algae may become harmful if they occur in an unnaturally high abundance or if they produce a toxin. A high abundance of algae can block sunlight to underwater bay grasses, consume oxygen in the water leading to fish kills, produce surface scum and odors, and interfere with the feeding of shellfish and other organisms that filter water to obtain their food. Some algal species can also produce chemicals that are toxic to humans and aquatic life. Fortunately, of the more than 700 species of algae in Chesapeake Bay, less than 2 percent of them are believed to have the ability to produce toxic substances.

Both the Departments of Environment and Natural Resources respond to reports of fish kills and nuisance algae blooms (see http://www.dnr.state.md.us/bay/hab/ and http://www.mde.state.md.us/Programs/MultimediaPrograms/environ_emergencies/FishKills_MD/index.asp). In the three year period from 2007 to 2009, the State has identified and investigated 12 HAB events where significant risk to human health from contacting or ingesting water existed, 31 fish kills associated with toxic algae, and 33 fish kills associated with oxygen deprivation caused directly by non-toxic algal blooms. An additional 40 fish kills occurred that were attributed to low dissolved oxygen with indirect links to algae and nutrient enrichment. Both MDE and DNR will continue to work with the Bay Program to develop, where appropriate, standards or other measures to protect both human health and aquatic life from harmful algal blooms.

C.3.9.6 Bathing Beach Closures

The Maryland Department of the Environment works with local health departments to enhance beach water quality monitoring and improve the public notification process regarding beach water quality in Maryland. In October 2000, the U.S. Environmental Protection Agency (EPA) passed the Beaches Environmental Assessment and Coastal Health (BEACH) Act and provided funding to improve beach monitoring in coastal states. Maryland's Beaches Program was established to protect the health of Marylanders at public bathing beaches. The program has evolved further to comply with the requirements of the federal BEACH Act of 2000. This program is administered by MDE; however, the responsibility of monitoring and public notification of beach information is delegated to the local health departments (http://www.mde.state.md.us/CitizensInfoCenter/Health/beaches_healthdepts.asp). To protect the health of citizens visiting beaches across Maryland, MDE's Beaches Program is working to standardize and improve recreational water quality monitoring in the State. In addition, Maryland provides access to real-time beach closure information (see http://www.marylandhealthybeaches.com/index.html) to inform the public of beach closures, advisories, and algal blooms before they head to the beach. The following key objectives outline EPA's and Maryland's Beaches Program:

1. Provide better public information regarding beach water quality; and

2. Promote scientific research to better protect the health of beach users.

The BEACH Act allows states to define and designate marine coastal waters (including estuaries) for use for swimming, bathing, surfing, or similar water contact activities. The State of Maryland defines beaches in the Code of Maryland Regulations (COMAR, http://www.dsd.state.md.us/comar/). In COMAR, beaches means, "natural waters, including points of access, used by the public for swimming, surfing, or other similar water contact activities." Beaches are places where people engage in, or are likely to engage in, activities that could result in the accidental ingestion of water. In Maryland, the beach season is designated from Memorial Day to Labor Day.

Maryland's water quality standards and regulations for beaches are published in COMAR 26.08.09 and 26.08.02.03. Some points included are:

1. *E. coli* and *Enterococci* are the bacteriological indicators for beach monitoring;
2. Prioritization of monitoring of beaches based on risk; and
3. All beaches, whether permitted or not, now receive protection.

PART D: Ground Water Monitoring and Assessment

Senate Joint Resolution No. 25 of 1985 requires the Maryland Department of the Environment (MDE) to provide an annual report on the development and implementation of a Comprehensive Ground Water Protection Strategy in the State and on the coordinated efforts by state agencies to protect and manage ground water. The most recent report provides an overview of the Fiscal Year 2007 activities and accomplishments of State programs that are designed to implement Maryland's Comprehensive Ground Water Protection Strategy.

Since the development of the original strategy, a variety of State programs at MDE, the Maryland Department of Agriculture (MDA) and the Maryland Department of Natural Resources (DNR) have endeavored to achieve this goal. These programs continue to be strengthened by the implementing agencies that contribute toward protecting ground water resources and characterizing the quality and quantity of these resources.

Ground water remains an abundant natural resource that serves as a significant source of drinking water in Maryland. About 31 percent of the State's population depends on ground water for drinking water supply, and ground water also serves as a critical source of base flow to the State's rivers and streams and a major source of freshwater to the Chesapeake Bay. As Maryland's population continues to grow, the demand for additional ground water supplies likewise will increase. The ongoing ground water protection efforts described in this report must be continued and strengthened to ensure that this important resource is protected for future generations.

Specific accomplishments coordinated by the State during fiscal year 2009 (July 1, 2008 – June 30, 2009) are highlighted below:

- In FY 2009 progress continued on Phase I of the Regional Coastal Plain Assessment of the Maryland Coastal Plain. Activities included enhancing the "beta" version of an aquifer information system, and documenting the hydrogeologic characteristics of the aquifer system. MGS completed a preliminary revision of the hydrogeologic framework of the Maryland Coastal Plain. All Phase I tasks are scheduled to be completed in SFY 2011.

- Funding provided through the Base Realignment and Closure Act (BRAC) enabled Maryland to initiate the first part of an evaluation of the Fractured Rock Water Resources in the State. The proposed work will address ground and surface water, existing and projected water withdrawals and return flows, and hydrologic and biological impacts of withdrawals. Initial work will focus on the development of a geospatially-referenced data base of stream flow, hydrogeology, water-use, and other appropriate information, and also the determination of factors affecting ground-water availability in different hydrogeologic settings.

- The Maryland Department of Environment initiated meetings of a stakeholder workgroup to develop regulations to implement SB 674 (2008), which authorizes the MDE to give priority to public water systems that provide water to a municipal corporation, when allocating ground water in Carroll, Frederick, or Washington Counties.

- In April 2009, the Maryland Water Monitoring Council, along with the Maryland Department of the Environment and other State and Federal agencies, sponsored a workshop, "The Roles of Science, Planning, and Regulation in Water Supply Management in Maryland's Fractured Rock Aquifers." The goal of the workshop was to improve the interdisciplinary understanding of the complex issues affecting the management of water supply in fractured rock aquifers.

- The Maryland Department of Planning and MDE have published written guidance to assist local governments in developing a Water Resources Element (WRE) for inclusion in their Comprehensive Plans, in accordance with HB 1141, which was signed into law in 2006. The Water Resources Element ensures that local comprehensive plans fully integrate water resources issues and potential solutions, including insuring that water resources are adequate to meet water supply needs and assimilate treated wastewater. As of March of 2010, 17 of the 23 Counties have submitted their WRE. These have all been reviewed for consistency. In addition to the County WREs, 72 Municipal WREs have also been reviewed.

- In 2009 MDE intensified outreach efforts to encourage citizens to use the Bay Restoration Fund to upgrade onsite sewage disposal systems by purchasing radio advertising and sending mailings. Applications increased from 50 per month during the summer of 2008 to 400 per month in the winter of 2009. Installations also increased to about 80 a month in the spring of 2009. By the end of April 2009 over 700 onsite sewage disposal systems have been upgraded through the fund.

- In May 2009, modifications to COMAR were finalized that will require the implementation of Environmental Site Design (ESD) to the maximum extent possible for new development runoff control. Using various planning techniques and small-scale, nonstructural practices, storm water management designers are now obligated to use ESD to meet a goal of returning post developed hydrologic characteristics back to "woods in good condition." Guidance was developed in the form of a revised Chapter 5 of the Manual to specify what practices are available and how they are to be sized and constructed.

Those stakeholders interested in the full groundwater report can send an email request to 303d@mde.state.md.us.

PART E: Public Participation

MDE utilizes a public participation process for Integrated Report (IR) similar to that used for promulgation of new regulations. The Administrative Procedures Act mandates that a minimum of 45 days from the date of publication in the Maryland Register must be allowed for the adoption of new regulations [see Annotated Code of Maryland, State Government Article, § 10-111(a)]. Thirty of those 45 days must be available for public review and comment. Thus, the Department is granting 30 business days for public review of the draft 2010 Integrated Report of Surface Water Quality. The draft Integrated Report is made available in both electronic and hard copy format to the public via the Internet (http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Maryland%20303%20dlist/index.asp), through distribution to local libraries, and by direct mailing (see Informational Public Meeting Announcement on next page).

During this open comment period for the IR, informational public meetings are held in the western (Williamsport), eastern (Easton), and central (Baltimore) regions of the State to facilitate dialogue between MDE and stakeholders concerning the format, structure, and content of the draft IR. MDE also engages interstate river basin commissions, Maryland tributary teams, and watershed councils during the public comment period and gives full presentations on the Maryland Integrated Report as requested.

Comments or questions may be directed in writing to the Department. All comments submitted during the public review period are fully addressed in a comment response document included with the final List submitted for EPA approval. Sufficient time is built into IR development to allow MDE to receive and fully respond to all public comments on the Report.

E.1 Informational Public Meeting Announcement:

Informational Public Meeting Announcement:
Maryland's Draft 2010 Integrated Report

The Federal Clean Water Act requires that States assess the quality of their waters every two years and publish a list of waters not meeting the water quality standards set for them. This list of impaired waters is included in the State's biennial Integrated Report (IR). Waters identified in Category 5 of the IR are impaired and may require the development of Total Maximum Daily Loads (TMDLs). The Maryland Department of the Environment (MDE) is announcing the availability of the Draft 2010 IR for public review and comment. The public review period will run from **February 12 to March 26, 2010**. The Draft IR is being posted on MDE's website at http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Maryland%20303%20dlist/index.asp . Copies of the document will also be available at selected county library branches statewide; a list of those libraries will be available on MDE's web site or by calling Ms. Danielle Anthony at (410) 537-3906. The Draft IR may also be requested in writing from Ms. Anthony at the address below.

The Department is hosting three informational public meetings. The public is cordially invited to attend a meeting in a region of their choice. Any hearing impaired person may request an interpreter to be present at the meeting by giving five (5) working days notice to Matthew Stover at *mstover@mde.state.md.us* or by calling (410) 537- 3611. Comments or questions may be directed in writing to Ms. Danielle Anthony MDE, Science Services Administration, 1800 Washington Blvd., Baltimore Maryland 21230, emailed to 303d@mde.state.md.us, or faxed to the attention of Ms. Danielle Anthony at 410-537-3998 on or before **March 26, 2010**. After addressing all comments received during the public review period, a final List will be prepared and submitted to the U.S. Environmental Protection Agency for approval.

Eastern Shore Region
Location: Easton
Date: March 11, 2010
Start Time: 6:00 p.m.
Talbot County Community Center
10028 Ocean Gateway
Easton, MD 21601
1(410) 770-8050

This meeting is co-sponsored by the Lower Eastern Shore Tributary Team.

Western Maryland Region
Location: Williamsport
Date: February 24, 2010
Start Time: 5:00 p.m.
Washington County Department of Water Quality
16232 Elliott Parkway
Williamsport, MD 21795
1(240) 313-2600

This meeting is co-sponsored by the Upper Potomac Tributary Team.

Central Region
Location: Baltimore
Date: March 11, 2010
Start Time: 6:00 p.m.
MDE Headquarters
1800 Washington Blvd.
Baltimore MD, 21230
1(410) 537-3873

This meeting is co-sponsored by the Patapsco/Back River Tributary Team.

E.2 Attendance Lists from Informational Public Meetings

MDE

Integrated Report Public Meeting Sign-in Sheet
Williamsport, MD February 24, 2010

Name	Address	Affiliation	email
Julie Pippel	16232 Elliott Parkway Williamsport MD 21795	Wash. Co. Div. of Env. Mngt	jpippel@washco-md.net
Les Mull	210 State Rt. 956 Rocket Center, WV 26726	Alliant Techsystems	les.mull@atk.com
DONALD BARTON	1 Clean Water Circle HAG MD 21740	City of Hag.	DBARTON@HAGERSTOWNMD.ORG
Allen Festerman	76E Mayhew Inn Rd Oakland MD 21550	Garrett Co. Sani Dist.	cafe@garrettcounty.org
Mike Thompson	80 W. Baltimore St. Hagerstown, MD 21742	Wash Co Planning	mthompson@washco-md.net
Dan Bard		MD DEPT AG	bardd@mda.state.md.
Keith Bloyer	17910 Mt Aetna Rd Hagerstown MD 21742		kbloyer@earthlink.net
Brent Walls	38 Willowby Ct Bunker Hill, WV 25413	Potomac Riverkeeper	brent@potomacriverkeeper.org
ELLIE KIRSCH	50 CITIZENS WAY #400 FREDERICK MD 21701	IWLA/Chesa.	KIRSCH3341@comcast.net
David Biser	13218 Clopper Rd	Antietam Creek Watershed	acwaond@gmail
Elmer Weibley	1260 MD Ave Suite 101	Wash Co SCD	wcscd1@verizon.net
Denise Price	" "	" "	wcscd1@verizon.net
Sally Hatch	1201 Jeff Blvd	ACWA	sally.6c6@verizon.net
Bob Hatch	"	"	"
Neil & Laura Wright	19774 Beaver Creek Church Rd Hagerstown MD	Upper Pot Trib Team	neilaura@myactv.net
Pat Shirley	20702 Ole Forge Rd Hagerstown	Citizen	[illegible]@myactv.net

February 24th, 2010 1

MDE

Integrated Report Public Meeting Sign-in Sheet
Baltimore, MD March 11, 2010 at 6 p.m.

Name	Address	Affiliation	email
Jan Carver	24 Atherton Rd	volunteer/writer	jan.carver@comcast.net
Tom Filip	7626 [illegible] Dr. [illegible] MD 21122	PIBTT	[illegible]@aol.com
John Martin	1326 Glendale Rd Balt 21234	Balt City	john.martin@baltimorecity.gov
Duncan Stuart	3001 Druid Park Dr. Balt.	Balt City DPW	duncan.stuart@baltimorecity.gov
Jack Anderson	10101 Windstream Dr #1 Columbia 21044	Howard Co CCT	jackandjane@msn.com
Eric Hines		USDA/NRCS	eric.hines@md.usda.gov
Andrea Gerhard		Carroll Co.	agerhard@ccg.carr.org
Susan Overstreet		HoCo DPZ	s.o.
STUART STAINMAN	1305 W. [illegible] Rd.		sstainman@gmail.com
Steve Stewart		Balt Co DEPRM	sstewart@baltimorecountymd.gov
Anne Martin	1326 Glendale	Citizen	

March 11th, 2010 1

MDE

Integrated Report Public Meeting Sign-in Sheet
Easton, MD March 11, 2010

	Name	Address	Affiliation	email
	Bill Wolinski		Talbot DPW	wwolinsk.@talbotcountymd.gov
	Preston Padden	5734 Pirates Cove Rd		paddenp@abc...
	BARBARA PADDEN	5734 PIRATES COVE RD		PADDENBL@AOL.COM
	ROGER BOLLMAN	2231 S. HANSON ST	CREEK WATCHER	bollman@goeast...
	TOM Hughes	9284 CHENAR FARM Rd EASTON, MD.	~~EASTON MD~~ CITIZEN	
*	Tom Leigh	100 N. Cross St Chestertown	Chester River Association	riverkeeper@chesterriverassociation.
	[illegible]	[illegible]	MES	JKore@MENV.COM
	Erin Murphy	Arnold, MD	MES	emurp@menv.com
	DIANE MILLER		EC	
	Diane Cole	Cambridge MD		
	Doc Kuntz	Easton, MD	CREB	
	Louise Henckel	10262 High field Rd Easton		
	William D. Beaver	9373 Kingston Ldg. Rd Easton		
	Richard Hutchison	11229 Lewistown Rd Cordova, MD 21625		
	Wilbur Levengood Jr	14902 Davis Rd, Goldsboro Md. 21636	Caroline County Hq.	poorboy5573@gmail.co
*	William Collier, Jr.	BLOLLIER46@GMAIL.COM	Caroline Co.	(410)482-6221
	Marica Fidis	9400 Bantry Rd		
	Sam Brinton	7569 Sawyer Lane	Chop Trib Team	BRNTSA@GMU.EDU
	Tom Alspach	Box 1358 Easton	TPA	talspach@goeaston.net
	TALBOT BONE	201 N-WASHINGTON ST, EASTON	EASTON UTILITIES	tbone@eucmd...
	JACK Fischer	P.O. Box 88 Sherwood MD	TALBOT COUNTY Public Works Advisory Board	
	Allison Dungan	3791 Rumsey Dr. Trappe	Caroline Planning	dungan.allison@...
	Kascie Herron	128 N. Queen St. Chestertown	Sassafras River Assoc.	riverkeeper@sassafrasriver.org
	Drew Koslow	104 Conner St. St Michaels	CREB Conservancy	dkoslow@verizon.net
	Jen Dindinger	363 Glebe Rd Easton, MD 21601	Chop. Trib Tm	jdinding@umd.edu

March 11th, 2010 1

Name	Address	Affiliation	email
Laird Wise	12217 Fawnhaven Ellicott City MD 21042	Wiselabs	Wiselabs@yahoo.com

March 11th, 2010 2

E.3 Comment-Response for the 2010 Integrated Report

List of Commentors

Author	Affiliation	Date Received
Allison Dungan	Caroline Planning Department	March 11, 2010
Miyoko Sakashita	Center for Biological Diversity	March 23, 2010
Eileen Deymier	Talbot Preservation Alliance	March 24, 2010

CAROLINE PLANNING DEPARTMENT, 3791 Rumsey Drive, Trappe, MD, Allison Dungan, dungan.allison@gmail.com

Caroline Planning Dept. Comment (paraphrased): What is the justification for delisting the Upper Choptank River (02130404) for PCBs since it was listed in Category 5 in 2008 and in 2010 it is now in Category 2?

MDE Response: Watershed 02130404 was listed category 5 in the 2008 Integrated Report based on the data in the table below. The mercury threshold of 300 ng/g was not exceeded; however, the total PCB threshold of 39 ng/g was exceeded. For the 2010 IR, MDE staff reviewed the data used to make this listing and discovered that the original analysis used inappropriate parts of the fish to make the impairment determination. Instead of using only the fillet of the fish, as the Toxics Listing Methodology specifies (Section C.2.3), the first two samples utilized the whole fish and the ovaries, respectively. Since Maryland fish advisories and fish tissue-based 303d listings are based on fillets and NOT whole fish or parts of; the first two samples should not have been considered. Therefore, MDE reanalyzed the fish tissue PCB data from fish fillets only and found a concentration level of 7.14 ng/g. Since this level is well below the threshold used for listing, the Upper Choptank River (02130404) PCB listing was moved to Category 2 of the IR.

Date	Site	Lat	Long	SAS_Area	Fish	Composite	Sample_ID	MHg ng/g	Hg ng/g	T-PCBs ng/g
3/1/2004	ChopR	38.806	-75.910	Choptank	Yellow Perch (whole)	5	ChopR_03012004_fish_yp1	11.80	46.99	104.76
3/1/2004	ChopR	38.806	-75.910	Choptank	Yellow Perch (ovaries)	5	ChopR_03012004_fish_yp2			221.93
3/6/2007	ChopR2	38.832	-75.855	Choptank	Yellow Perch (fillet)	5	CHOP_03062007_fish_yp			7.14

CENTER FOR BIOLOGICAL DIVERSITY, 351 California Street, Suite 600, San Francisco, California 94104, Miyoko Sakashita, Oceans Director, miyoko@biologicaldiversity.org

CFBD Comment (paraphrased and shortened): On April 30, 2009, the Center for Biological Diversity (CFBD) submitted scientific information supporting the inclusion of ocean waters on Maryland's 303(d) list. Nonetheless, Maryland's draft 2010 303(d) list failed to include any ocean segments threatened or impaired by ocean acidification. The overwhelming scientific evidence supports the inclusion of ocean waters on the 303(d) list because ocean acidification is causing degradation of seawater quality in violation of Maryland's water quality standards and threatens to become worse. Maryland must list ocean waters as impaired for ocean acidification because designated uses for aquatic life are not attained, and acidification is causing measurable degradation in violation of the Antidegradation policy. This letter and its source documents should be taken under consideration in support of listing ocean waters. CFBD's previous letter and documents are incorporated by reference.

CFBD also contends that Maryland's current marine pH water quality standard (pH of 6.5 – 8.5) is inadequate for protecting marine life. In light of EPA's current review and possible revision of its marine pH criterion, Maryland should gauge the need to list waters due to ocean acidification on the 303(d) list by the impacts on water quality and marine life.

MDE Response: MDE reviewed the data and information submitted by CFBD in both instances (April 30, 2009 and March 18, 2010) and has formulated the following conclusions.

MDE shares CFBD's concerns about the growing body of evidence supporting the relationship between increased levels of atmospheric carbon dioxide and ocean acidification. As a result, MDE will continue to take this issue seriously for consideration in the 303(d) process. However, with regard to listing the ocean and Chesapeake Bay waters as impaired due to ocean acidification, this would require site specific data (i.e., pH data from Maryland's ocean waters) indicating that the water quality criterion for pH is not being met. Unfortunately, at this point in time, no Maryland specific data have been provided that would support such a listing decision. MDE also does not have any data indicating that aquatic life uses are not being met in Maryland's ocean waters due to an inability of calcifying organisms to build their protective structures. If CFBD can provide such site specific information in the future, this would be helpful in making such determinations. It is worth mentioning that this year, 2010, Maryland is participating in EPA's nationwide Coastal Condition Assessment. It is possible that the results of this monitoring and assessment effort may yield data to support such a listing.
Regarding CFBD's comments about revising Maryland's water quality criterion for pH in marine waters, please contact Mr. John Backus (jbackus@mde.state.md.us or 410-537-3965) in MDE's Water Quality Standards Program. The Triennial Review process for water quality standards is the best forum to propose standards revisions, and Mr. Backus can provide you with details about that process.

It is also worth noting that EPA will be working to address this issue at a national level. EPA wishes to clarify that the Agency has come to no conclusion on the utility of TMDLs to address ocean acidification. In addition, the Agency has issued a Federal Register (FR) notice seeking comments on how to address ocean acidification under the CWA Section 303(d) program, including whether EPA should issue guidance regarding the listing of waters as threatened or impaired for ocean acidification, and what that potential guidance might entail. EPA expects to make a decision by November 15, 2010, about how to proceed with regard to the interplay between ocean acidification and the 303(d) program based on information received from this FR notice as well as information from other ongoing Federal efforts that are taking place on issues related to ocean acidification.

TALBOT PRESERVATION ALLIANCE, 210 Marlboro Road, PMB 31-208, Easton, MD 21601, Eileen Deymier – V. President, *www.talbotpreservation.org*

Explanation: The Talbot Preservation Alliance submitted a formal letter to the Secretary of MDE, Shari Wilson, regarding the pace of TMDL development for Talbot County waters. Since this letter and its comments dealt with matters relating to the TMDL program and not the IR, the response to this letter was submitted directly to the Talbot Preservation Alliance via a formal memo.