



2004 List of Impaired Surface Waters [303(d) List] and
Integrated Assessment of Water Quality in Maryland
Submitted in Accordance with Sections 303(d) and 305(b) of the Clean Water Act

Robert L. Ehrlich, Jr. – Governor
Michael S. Steele – Lt. Governor



Kendl P. Philbrick, Secretary
Jonas A. Jacobson, Deputy Secretary



Ronald L. Franks, Secretary
W.P. Jensen, Deputy Secretary

April 2004

TABLE OF CONTENTS

LIST OF TABLES	vii
LIST OF ACRONYMS	viii
EXECUTIVE SUMMARY	ix
ACKNOWLEDGEMENTS	x
PREFACE.....	1
1.0 INTRODUCTION	3
2.0 EPA GUIDANCE FOR THE 2004 INTEGRATED LIST.....	4
2.1 <i>Multiple Category List Structure</i>	4
2.2 <i>Public Participation</i>	5
2.3 <i>Listing Methodology Development</i>	6
2.4 <i>Watershed Size and Segmentation</i>	6
2.5 <i>Data Quality and Statistical Approaches to Data Analysis</i>	7
2.6 <i>Probabilistic Monitoring Data</i>	10
2.7 <i>Monitoring Schedules</i>	10
3.0 SUMMARY OF CHANGES IN THE 2004 INTEGRATED LIST	11
3.1 <i>Biological Listings</i>	11
3.1.1 Introduction.....	11
3.1.2 MBSS Data Analysis and Results.....	12
3.1.3 Biologically Impaired Waters.....	13
3.1.4 Waters with Insufficient Biological Data to Determine Impairment.....	13
3.1.5 Biologically Unimpaired Waters	16
3.1.6 Proposed Revisions for Waters Determined to be Unimpaired Based Upon New MBSS Data.....	17
3.1.6.1 Savage River, 02141006	17
3.2 <i>Chesapeake Bay Benthic Index of Biological Integrity (IBI)</i>	19
3.2.1 Listing Methodology for Identification of Estuarine Biological Impairments .	20
3.2.1.1 Scope	20
3.2.1.2 Criteria	20
3.2.1.3 Process	21
3.2.1.3.1 Natural conditions/assessment issues	23
3.2.1.4 Limitations and use of professional judgment	23
3.2.1.5 Reporting	23
3.2.1.5.1 Use of other data	23
3.3 <i>2004 303(d) bacterial listing changes</i>	28
3.4 <i>Bacteria Shellfish Water Adjustments</i>	30
3.4.1 Water Body Type Designations.....	30
3.4.2 Geographical Scale of Listing for Shellfish Harvesting Waters.....	31
3.4.3 New and Revised Listings to Tidal Shellfish Areas	31
3.4.3.1 New Listings	31
3.4.3.2 Revised Listings	32

3.5	<i>Nutrient Listing Changes</i>	37
3.6	<i>Mercury Impairment Additions</i>	37
3.7	<i>Toxic Water Quality Analysis</i>	39
3.8	<i>Other De-listings and Revisions</i>	43
3.8.1	Coastal Bays.....	43
3.8.2	Baltimore Harbor	43
3.8.3	Sediment Listings.....	43
3.8.4	Tidal and Non-Tidal Listings.....	43
3.8.5	Other Miscellaneous and Non-substantial Revisions	44
4.0	2004 NUMERICAL SUMMARY OF INTEGRATED REPORTING CATEGORIES	45
5.0	PRIORITY RANKING AND TMDL COMPLETION SCHEDULING	46
5.1	<i>Overview</i>	46
5.2	<i>WQLS Priority-setting</i>	49
5.3	<i>WATERBODY USE CONSIDERATION</i>	49
5.3.1	Pollution Severity Considerations.....	49
5.4	<i>TMDL Scheduling and Completion</i>	49
5.5	<i>Consideration of Priority Designations</i>	52
5.6	<i>Programmatic and Technical Considerations</i>	52
5.6.1	Basin Planning Cycle.....	52
5.6.2	Availability of Resources to Ensure Adequacy of Data and Technical Tools..	53
5.6.3	Technical Complexity	53
5.6.4	Coordination with Other Program Needs	55
5.6.5	Cooperation of Affected Parties.....	55
5.6.6	Other Factors.....	55
5.7	<i>Discussion of Priority Ranking and Scheduling for Maryland's 2004 303(d) List</i>	55
6.0	2004 REPORT FORMAT AND STRUCTURE.....	57
7.0	THE 2004 LIST OF IMPAIRED SURFACE WATERS [303(D) LIST] AND INTEGRATED ASSESSMENT OF WATER QUALITY IN MARYLAND.....	58
7.1	<i>Category 2 of the 2004 303(d) Integrated List – includes surface waters that are meeting some standards and have insufficient information to determine attainment of other standards.</i>	59
7.2	<i>Category 3 of the 2004 303(d) Integrated List – includes surface waters that have insufficient quantity (Category 3a) or quality (Category 3b) data and information to determine water body attainment status</i>	60
7.3	<i>Category 4a of the 2004 Integrated 303(d) List – includes surface waters that are still impaired but have a TMDL that has been completed or submitted to EPA</i>	61
7.4	<i>Category 4b of the 2004 Integrated 303(d) List – includes surface waters impaired for one or more water quality standards but not needing a TMDL because other pollution control requirements are reasonably expected to result in the attainment of water quality standards in the near future.</i>	62

7.5	<i>Category 5 of the 2004 Integrated 303(d) List - historically known as the 303(d) List and includes water bodies that may require a TMDL</i>	63
7.6	<i>Category 6 of the 2004 Integrated 303(d) List – includes surface waters that have been de-listed or removed from the current 2004 List of impaired surface waters</i>	64
APPENDICES		I
APPENDIX A – Data Solicitation		II
APPENDIX B - Data Sources		IV
APPENDIX C – Listing Methodologies		VI
8.1	LISTING METHODOLOGY FOR IMPLEMENTATION OF COMAR §26.08.02.01-B(2): BIOLOGICAL ASSESSMENT OF WATER QUALITY	VI
8.1.1	<i>ABSTRACT</i>	VI
8.1.2	<i>SCOPE</i>	VI
8.1.3	<i>APPLICATION</i>	VII
8.1.3.1	Stream Order	VII
8.1.3.1.1	Procedures for 8-digit watersheds	VII
8.1.3.1.2	Procedures for 12-digit (sub)watersheds	VIII
8.1.4	<i>PRIORITIZATION FOR WATERSHEDS WHERE MONITORING INTERPRETATION IS INCONCLUSIVE</i>	XI
8.1.5	<i>REPORTING</i>	XI
8.1.6	<i>EXCEPTIONS</i>	XI
8.1.7	<i>APPROACH TO USE OF NON-MBSS DATA IN BIOCRITERIA</i>	XII
8.1.7.1	Tier 1	XII
8.1.7.2	Tier 2	XIII
8.1.8	<i>STRESSOR IDENTIFICATION</i>	XIV
8.1.9	<i>REFERENCES</i>	XIV
8.2	METHODOLOGY FOR THE INTERPRETATION OF DISSOLVED OXYGEN STANDARDS IN MARYLAND’S THERMALLY STRATIFIED LAKES	XVII
8.2.1	<i>INTRODUCTION</i>	XVII
8.2.2	<i>BACKGROUND FOR PROPOSED INTERM INTERPRETATION OF DO STANDARDS AS APPLIED TO THERMALLY STRATIFIED LAKES IN MARYLAND</i>	XVII
8.2.3	<i>LISTING METHODOLOGY FOR INTERPRETATION OF DO STANDARD AS APPLIED TO THERMALLY STRATIFIED LAKES IN MARYLAND</i>	XIX
8.2.4	<i>REFERENCES</i>	XX
8.3	LISTING METHODOLOGY FOR PH AND MINE IMPACTED WATERS	XXI
8.4	LISTING METHODOLOGY FOR IDENTIFYING WATERS IMPAIRED BY BACTERIA ON MARYLAND'S 303(D) LIST	XXIII
8.4.1	<i>INTRODUCTION</i>	XXIII
8.4.2	<i>INTERPETATION OF FECAL COLIFORM DATA IN USE II, SHELLFISH HARVESTING AREAS</i>	XXIII
8.4.3	<i>INTERPRETATION OF FECAL COLIFORM DATA FOR SWIMMING BEACHES</i>	XXIV

8.4.4	<i>INTERPRETATION OF FECAL COLIFORM DATA FOR USE I, II OR IV WATERS</i>	XXIV
8.4.5	<i>DISCUSSION</i>	XXV
8.5	LISTING METHODOLOGY FOR DETERMINING IMPAIRED WATERS BY CHEMICAL CONTAMINANTS FOR THE MARYLAND 303(D) LIST	XXVII
8.5.1	<i>BACKGROUND</i>	XXVII
8.5.2	<i>INTRODUCTION</i>	XXVII
8.5.3	<i>WATER COLUMN</i>	XXVIII
8.5.4	<i>SEDIMENT</i>	XXIX
8.5.4.1	Ambient Sediment Bioassay Data.....	XXX
8.5.4.2	Sediment Chemistry Data.....	XXXI
8.5.5	<i>BIOLOGICAL BENTHIC ASSESSMENT DATA</i>	XXXII
8.5.6	<i>WEIGHT-OF-EVIDENCE APPROACH (Sediment Quality Triad)</i>	XXXIV
8.5.7	<i>FISH TISSUE</i>	XXXVII
8.5.7.1	Data Requirements.....	XXXVIII
8.5.7.2	Contaminant Thresholds.....	XXXIX
8.5.8	<i>REFERENCES</i>	XXXIX
8.6	LISTING METHODOLOGY FOR SOLIDS	XLII
8.6.1	<i>FREE-FLOWING STREAMS</i>	XLII
8.6.1.1	Water Clarity.....	XLII
8.6.1.1.1	Turbidity.....	XLII
8.6.1.2	Erosional and Depositional Impacts (limited to wadeable streams).....	XLII
8.6.2	<i>IMPOUNDMENTS</i>	XLIII
8.6.2.1	Water Clarity.....	XLIII
8.6.2.1.1	Turbidity.....	XLIII
8.7	LISTING METHODOLOGY – SEWAGE RELEASES	XLIV
8.7.1	<i>INTRODUCTION</i>	XLIV
8.7.2	<i>METHODOLOGY</i>	XLIV
	APPENDIX D - Maryland’s Watershed Cycling Strategy	XLV
	OVERVIEW.....	XLV
	WATER QUALITY STANDARDS.....	XLV
	MONITORING.....	XLVI
	ASSESSMENT AND TMDL DEVELOPMENT.....	XLVII
	TMDL IMPLEMENTATION AND WATERSHED-BASED PERMITTING.....	XLVII
	FOLLOW-UP EVALUATION.....	XLVIII
	APPENDIX E – Comment-Response Document for the 2004 303(d) List	XLIX
	APPENDIX F – MDE Response to EPA’s Comments on the Final Draft 2004 Integrated Report	LXXVIII

LIST OF FIGURES

Figure 1: Names of the 8-digit basins (averaging 75 square miles each) used to list waters on the 2004 Integrated 303(d) List.	8
Figure 2: Maryland 12-Digit subwatersheds (outlined in white and approximately 11 square miles each) used to identify subbasins within the 8-Digit planning scale. The 8-digit basins (outlined in black) are overlaid for comparison.....	9
Figure 3: Land use map for the Savage River watershed.	19
Figure 4: Maryland 8-digit basin map highlighting the Potomac River lower tidal basin (02140101).....	31
Figure 5: Potomac River lower tidal basin with the two bacterial impaired shellfish waters of Whites Neck Creek and Tall Timbers Cove.	32
Figure 6: WQLS Priorities and TMDL Completion Scheduling. Information types (1) and (2) are used to determine the priority designation for each water quality limited segment (WQLS), (3). The priorities, (3), and other management factors, (4), serve as inputs to determine the TMDL completion schedule.	48
Figure 7: Five different regions in Maryland’s designated for the Watershed Cycling Strategy.	54
Figure 8: 2004 Integrated 303(d) List highlighting listed segments and supporting data.	57
Figure 9: Biological impairment determination based upon confidence intervals.	X
Figure 10: Biological Monitoring Decision Flow.....	XVI
Figure 11: Nomogram showing relationship between water temperature, DO concentration, and DO saturation. <i>Source:</i> Reid 1961.	XVIII
Figure 12: Minimum allowable hypolimnetic dissolved oxygen saturation and concentration in a meso-eutrophic lake ($T = 10^{\circ}\text{C}$).....	XX
Figure 13: Decision flowchart for pH impaired waters.	XXII

LIST OF TABLES

Table 1: 8-Digit watersheds determined to be impaired using Maryland Biological Stream Survey Data.....	13
Table 2: 8-Digit watersheds assessed as indeterminate using Maryland Biological Stream Survey Data.....	14
Table 3: 8-Digit watersheds determined to be unimpaired using Maryland Biological Stream Survey data.....	16
Table 4: pH Values for Savage River subbasins measured during Maryland Biological Stream Survey sampling.....	17
Table 5: DECISION MATRIX – Interpretation of other data affecting observed benthic IBI (Dissolved oxygen, Toxic contaminants)	22
Table 6: Bay IBI impairments (Category 5)	25
Table 7: Assessment Status for all waters evaluated as inconclusive using the Chesapeake Bay IBI	26
Table 8: Bacteria Shellfish Water Adjustments.....	33
Table 9: Maryland Department of the Environment Fish Consumption Guidelines.....	38
Table 10: Numeric Water Quality Criteria (Metals).....	40
Table 11: Sediment Toxicity Test Results	42
Table 12: Numerical summary of water bodies appearing in the various categories of the 2004 Integrated List	45
Table 13: Relationship between Lake Trophic Status and Dissolved Oxygen Saturation in the Hypolimnion of a Thermally Stratified Lake.....	XVIII
Table 14: Extended Relationship between Lake Trophic Status and Dissolved Oxygen Saturation in the Hypolimnion of a Thermally Stratified Lake.....	XIX
Table 15: Possible Conclusions Provided by Using the Sediment Quality Triad Approach (Chapman, 1992).....	XXXV
Table 16: Table of Sediment Screening Values.....	XLI

LIST OF ACRONYMS

ANC – Acid Neutralizing Capacity
BIBI – Benthic Index of Biological Integrity
CFR – Code of Federal Regulations
Cd - Cadmium
CI – Confidence Interval
CL – Confidence Limit
COMAR – Code of Maryland Regulations
Cr - Chromium
CWA – Clean Water Act
DO – Dissolved Oxygen
DOC – Dissolved Organic Carbon
ERL – Effects Range Low
ERM – Effects Range Median
EPA – U.S. Environmental Protection Agency
ESGs – Equilibrium Sediment Guidelines
FACA – Federal Advisory Committee Act
FIBI – Fish Index of Biological Integrity
GIS – Geographic Information System
IBI – Index of Biological Integrity
ICs – Individual Control Strategies
MBSS – Maryland Biological Stream Survey
MDE – Maryland Department of the Environment
MDNR - Maryland Department of Natural Resources
Mg/L – Milligrams Per Liter
MPN – Most Probable Number
NHD – National Hydrography Dataset
NSSP – National Shellfish Sanitation Program
Pb - Lead
PSU – Primary Sampling Unit
QA/QC – Quality Assurance/Quality Control
SE – Standard Error
STORET – EPA’s “STOrage” and “RETreival” database
TARSA – Maryland Department of the Environment’s Technical and Regulatory Services Administration
TMDL – Total Maximum Daily Loads
USGS – U.S. Geological Survey
WQA – Water Quality Analysis
WQLS – Water Quality Limited Segment
WQC – Water Quality Criteria
WQS – Water Quality Standards
Zn - Zinc