2025-2032 Vision for Clean Water Act Section 303(d) Program

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List of Abbreviations

APG	Aberdeen Proving Ground
BIBI	Benthic Index of Biotic Integrity
BMP	Best Management Practice
BSID	Biological Stressor Identification
CBL	Chesapeake Biological Laboratory
CBP	Chesapeake Bay Program
CBPO	Chesapeake Bay Program Office
CBP5.2	Chesapeake Bay Model Phase 5.2
CBRAP	Chesapeake Bay Regulatory and Accountability Program
CDC	Center for Disease Control
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Chl-a	Chlorophyll a
Cl	Chloride
CWA	Clean Water Act
DC	District of Columbia
DFIRMs	Digital Flood Insurance Rate Maps
DO	Dissolved Oxygen
DOEE	DC Department of Energy and Environment
EFDC	Environmental Fluid Dynamics Code
EJ	Environmental Justice
FEMA	Federal Emergency Management Agency
FIRMs	Flood Insurance Rate Maps
FFIT	Maryland Forest Financing Implementation Tool
FFY	Federal Fiscal Year
Gen X	Hexafluoropropylene oxide dimer acid or HFPO-DA
GIS	Geographic Information Systems
HFPO-DA	Hexafluoropropylene oxide dimer acid or GenX
Hg	Mercury
HOA	Homeowner's Association
IBI	Index of Biotic Integrity
ICPRB	Interstate Commission on the Potomac River Basin
IR	Integrated Report of Surface Water Quality
LMA	Land Management Administration
MATS	Mercury and Air Toxics Standards (EPA's)
MBM	Main Bay Model
MBSS	Maryland Biological Stream Survey
MCLs	Maximum Contaminant Levels
MDA	Maryland Department of Agriculture
MDDNR	Maryland Department of Natural Resources
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MeHg	Methylmercury
MOU	Memorandum of Understanding
MS4	Municipal Separate Stormwater Sewer System
MTMs	Multiple Tributary Models
NADP	National Atmospheric Deposition Network
ng/g	Nanogram/gram
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPDWR	National Primary Drinking Water Regulation
NPL	National Priority List (Superfund)
NRDC	Natural Resources Defense Council

Pb	Lead
PCB(s)	Polychlorinated Biphenyls
PEARL	Patuxent Environmental & Aquatic Research Laboratory, Morgan State University
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFAS	Per and Polyfluoroalkyl Substances
PFBS	Perfluorobutane sulfonate
PFHxS	Perfluorohexanesulfonic acid
PFOS	Perfluorooctane Sulfonic Acid
pH	Percent of Hydrogen
Phase 6 Model	Chesapeake Bay Program's Phase 6 Model
POTW	Publicly-Owned Treatment Works
QA/QC	Quality Assurance/Quality Control
SERC	Smithsonian Environmental Research Center
SHA	State Highway Administration
SO_4	Sulfate
SSN	Spatial Statistical Network model
SWAT	Soil and Water Assessment Tool
SWI	Sediment Water Interface
SW-WLA	Stormwater Wasteload Allocation
TIPP	TMDL Implementation Progress and Planning Tool
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
UMBC	University of Maryland Baltimore County
UMD	University of Maryland
UMCES	University of Maryland Center for Environmental Science
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
VIMS	Virginia Institute of Marine Science
WIP	Watershed Implementation Plan
WLA	Waste Load Allocation
WPRPP	Watershed Protection, Restoration and Planning Program
WQA	Water Quality Analysis
WQLS	Water Quality Limited Segment
WQS	Water Quality Standards
WREC	Wye Research and Education Center
WSA	Water and Science Administration
WWTP	Wastewater Treatment Plant
Zn	Zinc

Introduction

The Maryland Department of the Environment (MDE) is largely responsible for fulfilling Maryland's mandates under the federal Clean Water Act (CWA). One important mandate is monitoring the State's waters to determine attainment of water quality standards. Section 303(d) of the Federal Clean Water Act directs states to identify and list waters, known as water quality limited segments (WQLSs), for which technology-based effluent controls of a specified substance are inadequate to achieve water quality standards (33 U.S.C. § 1313(d); see also 40 Code of Federal Regulations 130.7(b)(i - iii)). For each WQLS, the State must establish a total maximum daily load (TMDL) of the impairing substance that the WQLS can receive without violating water quality standards. Each TMDL addresses a single pollutant or stressor for a specified waterbody. Therefore, waterbodies with multiple impairments may require multiple TMDLs. If the existing water quality information demonstrates that water quality standards are being met, a Water Quality Analysis (WQA) may be conducted and the waterbody-pollutant listing would be removed from the impaired waters list.

In 2013, the United State Environmental Protection Agency (USEPA) developed a vision for Section 303(d) of the federal Clean Water Act. The Vision is designed to help coordinate and focus efforts to advance the effectiveness of CWA. It consists of Engagement, Prioritization (of a state's watersheds), Protection (i.e., of unimpaired watersheds), Alternatives (to traditional TMDL development), Integration (with other major environmental statutes), and Assessment (of overall results). The Engagement and Prioritization components are implemented first, followed by Protection, Alternatives and Integration, with Assessment last. The first 'cycle' of full implementation of the New Vision began with the 2016 Integrated Report of Surface Water Quality (IR) and ended in 2022. New TMDL development focused on (1) the protection of public health, and (2) the protection of aquatic life in all of Maryland's waterways.

Maryland developed and submitted its list of priority watersheds in 2016 after presenting the information at four public meetings. The presentation can be found here: https://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Documents/prioritiz_IR_Pubmeet_hdt.pdf.
The full documentation of this prioritization is available in the 2016 IR Part G available at: https://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Documents/Integrated_Report_Section_PDFs/IR_2016/Final_2016_IR_Part_G.pdf.

The CWA Section 303(d) Program made significant advances implementing the 2013 Vision. States and territories have been using the goals outlined in the 2013 Vision to guide program management for the past ten years. With lessons learned from the last decade, USEPA finalized the development of the 2022-2032 Vision (2022 Vision). The 2022 Vision builds on the experience gained from implementing the 2013 Vision outlined in A New Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program. Like the 2013 Vision, 2022 Vision is intended to encourage flexible and innovative approaches for states, territories, and authorized tribes ("states, territories, and tribes") to implement CWA Section 303(d), as well as to identify ways to best use limited resources to lead to restoration and protection, to leverage partnerships, and to encourage development of solutions to emerging and difficult water quality issues.

The goals presented in the 2022 Vision are Planning and Prioritization, Restoration, Protection, Data and Analysis, and Partnerships. Maryland has built upon its 2016 Vision and components of that document are incorporated herein. This document updates the Prioritization and Planning goal and identifies Maryland's priorities related to addressing Category 5 listings, along with the rationales for those priorities. Throughout this document, actions towards the other goals are integrated where applicable, as Maryland's water quality management has operated in an integrated fashion for some years.

Background

In Maryland, the responsibility for the preparation of the Integrated Report of Surface Water Quality, TMDL and other plan development belongs to Maryland Department of the Environment's Water and Science Administration, specifically the Watershed Protection, Restoration & Planning Program (WPRPP).

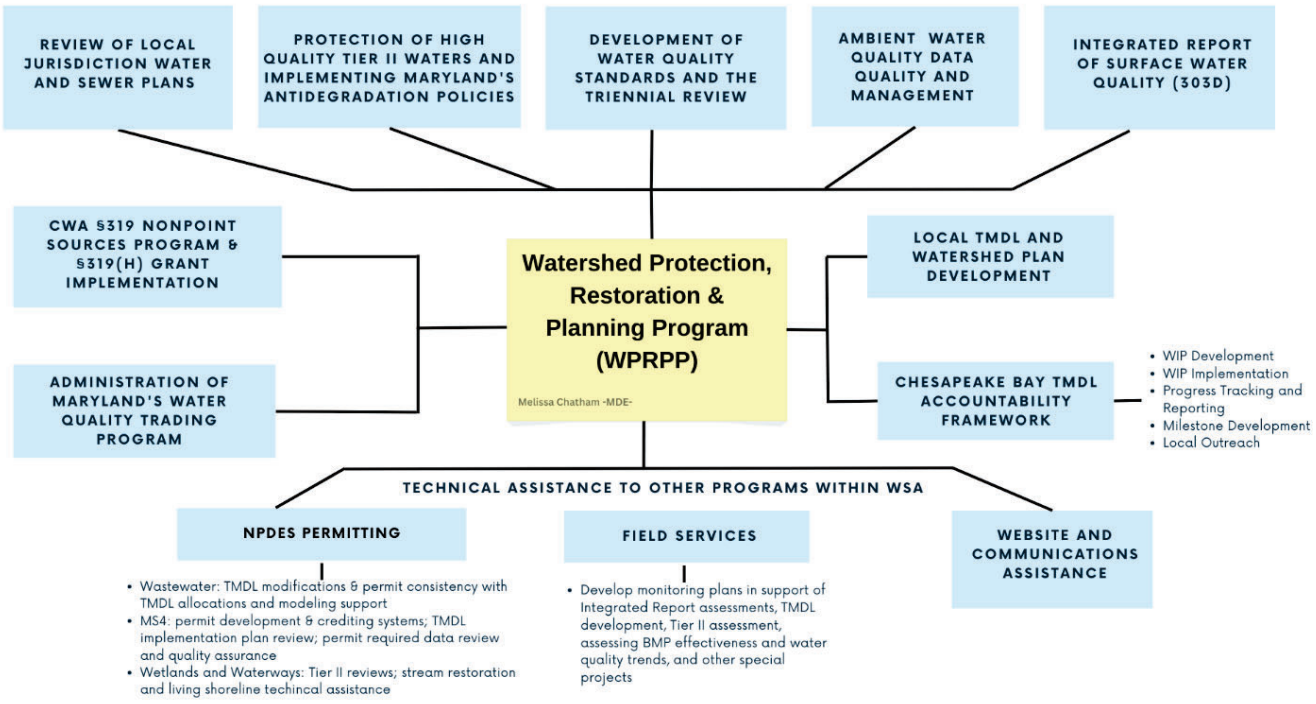


Figure C- 1: Functions of the WPRPP

The many functions and facets of WPRPP played a significant role in the development of Maryland's 2025-2032 Vision for TMDL and other plan development. Because of the Program's many and variable responsibilities which requires interactions with not only other MDE Programs but also other State agencies, the 2025-2032 Vision reflects a comprehensive strategy for addressing §303(d) impairment listings that align with Departmental priorities that also have the highest likelihood of resulting in tangible actions to improve water quality in waterbodies throughout the State of Maryland.

Water quality management in Maryland is a cyclical process.

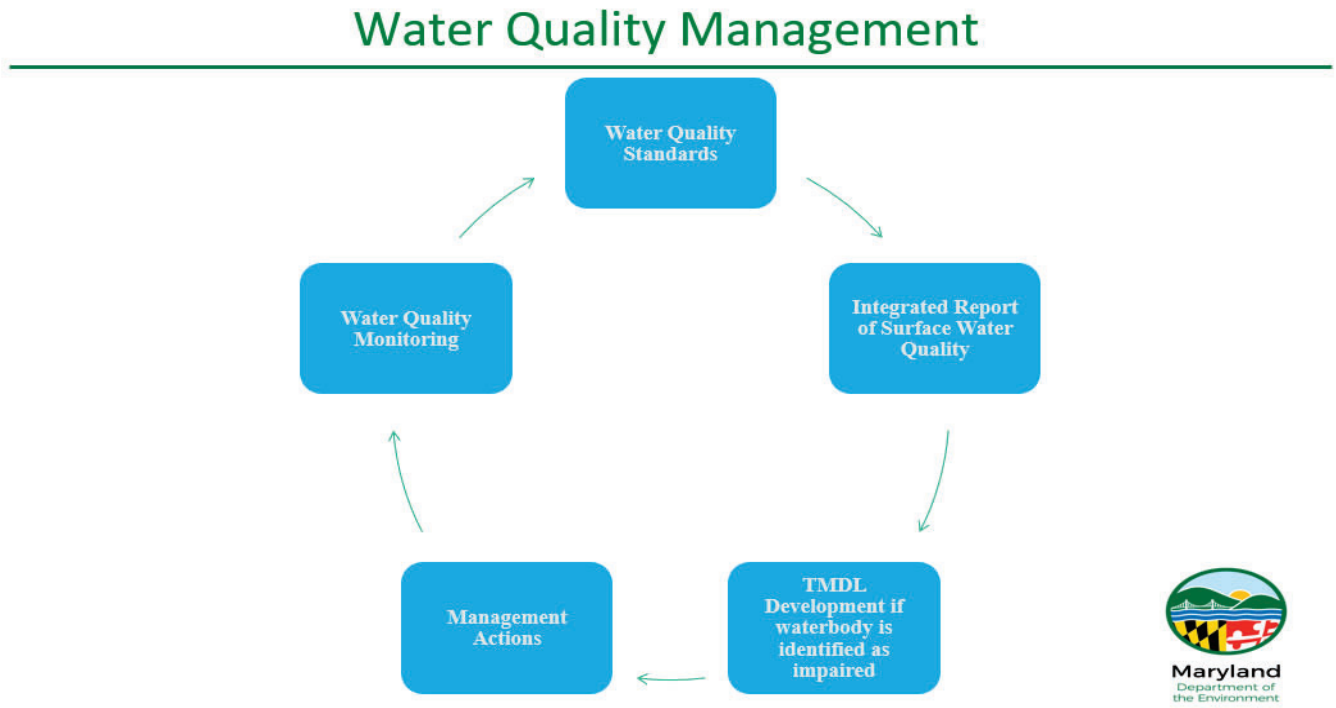


Figure C- 2:Maryland's Water Quality Management process.

Water quality monitoring is conducted by a wide variety of agencies including but not limited to Maryland Department of the Environment, Maryland Department of Natural Resources, various county agencies, the State Highway Administration, non-government organizations and citizen scientists. Water quality standards are developed and reviewed in what is called the Triennial Review. This process occurs every three years and the standards are based on the best science available and an opportunity for the public to review and comment is provided. Maryland's water quality standards and information can be found at: https://mde.maryland.gov/programs/water/TMDL/WaterQualityStandards/Pages/index.aspx. The Integrated Report of Surface Water Quality uses the best readily available data and methodologies to determine if a waterbody is impaired by a specific pollutant. This process is currently repeated every two years. Information about what data qualifies, the methodologies used and the actual reports is available at: https://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/index.aspx. TMDL development occurs when a waterbody is considered impaired. Maryland has established over 488 TMDLs and 161 Water Quality Analyses (WQAs) which are available at: www.mde.maryland.gov/tmdl. If a TMDL is in place, implementation of plans to reduce the amount of the affecting pollutant can begin. These management actions such as best management practices, reductions at wastewater treatment plants and upgrading septic systems are implemented and the waterbody continues to be monitored to hopefully see trends with water quality improving. Maryland's 2025-2032 Vision for TMDL and and other plan development reflects a continuation of this overall process and will prioritize waterbodies within this schema.

Methodology

When Maryland conducted this analysis, the latest approved Integrated Report of Surface Quality (IR) was the 2020/2022 IR. The list included impairments for nutrients, sediment, chlorides, sulfates, temperature, polychlorinated biphenyls (PCBs), bacteria, mercury, per and polyfluoroalkyl substances (PFAS), pH (acidity/basicity) and unidentified biological impairments. There were a total of 359 watershed/pollutant combinations identified on the impairment list (Category 5/5s of the IR). These include 15 pollutants at various watershed scales.

Maryland's primary objective under the 2022 Vision was to identify which of the 359 impairment listings on the 2022 Integrated Report would be priorities for TMDL and other plan development over the eight-year span covered by the 2022 Vision. Maryland developed a robust methodology utilizing both objective metrics and subjective best professional judgment to identify these priority listings. Initial, potential decision factors and metrics were developed and ultimately grouped into four main categories: policy (orange boxes), science (green boxes), collaboration opportunities (yellow) and implementation factors (pink).

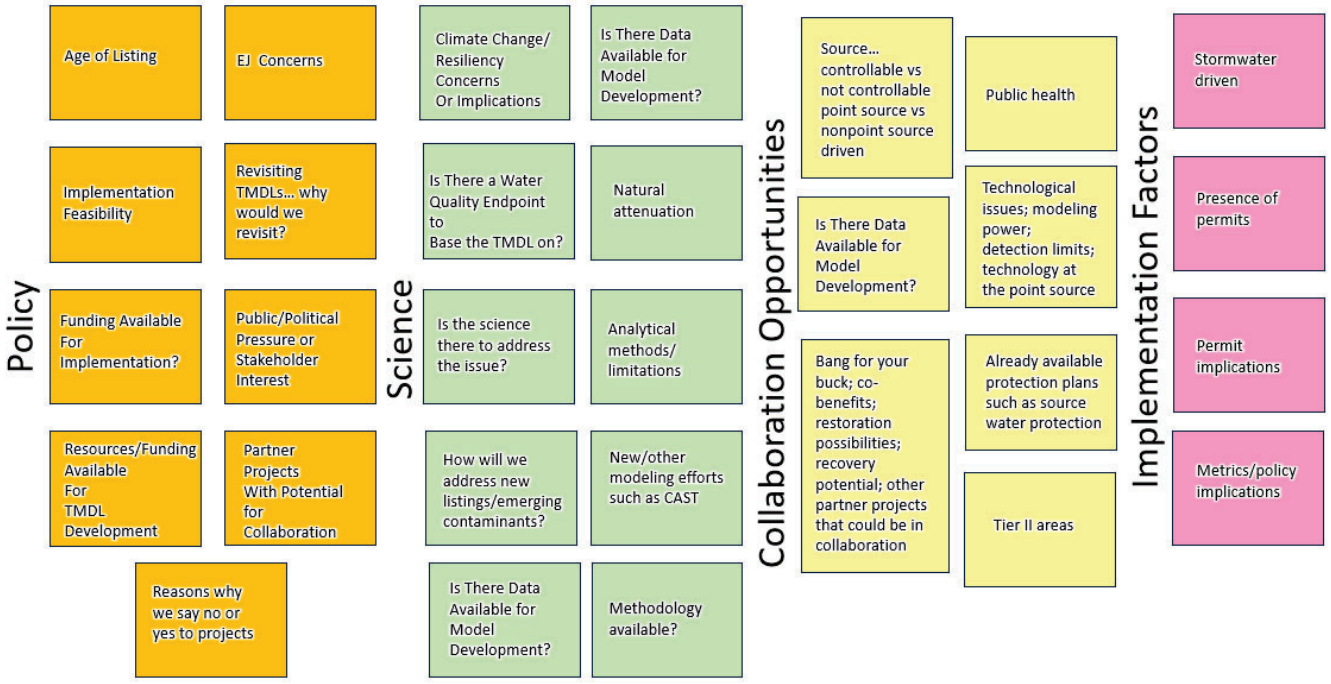


Figure C- 3: Initial Decision factors and how they were grouped.

Using many of the categories identified in Figure 3, a geographic information system (GIS) analysis was conducted as well as a weighting exercise for categories or items that did not have enough information to be included in a GIS analysis. Table 1 below provides further information about the categories. Many of the metrics in Groups 2 and 3 were assessed based on the best professional judgment of WPRPP staff. The GIS data for three of the key variables included in WPRPP's GIS analysis are shown in Figures 4, 5, and 6. Flood mitigation and the Federal

Emergency Management Agency (FEMA) Digital Flood Insurance Rate Maps (DFIRMs) were used as a surrogate for a climate resiliency metric. The Department, in early July 2022, released an environmental justice (EJ) screening and mapping tool which was posted on MDE's website at https://mdewin64.mde.state.md.us/EJ/. The tool is being used by MDE staff, permit applicants, and the general public to facilitate engagement during the permitting process. It incorporates demographic and socioeconomic data with MDE elements like industrial facilities, wastewater treatment plants and proximity to dams to prioritize EJ concerns. WPRPP utilized the same tool in its GIS analysis for its EJ metric. For Tier II watersheds, the Department utilized its own Tier II watershed maps located on its website here: https://mde.maryland.gov/programs/Water/TMDL/WaterQualityStandards/Pages/Antidegradation_Policy.aspx.

Table C- 1: Decision Factors Groups

Group 1: GIS Analysis	Group 2	Group 3
Flood mitigation	Stakeholder Interest/External Pressures	Data Availability
Environmental Justice (EJ)	Funding Availability for Restoration	Available Methodology
Tier II Watershed Protection	Source Characterization	Technical Limitations (example, lab detection limits)
Public Health	Degree of Impairment	Age of Listing
Emerging contaminants (PFAS)	Alignment with other Programs	
Chesapeake Bay Restoration	Address multiple stressors (co-benefits) example: CERCLA	
Drinking Water Protection		

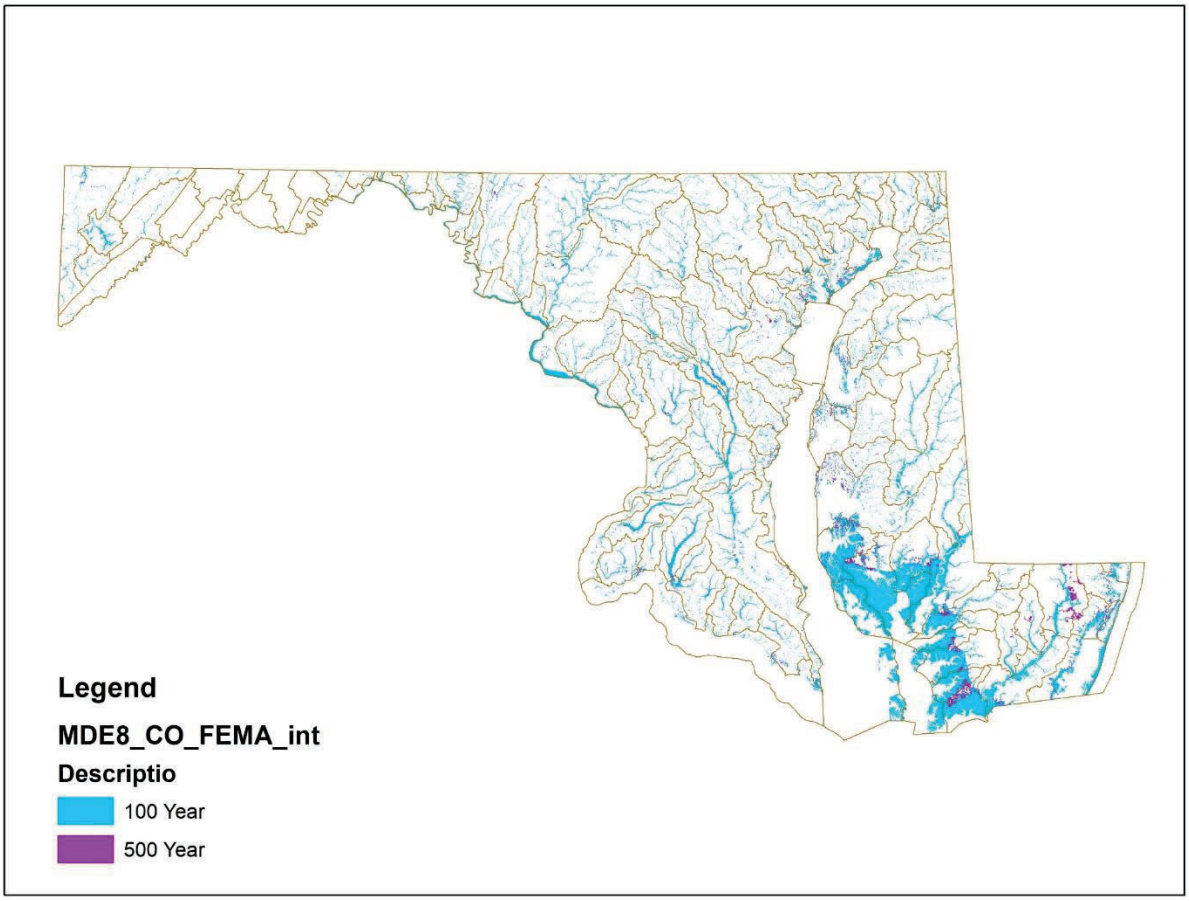


Figure C- 4: Areas where the 100 year and 500 year flood plain occurs.

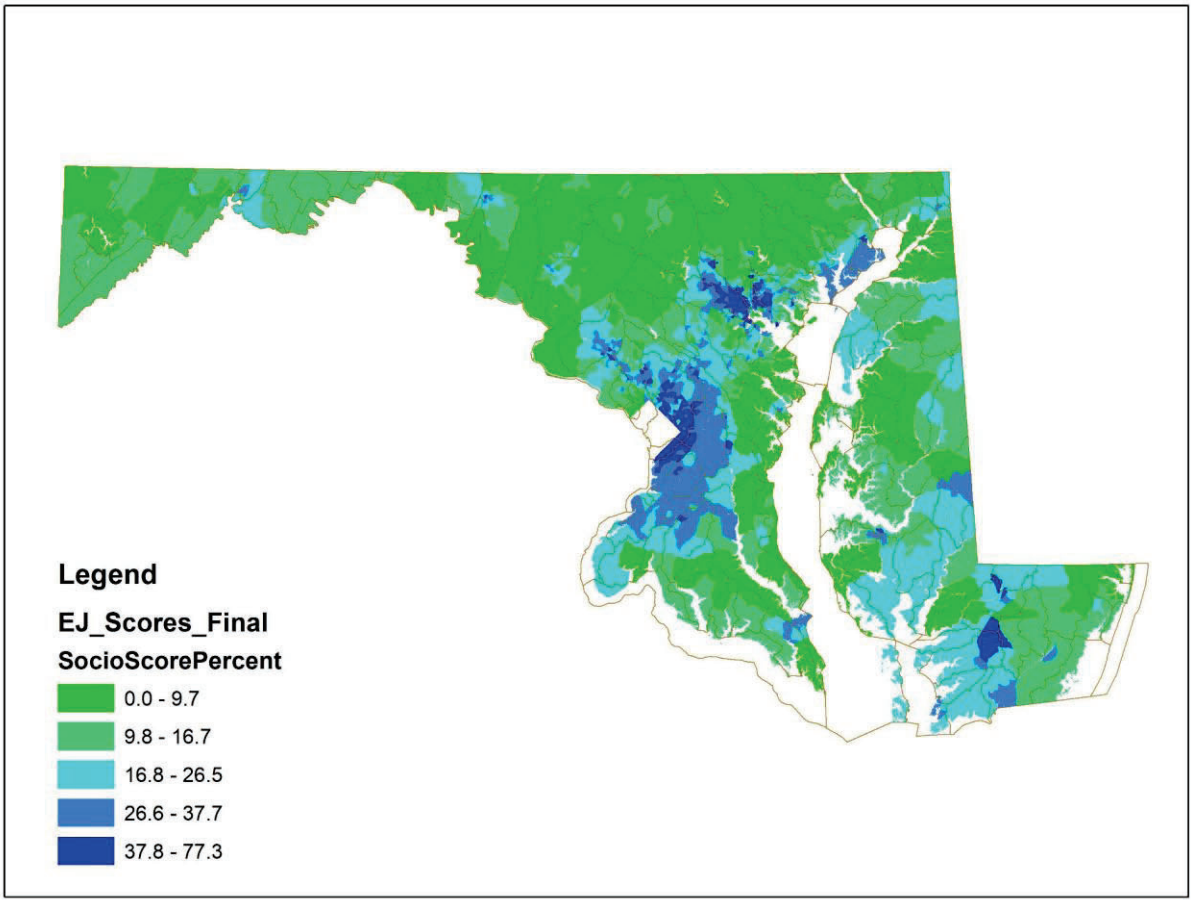


Figure C- 5: Results from using the MDE EJ Screening Tool

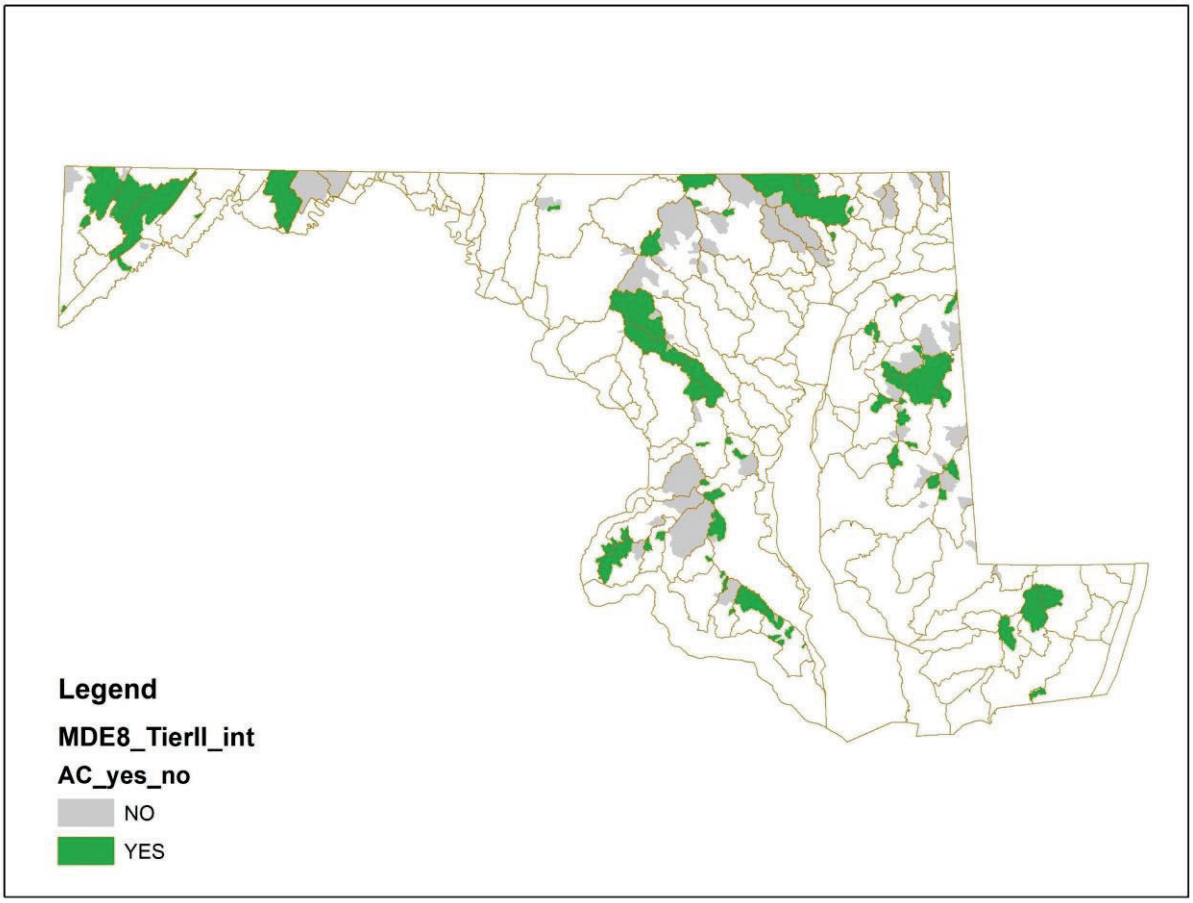


Figure C- 6: Locations of Tier II catchment areas and if there is assimilative capacity available for that catchment.

When these layers are weighted and combined, the map below indicates watersheds that become priorities for TMDL and other plan development.

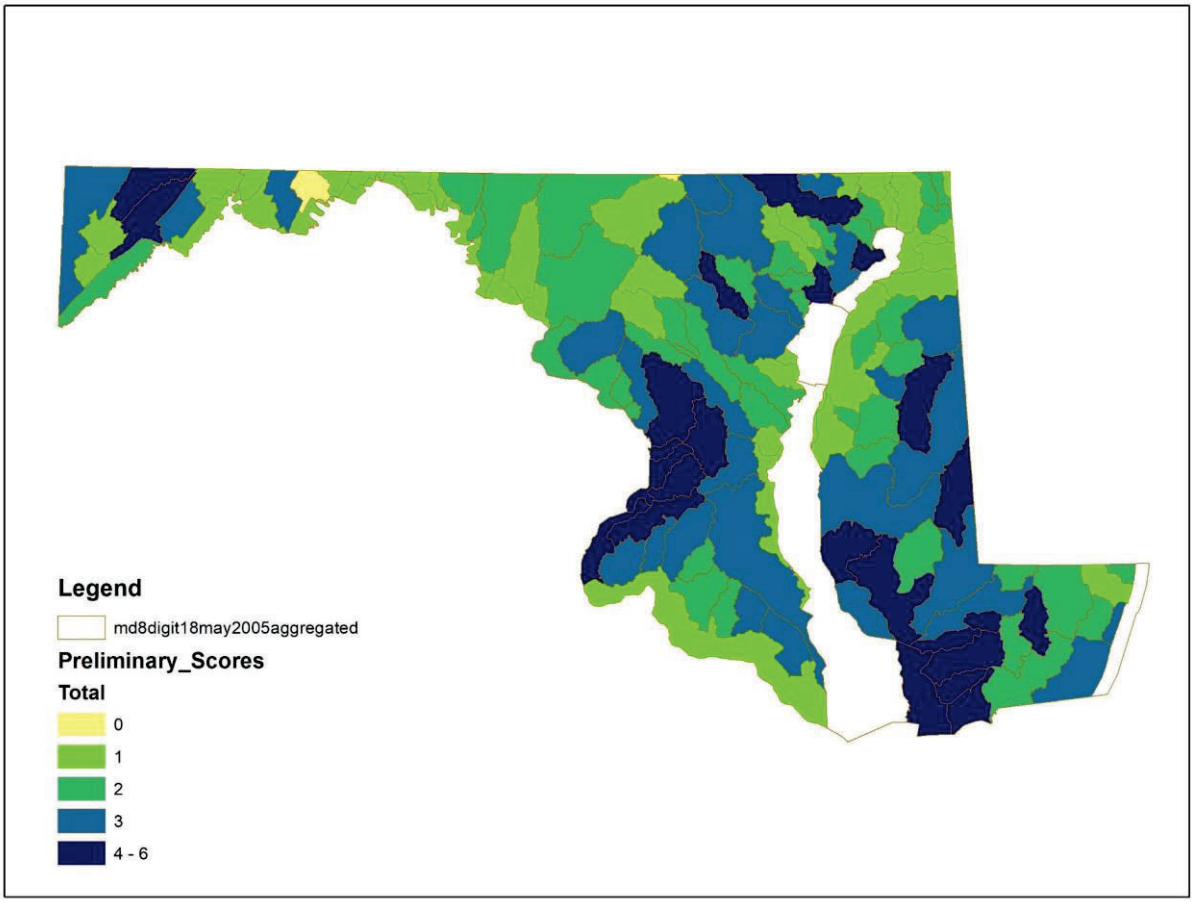


Figure C- 7: Results of combining the flood, EJ and Tier II layers. The higher the score, the more overlap between the layers. This gives a geographic idea of where TMDL development could be targeted.

Based on the factors listed above and WPRPP's GIS weighting exercise, and the knowledge the Department has gained over the last 25 years of TMDL development, a prioritization list for TMDL development was determined (Table 2 below). Note in the 2024 IR, there are an additional 293 Category 5 listings, which are the same 15 pollutants, with the majority being smaller geographic scale temperature listings, several of which fall into watersheds that have been identified in this prioritization process.

Table C- 2:Category 5 Listings to be addressed from 2025-2032.

8-Digit Basin Number	Basin Name	Pollutant/Impairing Substance	Priority Rationale	2024 303(d) List Count
02130306	Marshyhope Creek	Non-tidal Sediment	High EJ Score, Age of listing	1
02130403	Lower Choptank River	Non-tidal Sediment	Stakeholder interest, Age of listing	1
02130308	Transquaking River	Non-tidal Sediment	Flooding, Age of listing	1
05020203	Deep Creek Lake	Non-tidal Sediment	Stakeholder interest, Age of listing, In-progress project	1
02130806	Prettyboy Reservoir	Temperature	Climate Change, Tier II, In-progress project	37
02140303	Upper Monocacy River	Temperature	Climate Change	24
02120202	Deer Creek	Temperature	Climate Change, Tier II	29
02140305	Catoctin Creek	Temperature	Climate Change	13
02130904	Jones Falls	Temperature	Climate Change	19
02130905	Gwynns Falls	Temperature	Climate Change, Previous project available, High EJ Score	11
MD-02140203-Mainstem	Piscataway Creek Mainstem	PFOS - Fish Tissue	Emerging contaminant, High EJ Score, Public Health	1
MD-PISTF	PISTF – Piscataway Creek Tidal Fresh	PFOS – Fish Tissue	Emerging contaminant, public health	1
02130403	Lower Choptank River	Non-tidal Nutrient	Age of Listing	1
02130301	Lower Wicomico River	Non-tidal Nutrient	Flooding, Age of Listing	1
02130509	Middle Chester River	Non-tidal Nutrient	Tier II, Age of Listing	1
02130706	Swan Creek	Non-tidal Nutrient	EJ areas, Age of Listing	1
02130903/ PATMH	Baltimore Harbor	Bacteria	Technical fixes may be appropriate (4b plan), stakeholder interest, age of listing, public health	1
02120204	Susquehanna River/Conowingo Dam	PCBs – Fish Tissue	Public Health, Age of listing, project in progress	1
02120201	Lower Susquehanna River	PCBs – Fish Tissue	Public Health, Age of listing, project in progress	1
02130807	Middle River	PCBs – Fish Tissue	Public Health, Age of listing, EJ areas, project in progress	1
02130904	Jones Falls	PCBs – Fish Tissue	Public health, EJ areas	1
02130905	Gwynns Falls	PCBs – Fish Tissue	Public health, EJ areas	1
02130903	Bear Creek in the Baltimore Harbor watershed	Zinc	Potential 4b plan, Superfund National Priorities List (NPL) site, Age of listing	1
02130903	Bear Creek in the Baltimore Harbor watershed	Lead	Potential 4b plan, Superfund National Priorities List (NPL) site, Age of listing	1
	2025-2032	**Total Listings Addressed from 2024 303(d) List**		**151**

Per EPA guidance on the 2022 Vision, WPRPP has the ability to reassess its priorities for TMDL and other plans development every two years in conjunction with the Integrated Report. WPRPP has every intention of reassessing its priorities on a rolling basis. There are many applicable factors that WPRPP did not consider in its prioritization that could alter priorities in the future. For instance, WPRPP is working closely with the Chesapeake Bay Program on the development

of its Phase 7 water quality and watershed modeling tools. These updated modeling tools may cause WPRPP to revisit nutrient TMDLs for some of its tidal waters, especially in areas where a high level of effort has been made in water quality improvements, such as the Baltimore Harbor and Back River. In addition, MDE's Stormwater, Dam Safety, and Flood Management Program is in the process of developing priority watersheds for quantifying flooding impacts. There is a desire, both internally and externally, to tie these models to water quality models for the same basins. Therefore, some of these joint initiatives could become priorities for TMDL or other plan development. There are many factors still to be considered to set priorities going forward, and WPRPP intends to continually evaluate these factors over the next eight years. Detailed information about the ongoing work WPRPP is doing related to specific watershed/pollutant combinations are presented below in groups by pollutant categories in alphabetical order.

Bacteria

The Maryland Department of the Environment (MDE) routinely monitors shellfish harvesting waters for fecal coliform bacteria and conducts pollution source surveys to ensure that shellfish harvested in Maryland are safe for human consumption. In addition, MDE coordinates the State's Beach Bacteria Monitoring Program. Beach sample collection and notification of advisories are delegated to the Counties in order to protect public health at Maryland's designated bathing beaches.

Fecal indicator bacteria are used in these programs since monitoring for actual pathogens is not feasible. It is assumed that if fecal indicator bacteria are present, then human pathogens may also be present. Since the primary goal of both the Shellfish and Beach Programs is to ensure that public health concerns are addressed in a timely fashion, ongoing day-to-day management decisions by these programs are designed to be overly conservative. One such example is that beach advisories may be based on a single sampling event which shows a high level of indicator bacteria. However, bacteriological indicators are known to be variable in the environment and a single high measurement does not always coincide with fecal contamination. For this reason, the assessment methodology, developed for conducting Integrated Report (IR) assessments, will make use of larger longer-term sample sizes before making impairment determinations that could result in listings requiring a Total Maximum Daily Load (TMDL). Doing this allows MDE to continue to protect public health in a timely fashion (by both the Shellfish and Beach Programs) but also allows for a higher level of confidence to be used prior to initiating potentially costly TMDL development and implementation efforts. This helps to enhance the accuracy with which impairment determinations are made and enables the Department to focus on the highest priority impairments first. Additionally, for TMDL development to occur, the waterbody/impairment has to be identified in three consecutive Integrated Report cycles. Waterbody impairments related to human health are a high priority for identification in the Integrated Report, however, there are other programs that manage these waters in a more time sensitive manner than TMDL or other plan development.

Please note, a restricted shellfish harvesting area may have an active shellfish lease where prohibited shellfish harvesting areas may not. Therefore, relay of oysters from restricted to approved or conditionally approved waters may occur upon request to MDE and observation by

Maryland Department of Natural Resources (MDDNR). After the 14-day depuration period, oysters may be harvested from the approved or conditionally approved waters and marketed.

Two portions of the non-tidal Baltimore Harbor watershed, the Middle Branch and the Northwest Branch, were listed as impaired by bacteria on the 2010 IR, indicated by the presence of enterococcus. Baltimore City has been under a federal consent decree since 2002 to eliminate discharges of untreated sewage from its publicly-owned treatment works (POTWs). The consent decree was modified in 2017, with increased requirements for compliance of Phase I (83% reduction in sewer overflow volume) by 2021 and Phase 2 (100% reduction of sewer overflows) by 2030. In FFY20, MDE began development of a 4b plan demonstration for the Harbor bacteria IR listing. A 4b plan is appropriate when other pollution control requirements are expected to result in the attainment of an applicable water quality standard (WQS) in a reasonable period of time. In FFY22, MDE anticipated completing the development of the 4b plan and soliciting feedback from USEPA and local stakeholders. However, this project was delayed. Development of this 4b plan is still a priority for WPRPP, and it has been added to Maryland's plan for 2025-2032. The intent is to work with Baltimore City and MDE's Municipal Permits Division to demonstrate that current regulations and future required controls will ensure attainment of water quality standards in these sections of Baltimore Harbor related to elevated fecal bacteria concentrations.

Biological Impairments

Non-Tidal

The State of Maryland has two major monitoring programs for assessing non-tidal flowing 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 (both conducted by MDDNR). 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.) and nutrient species. In addition to these two monitoring programs, Maryland also makes use of other ad-hoc stream monitoring data as well as data submitted by non-state organizations to assess state waters.

In 2002, Maryland began listing biological impairments in the IR. Biological listings are resolved through stressor identification citing specific pollutants identified in the Biological Stressor Identification (BSID) analysis. Using this approach, the majority of the listings have been revised in the IR. Additional data was incorporated into the assessment methodology analysis from specific counties to provide better sampling resolution for stream bioassessments. Adding this higher geographic resolution data resulted in the addition of more watersheds to Category 5 for biological impairment. In addition, in the next several years, all Phase I Municipal Separate Storm Sewer System (MS4) jurisdictions will be collecting biological monitoring data consistent with MDDNR's MBSS protocols and will be submitting this data for integration into Maryland's IR bioassessments. Maryland is currently in the process of rerunning its biological assessments statewide for all 8-digit watersheds using the most recent MDDNR MBSS data as well as additional data from Maryland's local jurisdictions. It is anticipated that these new biological assessments will be updated and revised again in the next several years with a new influx of data from local jurisdictions. New BSID analyses will be conducted in addition to the

biological assessments. It is anticipated that some new biological listings will appear, some previous biological impairments will be resolved, new stressors will be identified, and some stressors will be resolved, either due to restoration work that has been ongoing throughout the State or improvements to the BSID and biological assessment methodologies. All but five of the original 2002 Category 5 biological listings have been addressed through the BSID process.

Tidal

In 2006, Versar completed an analysis of biological data to determine if a watershed is impaired using Chesapeake Bay Program data. As a result of this analysis and an erring on the side of caution, Maryland listed several tidal watersheds as impaired for effects on the biological community. In non-tidal areas, a BSID analysis is conducted to identify the cause of the degraded biological community. A BSID analysis evaluates numerous key stressors using the most comprehensive data sets available that meet the requirements outlined in the methodology report. It is important to recognize that stressors could act independently or act as part of a complex causal scenario (e.g., eutrophication, urbanization, habitat modification). Also, uncertainties in the analysis could arise from the absence of unknown key stressors and other limitations of the principal data set. The results are based on the best available data at the time of evaluation. A reliable dataset and benthic index of biotic integrity (B-IBI) play an integral role in the development and performance of a BSID analysis. Thus far, academia is still conducting research evaluating the performance and use of the B-IBI in the identification of stressors and sources of biological impacts for tidal waters. Compared to freshwater systems, estuaries pose additional challenges due to the complexity and variability of physical and chemical factors such as tidal mixing and salinity gradients. The habitat specificity of biotic communities also hampers estuarine studies at large spatial scales. For example, the numbers of and kinds of benthic organisms vary with salinity zone and sediment type and confound efforts to assess relative condition and to associate causes and effects across boundaries (Dauer, Weisberg, and Ranasinghe 2000).

Due to the spatial and temporal data limitations, salinity gradients, missing data, various sources for data or consistent data collection from one source, etc. and all of the work in progress to improve water quality, developing a BSID methodology for these listings is not a priority for the 2025-2032 time period. MDE in cooperation with CBP, will continue to work with academia to develop reliable benthic and fish indices for tidal waters and subsequently stressor identification methodologies. However, because of the massive effort in Maryland and the rest of the Chesapeake Bay watershed to reduce nutrient inputs and resolved dissolved oxygen (DO), chlorophyll a (chl-a), and clarity issues in the tidal Bay, development of these indices and methods is not a top priority, since it is anticipated that tidal biological communities should respond positively to the on-going nutrient and sediment reductions to the Chesapeake Bay. In the meantime, Maryland participates in the cooperative partnership of the Chesapeake Bay Program from a variety of angles including toxics subcommittee, the Criteria Assessment Protocols workgroup, various elements of model input development, including participation in the Best Management Practices (BMP) expert panel process, and providing updates to the Modeling Workgroup on various state efforts such as the development of local stream temperature, sediment and phosphorus models. In addition, WPRPP provided feedback to the CBP on the development of the Phase 7 suite of modeling tools, including the development of

the new Watershed Model, the Main Bay Model (MBM), and Multiple Tributary Models (MTMs). These new models will significantly increase overall resolution and improve the simulation and assessment of shallow waters. In addition, there are watershed implementation plans (WIPs) for the Chesapeake Bay TMDL, stormwater implementation plans as required by Municipal Separate Storm Sewer System (MS4) permits and TMDLs developed for those areas. Participation and implementation of these efforts should help improve tidal biological communities.

Chloride

For the 2020-2022 combined IR, Maryland established a new subcategory, 5s, for waters impacted by chloride. Twenty-eight waters were moved from Category 5 (2018 IR) to Subcategory 5s on the 2020-2022 IR.

Chloride is naturally present in most surface waters, but elevated concentrations can harm freshwater organisms. The main source of elevated chloride in Maryland Category 5s waters is urban runoff of road salt. Road salt, primarily composed of sodium chloride, is applied to paved surfaces during winter to either remove snow and ice (de-icing), or to prevent them from accumulating (anti-icing). The salt then enters Maryland's waterways and impacts aquatic life and wildlife. The use of road salt also results in higher levels of sodium in drinking water and causes damage to public and private infrastructure including bridges, roads, cars, and stormwater treatment devices. Maryland's biological stressor identification process indicated that chloride is a major stressor affecting biological integrity in these Category 5s watersheds. There are no effective structural best management practices to remove chloride; therefore, an adaptive management approach to reducing salt application is appropriate. Adaptive management is an iterative decision-making process, incorporating monitoring and feedback for evaluating past actions in order to adjust future actions. Chloride pollution controls will be applied statewide. Maryland's salt reduction strategies include: 1. Requirement for Salt Management Plan in State law for State Highway Administration (SHA); 2. Requirements for Salt Management Plans in MS4 permits, which cover over 90% of Maryland's impervious surface area; 3. Voluntary actions, such as private applicator training; and 4. Public awareness, partnerships with other State agencies and non-governmental organizations, and engagement with elected officials. Through adaptive management, trend analysis, and responsible implementation, long-term goals can be established to lessen the usage of salt and reduce its impact while maintaining safety and mobility. State requirements for SHA's Salt Management Plan are already in place and being implemented. The Plan has helped reduce salt application through increased training, tracking and recording usage, and techniques such as the use of brines. Implementation of SHA's Plan has already resulted in approximately 50% reduction of road salt application. More information can be found on MDE's road salt web page.

In 2025-2032, Maryland will continue applying the best science and methods to address the aquatic life impairments caused by elevated Cl concentrations while recognizing public safety issues. In FFY2021/2022, Maryland drafted a loading analysis for Cl in the Cabin John Creek watershed. The methodology used focuses on Cl loads during winter months using continuous sampling and endpoints defined by a draft laboratory-based Cl criteria Maryland developed in the past but decided not to promulgate.

As a result of the Cabin John Creek analysis, the Department's strategy for reducing application of winter salts has been two-fold. First, MDE has been actively engaging watershed stakeholders to reduce chloride loads and has implemented a strategy to reduce chloride levels in surface water through requirements in Municipal Separate Storm Sewer System (MS4) permits and through voluntary efforts. Second, the Department is working to create a voluntary training and certification program that will target non-governmental applicators within the State.

The majority of Phase I MS4 permits in Maryland were recently reissued. Phase I Large jurisdictions' permits were finalized on November 5, 2021, and the Phase I Medium permits were finalized on December 30, 2022. MDE included a condition within both sets of permits requiring countywide salt management plans to better manage the application of chlorides and reduce surface water chloride levels. This includes:

- Plans for continual improvement
- Training for applicators
- Education and Outreach
- Tracking and Reporting of material used

Surface water monitoring is a requirement of the permit to determine the effectiveness of chloride reduction strategies. Following the end of the 5-year permit term MDE plans to evaluate the monitoring results and determine future permit conditions and actions, including but not limited to whether establishing chloride TMDLs will be necessary.

Through this work, WPRPP will also be looking for a way to engage directly with homeowners, property managers and private applicators, to drive reductions of winter salt applications on homeowner association (HOA) roads and commercial parking lots. It is anticipated that the result of this work will demonstrate the effectiveness of salt management on water quality and will serve as a validation of the reduction methodology used in the study. MDE's current strategy for resolution of these impairment listings is the creation of a statewide implementation and protection plan.

Heptachlor Epoxide

The Maryland portion of the non-tidal and tidal Anacostia River is currently listed for heptachlor epoxide in Maryland's IR. The District of Columbia (DC) is currently under consent decree to develop a TMDL for several toxics impairments including heptachlor epoxide for its portion of the tidal Anacostia River by January 1, 2017. The USEPA submitted an extension request to the US District Court for DC in September 2016 to extend the consent decree deadline of January 1, 2017, to January 1, 2020, which was granted. MDE informed the USEPA and DC that the Department was interested in collaborating in the development of an inter-jurisdictional TMDL to address all three heptachlor epoxide listings. The USEPA modified their work plan to include development of a TMDL to address the heptachlor epoxide listings in Maryland. The USEPA funded a contract with TetraTech to review historical data, identify data gaps, and develop a monitoring plan to support TMDL development. The USEPA is currently funding a second contract with TetraTech to develop the TMDL. The TMDL was originally anticipated for completion and approval by USEPA by January 31, 2020, in order to meet the deadline under the

consent decree extension. However, due to delays in data collection and model development a second extension request was submitted by USEPA to the US District Court for DC in January 2020 to extend the consent decree deadline of January 31, 2020, to September 30, 2021, which was granted. Maryland actively coordinated and participated in the TMDL development and report writing. The TMDL was made available for public comment in July 2021. A third extension was submitted by USEPA and granted by the US District Court to extend the consent decree deadline by four months to January 31, 2022, to provide USEPA and the jurisdictions sufficient time to complete the comment response document and submit the TMDL document. Several sets of comments were received and as a result of MDE's careful review and consideration of those comments, this project has been delayed while MDE considers how best to address this impairment. USEPA approved DOEE's toxics TMDLs on March 29, 2024. It is uncertain how much time or what format addressing this listing will take as more recently collected fish tissue samples were all below the listing threshold except for one fish composite of brown bullhead catfish in the MD segment of the Tidal Anacostia River. The sample was barely above the listing threshold. MDE anticipates that newly collected data for catfish will demonstrate that levels are attained.

Mercury Impairments

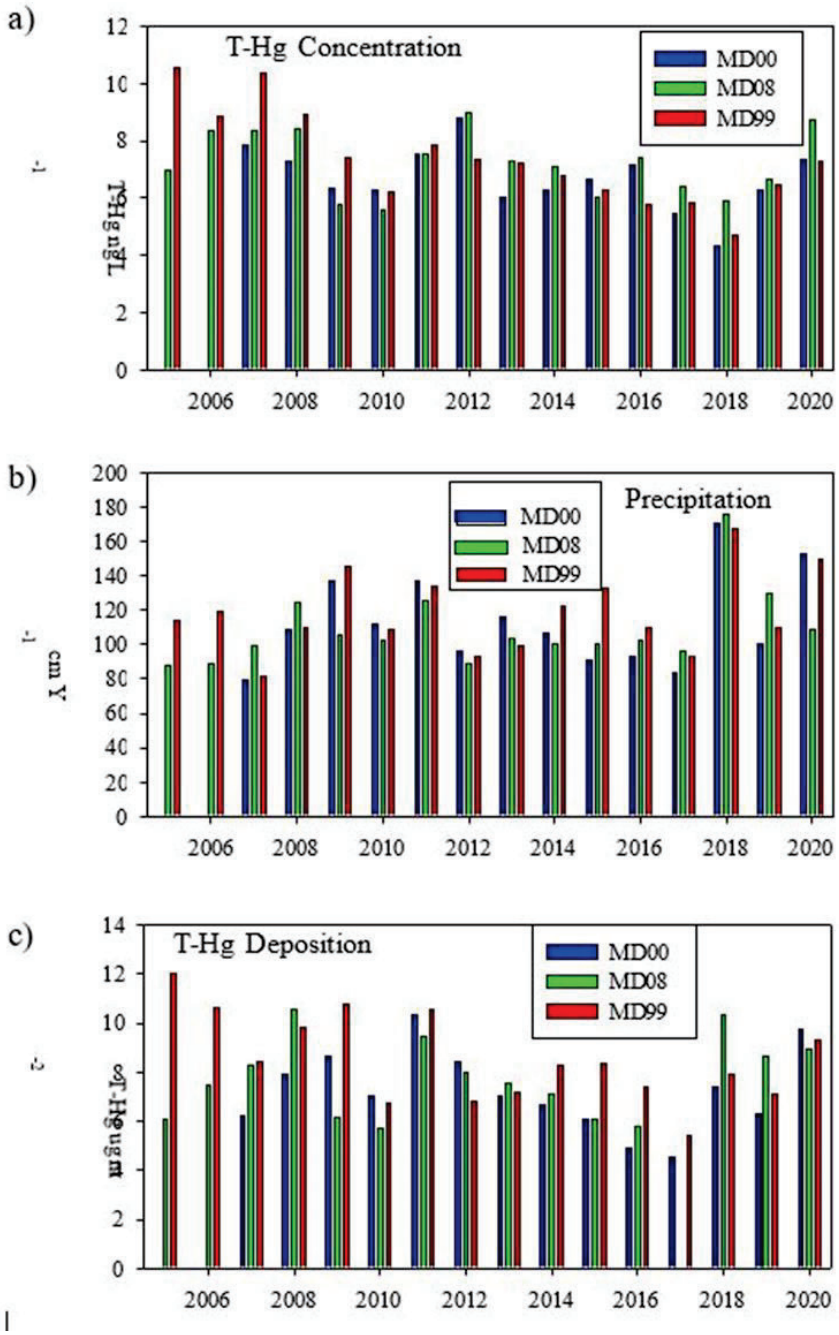
In Maryland's 2018 Integrated Report (IR), there were six mercury (Hg) fish tissue impairment listings in Category 5, all of which are located within Western Maryland. These listings included the Youghiogheny River Lake (2010), the Potomac River Frederick County (2014), Potomac River Washington County (Dam 4 to 5) (2014), the Lower North Branch of the Potomac (2014), Conococheague Creek (2014 IR), and Jennings Randolph Reservoir (2014). The Potomac River Washington County (Dam 3 to 4) mainstem segment was delisted in the 2018 IR as fish tissue data for channel catfish collected in 2015, the species on which the listing was based, demonstrated Hg concentrations were below the listing threshold of 300 ng/g. Fish collections were also conducted for the remaining listings in 2015, and annually from 2018 through 2020. Fish tissue data from the Lower North Branch of the Potomac, Conococheague Creek, and Jennings Randolph Reservoir for smallmouth bass and channel catfish, the fish species that the original listing was based on, were below the listing threshold and no longer required TMDLs.

These impairments were delisted from Category 5 in the 2020-2022 IR. Fish tissue data from the Potomac River Frederick County collected in 2015 for channel catfish demonstrated that Hg concentrations were below the listing threshold. However, smallmouth bass was also the basis for the listing which was not collected in 2015. Collection attempts for smallmouth bass were made each year from 2018 through 2020 and were unsuccessful. The smallmouth bass population in this segment appears to be in decline and no longer a representative species for assessing the Hg impairment. This segment no longer requires a TMDL and has been delisted from Category 5 in the 2024 IR. Fish collections in the Potomac River Washington County (Dam 4-5) have been conducted annually from 2018 through 2020. Only one composite of smallmouth bass was collected. Collection attempts for largemouth bass were unsuccessful. The largemouth bass population in this segment also appears to be in decline and no longer a representative species for assessing the Hg impairment. The Hg concentration for the smallmouth bass composite is below the listing threshold. However, the median concentration of all smallmouth bass collected within the past 10 years exceeds the listing threshold. If the

smallmouth bass composites from the Conococheague Creek are combined with the composites from this waterbody, which are a part of the same population, the median concentration is below the listing threshold and could be delisted from Category 5. MDE has determined to delist it in the 2024 IR. MDE anticipates that the waterbody will reach attainment through natural recovery as Hg concentrations in fish are declining throughout Western Maryland and will not require development of a TMDL.

While fish tissue data in the Youghiogheny River Lake remains above the listing threshold, MDE also anticipates that this waterbody will reach attainment through natural recovery as Hg concentrations in fish are declining throughout Western Maryland and will not require development of a TMDL. Mercury emissions from coal and oil-fired power plants have declined substantially due to the implementation of Maryland's Healthy Air Act and USEPA's Mercury and Air Toxics Standards (MATS). Maryland's Healthy Air Act was established in 2007 requiring a 90% in Hg emissions by 2013 and USEPA's MATS was established in 2011 requiring a 95% reduction nationwide in Hg emissions by 2016. MDE will continue monitoring fish for Hg in this waterbody through MDE's Fish Consumption Advisory Program which routinely conducts a state-wide fish tissue monitoring effort. Fish are collected annually at 58 core monitoring sites through-out the State on a 5-year cycle including a monitoring site within Youghiogheny River Lake.

The following figures display a) average Hg concentrations in rainfall, b) annual precipitation, and c) Hg wet deposition at three National Atmospheric Deposition Network (NADP) sites throughout Maryland. The sites are located in Beltsville (MD99), Piney Reservoir (MD08) and Smithsonian Environmental Research Center (SERC) (MD00). The sites may not cover the full range of deposition within Maryland but they are representative of urban development (MD99), the Chesapeake Bay shoreline region (MD00), and the Western Maryland region (MD08). NADP site location and data can be found at: https://nadp.slh.wisc.edu/maps-data/mdn-interactive-map/.



Figures C- 8a: average Hg concentrations in rainfall, 8b) annual precipitation, and 8c) Hg wet deposition at three National Atmospheric Deposition Network (NADP) sites throughout Maryland.

Metals: Lead (Pb) and Zinc (Zn)

Two tidal segments within the Baltimore Harbor were originally listed for metals in Maryland's IR in 1998; Northwest Branch (Pb and Zn) and Bear Creek (Zn). As Maryland does not currently have sediment quality standards for metals, site-specific sediment quality thresholds were developed in the Baltimore Harbor as an endpoint for TMDL development. MDE

previously funded three contracts with Wye Research and Education Center (WREC) from 2010 through 2014 to develop sediment quality thresholds for Pb and Zn. In the first study, sediment quality thresholds were developed based on ambient sediment bioassays using the amphipod, Leptocheirus plumulosus, as the test organism. In the second study, a sediment water interface (SWI) toxicity test for the fish species Cyprinodon variegatus was developed in order to assess whether a second organism is more sensitive to metals than the amphipod. In the third study, sediment quality thresholds were developed based on SWI toxicity tests using the fish species Cyprinodon variegatus as the test organism. The most conservative sediment quality threshold for the two test organisms was the amphipod, Leptocheirus plumulosus, which was selected in order to reassess whether Pb and Zn continue to impair the sediments of the Baltimore Harbor. MDE contracted University of Maryland Center for Environmental Science (UMCES) Chesapeake Biological Laboratory (CBL) and WREC in 2015 to conduct a sediment contaminant and toxicity survey to provide current sediment quality data in order to reassess the metals impairment listings in the Baltimore Harbor. Information from this survey was evaluated and found to be insufficient to reassess Pb and Zn water quality to determine whether WQA or TMDL development would be necessary to address these listings. MDE contracted UMCES CBL and WREC in 2017 to conduct metals pore water analyses; chronic sediment and porewater toxicity tests to provide additional sediment quality data in order to complete the reassessment. An evaluation of the information from this study, along with the data from the previous study in 2015, determined that only a localized portion of the sediments in Bear Creek, adjacent to historical operations at Bethlehem Steel, are impaired for metals. USEPA has completed an investigation of the Bear Creek sediment contamination and added the site to the National Priority List (NPL) in March 2022. Sites on the NPL are designated as a Superfund site and become eligible for federal financial assistance and a long-term cleanup. USEPA anticipates that the remedial investigation will begin Fall 2024. At this time, USEPA has not estimated when remedial action will begin. For more information on USEPA's actions visit: https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.cleanup&id=0305762#Status.

MDE plans to address this listing through a TMDL alternative under Category 4b as the remediation effort will address the metals impairment in Bear Creek. MDE will continue to monitor progress on this remediation effort in order to acquire the necessary documentation to support a Category 4b approach. The evaluation remains inconclusive as to whether Pb and Zn are impairing substances in the Northwest Branch. MDE contracted UMCES CBL and WREC in Spring 2018 to conduct a sediment spiking study for Pb and Zn in the Northwest Branch to determine if these metals are responsible for sediment toxicity and impair the system. The study has been completed and a draft of the report was submitted to MDE in July 2019. The findings of this study will be evaluated in 2024/2025 to determine whether WQA or TMDL development is necessary to address the listings in the Northwest Branch.

Nutrients

Non-Tidal

From 2014 to 2016, MDE conducted monitoring of dissolved oxygen (DO), nutrients and chlorophyll a at lakes across Maryland where TMDLs for phosphorus have been developed, including Centennial and Clopper Lakes. This was done as part of a plan to revisit the TMDLs

using updated water quality criteria, modeling methods and requirements such as allocations to MS4s.

As part of this effort, MDE worked with the Virginia Institute of Marine Science (VIMS) to develop a revised phosphorus TMDL for Lake Linganore. The original phosphorus TMDL for Lake Linganore, developed using the Vollenweider Relationship, was approved by the USEPA in 2003. In addition, an analysis to define nutrient fluxes from bottom sediment in Lake Linganore was completed in FFY2017, and the results were used as inputs for the water quality model. The modeling for this project is complete, and the results have demonstrated that the original TMDL is still valid. A technical paper will be drafted showing this information. WPRPP was also working on similar analyses for other lakes, however, that work has been temporarily put on hold while the Program investigates the potential for adopting new lake criteria based on USEPA's "Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs". Once this investigation concludes, WPRPP will resume work to reassess and/or review its lake TMDLs, if applicable. Since TMDLs are in place for the majority of lakes for nutrients, these revisions are not a priority for TMDL redevelopment.

During the GIS analysis, four listings for non-tidal nutrients were identified as priorities. MDE is working on modeling methodologies in other watersheds that may provide a method for addressing these impairments. It should be noted that the majority of watersheds throughout the State have nutrient TMDL allocations assigned to them via the Chesapeake Bay TMDLs and Maryland Coastal Bays TMDLs.

Tidal

In 2010, the USEPA established TMDLs for all Chesapeake Bay Tidal segments for nitrogen and phosphorus to address nutrient and sediment impairments throughout the Chesapeake Bay watershed. These TMDLs addressed all of Maryland's tidal Chesapeake Bay nutrient impairment listings. As a requirement of the Chesapeake Bay TMDLs, jurisdictions were required to develop and implement watershed implementation plans (WIPs). These are coordinated efforts in Maryland and are tracked for progress. More information about the Chesapeake Bay WIPs can be found here: https://www.epa.gov/chesapeake-bay-tmdl/chesapeake-bay-watershed-implementation-plans-wips

In addition, several tidal nutrient TMDLs were established by the State, before the Chesapeake Bay TMDLs. These are still in place and jurisdictions should review both to see which is more stringent. Implementation efforts for both the Bay TMDL and 8-digit watersheds should work together to ensure the best use of resources. There are a total of 277 tidal nutrient impairments addressed by TMDLs.

pH Impairments

Methodology to Address Conococheague Creek High pH Listings

The Conococheague Creek is listed (2002) for high pH in Maryland's IR. In FFY2015 and FFY2016, the MDE Field Office conducted several rounds of pH monitoring in the Conococheague Creek. An analysis of this data demonstrated that the high levels of pH is most

likely due to the Karst geology in the watershed. In FFY2016, MDE developed a report describing this analysis and recommended that the watershed be removed from the Category 5 list due to natural causes. In FFY2017, the document was sent to outside agencies for review and the documentation was submitted for the draft 2018 IR. In FFY2018, USEPA provided comments on the report and recommended a nutrient analysis. In FFY2019, USEPA and MDE worked to address USEPA's comments and determined that nutrient sampling was needed. MDE Field Office began nutrient and continuous pH monitoring at 10 stations in the Conococheague Creek, Antietam Creek, and Little Conococheague Creek watersheds.

In FFY2020, MDE Field Office completed monitoring and the data was analyzed. The data analysis determined that there is a connection between phosphorus and the high pH as described in detail in the 2020/2022 IR. Conococheague Creek is currently listed as impaired by phosphorus on the IR. Upon review by USEPA, it was decided that the entire Conococheague Creek watershed will continue to be listed as impaired by pH on the IR. An appendix was included in the 2020/2022 IR regarding the work that has been done for this listing. A phosphorus TMDL will be developed that will address both the phosphorus and high pH impairment listings. At this time, MDE and ICPRB are testing sediment and phosphorus modeling methodologies in other watersheds which will assist in the assessment of these impairments.

Low pH

Four low pH impairments were listed in Maryland's 2014 IR for St. Mary's River, Mattawoman Creek, Licking Creek, and Little Tonoloway Creek. Biological Stressor Identification (BSID) studies for each of these watersheds determined that low pH was significantly associated with degraded biological conditions resulting in these watersheds being listed as impaired. Streams impaired for low pH are generally found in the western portion of the State due to acid mine drainage from historical mining activities. However, within these watersheds, low pH is likely due to a combination of low acid neutralizing capacity from geology with poor buffering and atmospheric deposition. MDE will need to collect additional data to determine the extent of impairment within these watersheds as low pH will be localized in lower order streams with low buffering capacity. Existing data is insufficient to make this determination as the MBSS surveys used to support the findings of the BSID studies were designed to characterize water quality at the 8-digit watershed scale using random-probabilistic sampling which does not provide sufficient resolution to define localized impairments.

Polychlorinated Biphenyls (PCBs) Listings

There are currently 14 polychlorinated biphenyls (PCB) impairment listings in Maryland's 2024 IR. The number of impairment listings has declined from 25 reported in the 2018 IR as several impairments have been delisted as new fish tissue data demonstrates the waterbodies are now in attainment for PCBs in fish tissue. MDE has completed monitoring and has developed 23 PCB TMDLs to date, which have been approved by the USEPA. MDE generally develops water quality models in-house for PCB TMDL development. For more complex systems, such as Baltimore Harbor and Conowingo Pool, MDE has contracted Virginia Institute of Marine Sciences (VIMS), to develop 3-D hydrodynamic water quality models using the Environmental Fluid Dynamics Code (EFDC) framework for PCB TMDL development. In-house models used

to develop PCB TMDLs include the tidal prism model and 1-D multi-segmented numerical model.

MDE is addressing the following five PCB impairment listings in the 2022 Vision priority universe: Conowingo Pool, Lower Susquehanna River, Middle River, Jones Falls, and Gwynns Falls. A detailed summary on the development status of these impairment listings is provided below.

Conowingo Pool/Lower Susquehanna River PCB TMDL

In 2016, MDE contracted VIMS to develop PCB TMDLs for the Conowingo Pool and Lower Susquehanna River. A draft document of the Lower Susquehanna River PCB TMDL was originally completed in November 2013; however, it is now being redeveloped in conjunction with the development of a PCB TMDL for the Conowingo Pool, which drains into the Lower Susquehanna River. PCB TMDL model development has been completed and VIMS provided a draft TMDL document to MDE in Fall 2023. MDE anticipates that the TMDL will be submitted to USEPA in FFY2024.

Middle River PCB TMDL

MDE completed a draft document of the Middle River PCB TMDL in April 2016; however, during internal review the findings of the TMDL were brought into question. The TMDL established that tidal influence and legacy sediments were the predominant source of PCBs in the system and watershed load reductions would not be required in order to achieve water quality. Further analysis of the modeling results and observed water quality data found that the watershed load may play a greater role in the impact on water quality. MDE conducted a comprehensive sediment survey in Fall 2018 to help determine if ongoing sources from the watershed may contribute to sediment contamination. University of Maryland Center for Environmental Science (UMCES) – Chesapeake Biological Laboratory (CBL) conducted the analysis and provided the data to MDE in June 2018. The results of the study show sediment concentrations are elevated in several headwater tributaries which drain predominantly developed areas within Middle River and the concentrations decline as you move down river into the open water of the estuary. MDE conducted a second survey in May 2019 to investigate sediment PCB concentrations within the non-tidal stream system as well as stormwater outfalls discharging to the headwater tributaries to provide additional information in determining if ongoing sources are responsible for sediment contamination in the estuary. UMCES CBL conducted the analysis and provided the data in October 2019. The results of the study indicate that sediment concentrations in several non-tidal streams and stormwater outfalls are elevated in comparison to estuarine concentrations. Based on the results of these studies, MDE plans to revise the TMDL to include a watershed reduction. It is anticipated that the TMDL will be revised and submitted in FFY2024.

Gwynns Falls PCB TMDL

The Gwynns Falls is a non-tidal tributary of the Baltimore Harbor. A PCB TMDL for the Baltimore Harbor was approved by USEPA in October 2012. At that time Gwynns Falls was not specifically listed as impaired for PCBs as fish had not been collected directly within the non-tidal tributary. In the Baltimore Harbor PCB TMDL, the Gwynns Falls was assigned a tributary load allocation. Based on fish collections following development of the Baltimore Harbor PCB

TMDL, the Gwynns Falls was listed as impaired for PCBs in fish tissue in 2016. MDE plans to develop a PCB TMDL for the Gwynns Falls using a similar approach applied in the non-tidal Anacostia River PCB TMDL where tributary load allocations are broken out into load and waste load allocations. Currently, MDE has not determined when the PCB TMDL will be developed within the 8-year time frame of the 2022 Vision.

Upper Jones Falls PCB TMDL

The Upper Jones Falls is a tributary of Lake Roland. A PCB TMDL for Lake Roland was approved by USEPA in June 2014. At that time the Upper Jones Falls was not specifically listed as impaired for PCBs as fish had not been collected directly within the tributary. In the Lake Roland PCB TMDL, baseline loadings and allocations were calculated for the individual subwatersheds which includes the Upper Jones Falls, however, the load and waste load allocations were aggregated for the entire watershed in assigning the TMDL. MDE plans to develop a PCB TMDL for the Upper Jones Falls by disaggregating the allocations for the individual subwatersheds. Currently, MDE has not determined when the PCB TMDL will be developed within the 8-year time frame of the 2022 Vision.

Approach for addressing remaining PCB listings

Four PCB impairment listings in the non-tidal Potomac River watershed, Conococheague Creek, Antietam Creek, Potomac River Frederick County, and Potomac River Montgomery County, show a declining trend in fish tissue concentrations as a result of natural attenuation of PCBs in the environment. Current PCB concentrations in fish tissue within these waterbodies do not greatly exceed the fish consumption listing thresholds. MDE does not plan to develop TMDLs to address these listings as it anticipates fish tissue concentrations will continue to decline to levels that fall below the listing threshold resulting in the impairments being delisted. Recently collected fish in the Conococheague Creek demonstrate levels are below the listing threshold and was delisted in the 2024 IR. MDE plans to collect fish in the Potomac River Montgomery and Frederick County mainstem in Spring/Fall 2023 and anticipates that the waterbodies could be delisted in 2026 IR. MDE will continue to collect fish within the Antietam Creek through MDE's fish consumption advisory monitoring program to determine when fish tissue concentrations have declined to levels resulting in water quality attainment and impairment delisting.

Seven PCB impairment listings in Lower Wicomico River, Nanticoke River, Choptank River, Herring Bay, Lower and Middle Chester River, and Seneca Creek, are likely due to legacy PCB contamination in sediments and tidal influence due to elevated PCB concentrations from the Chesapeake Bay mainstem. Land use within these watersheds is predominantly forest and agriculture, indicating that PCB watershed loadings would be insignificant and that reductions to these loadings would make no difference in achieving water quality. These watersheds have minimal urban development and historical industrial activity which are the predominant sources of PCBs. Previous PCB TMDLs with similar watershed characteristics (e.g., Bohemia River, Sassafras River) required no watershed load reductions as the TMDL could only be achieved by reducing concentrations at the Chesapeake Bay mainstem boundary and through natural attenuation of PCB contamination within the estuarine sediments. Any reduction to watershed loadings provided no benefit in achieving water quality. Based on this assessment, MDE does

not plan to develop PCB TMDLs to address these listings. MDE also anticipates that fish tissue concentrations will continue to decline in these waterbodies as has been demonstrated in similar PCB impaired waterbodies (e.g., Corsica River, Lower Pocomoke River) which were delisted in the 2020-2022 IR. MDE will continue to collect fish within these waters through MDE's fish consumption advisory monitoring program to determine if fish tissue concentrations have declined to levels resulting in water quality standards attainment and impairment delisting.

The PCB impairment listing for Middle Chesapeake Bay requires additional fish tissue data to determine the geographical extent of the impairment within the mainstem segment. It is very likely that fish collected within the mainstem segment are accumulating PCBs in tributaries within their home range that are impaired for PCBs (e.g., Elk River, Bush River) and not directly from the mainstem. MDE will continue to collect fish within the Middle Chesapeake Bay through MDE's fish consumption advisory monitoring program to determine the geographical extent of the impairment. MDE does not anticipate developing a TMDL to address this listing as the source of PCB contamination is most likely within the tributaries and not the mainstem segment.

The PCB impairment listing for Stansbury Pond is based on white perch with elevated levels of PCBs that are likely not resident species within the pond. It is possible that the white perch are resident within Bear Creek, which is adjacent to the pond, and either traveled in through an open pipe connection during spawning season or during high tide when water overflows the pond embankment, or were released into the pond. A PCB impairment listing for Bear Creek was addressed by the Baltimore Harbor PCB TMDL which was approved by USEPA in October 2012. MDE Field Services have been unable to collect white perch within the pond since 2017. Resident species of adult sunfish and juvenile largemouth bass and sunfish have been collected and MDE is awaiting the results of the analysis. MDE delisted Stansbury Pond from Category 5 in the 2024 IR based on the results of the resident species collected in the pond and expert opinion of MDE's Field Services that the white perch collected in the pond that have historically exceeded the PCB listing threshold are not resident.

Per and polyfluoroalkyl substances (PFAS)

PFAS – short for per- and polyfluoroalkyl substances – refers to a large group of more than 4,000 human-made chemicals that have been used since the 1940s in a range of products, including stain- and water-resistant fabrics and carpeting, cleaning products, paints, cookware, food packaging and fire-fighting foams. These uses of PFAS have led to PFAS entering our environment, where they have been measured by several states in soil, surface water, groundwater and seafood. Some PFAS can last a long time in the environment and in the human body and can accumulate in the food chain.

Maryland has for several decades monitored for certain chemical contaminant levels (e.g., PCBs and mercury) in Maryland's recreationally caught fish. 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 are the basis for MDE's fish consumption guidelines. In Fall 2020, MDE began a two-year state-wide monitoring effort

to analyze fish tissue for PFAS within five regions of the State: Eastern Shore, Harbors and Bays, Baltimore-Washington Metro Area, Western Bay Tributaries, and Western Maryland.

In addition to 59 core sites under the state-wide monitoring effort, MDE also targeted two additional monitoring sites within the tidal and non-tidal waters of Piscataway Creek due to the presence of a military facility that was known to be a source of PFAS within the watershed and an area near the mouth of the Piscataway Creek, popular for recreational fishing. Fish collections from Fall 2020 and 2021 found elevated levels of perfluorooctane sulfonic acid (PFOS) resulting in fish tissue impairment listings in Category 5 of the 2020/2022 IR for the non-tidal and tidal waters of Piscataway Creek.

The fish tissue listing threshold from the 2020-2022 IR toxics assessment methodology was based on risk parameters from USEPA's 2016 drinking water health advisories for PFOS as human health criterion for fish consumption has not yet been developed by USEPA.
MDE IR Toxics Assessment Methodology can be accessed at:
https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Documents/Assessment_Methodologies/Toxics_Assessment_Methodology_Final_12_19_23.pdf

USEPA's Drinking Water Health Advisory for PFOS (USEPA 2016) can be accessed at:
https://www.epa.gov/sites/default/files/2016-05/documents/pfos_health_advisory_final_508.pdf

MDE completed the state-wide fish tissue monitoring effort in Fall 2022 and the PFOS fish tissue data was assessed for the 2024 IR. The fish tissue listing threshold for PFOS has been revised based on risk parameters developed by Center for Disease Control (CDC) for use in USEPA's regional screening levels for risk assessment. The revised listing threshold is an order of magnitude more stringent than the previous threshold and will result in several new listings for PFOS throughout the State in the 2024 IR. MDE has also assessed fish tissue data for four additional PFAS compounds, perfluorobutane sulfonate (PFBS), perfluorohexanesulfonic acid (PFHxS), perfluorooctanoic acid (PFOA), and perfluorononanoic acid (PFNA), for which USEPA has proposed drinking water maximum contaminant levels (MCLs) under the National Primary Drinking Water Regulation (NPDWR). The listing thresholds for these PFAS compounds were also based on CDC risk parameters. The fish tissue concentrations for these compounds were generally not detected or were at very low levels and will not result in any fish tissue impairment listings in the 2024 IR. USEPA also proposed an MCL for the PFAS compound, Gen X (hexafluoropropylene oxide dimer acid or HFPO-DA), under the NPDWR. MDE does not currently have data for this compound as the laboratories contracted to analyze fish tissue for PFAS used a method that does not quantify Gen X. In the future, MDE will ensure the method being used to analyze fish tissue will include this PFAS compound. However, it is unlikely that Gen X will result in additional fish tissue impairment listings as it does not readily bioaccumulate in fish.

To access the USEPA Regional Screening Level Generic Tables please visit:
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

MDE anticipates that a TMDL will not be required to address the non-tidal and tidal fish tissue impairment listings for PFOS in Piscataway Creek. The predominant source of PFAS

responsible for the impairment is most likely due to releases from the military facility. MDE's Land and Materials Administration (LMA) is currently working with the facility to address PFAS site contamination. Control and remediation of PFAS sources at the military facility should reduce groundwater and surface water contamination resulting in fish tissue concentrations declining over time and eventually reaching attainment. Category 4b would be applicable for addressing the listing based on the remedial activities at the site. MDE will continue to monitor progress on this remediation effort in order to acquire the necessary documentation to support a Category 4b approach. There is currently no timeline available for when a remedial action plan will be finalized.

It is likely that for many of the listings anticipated in the 2024 IR, that the sources of PFAS contamination may not be driven solely by releases from Department of Defense facilities or other discrete sources of PFOS (i.e., commercial airports, fire training facilities, wastewater treatment plants, and Industrial Dischargers). There is the possibility that due to the stringency of the listing thresholds, PFAS contamination may be due to more diffuse sources (i.e., atmospheric deposition, agriculture, and municipal stormwater). In this situation, a Category 4b approach may not be applicable and a TMDL or other plan will need to be developed to address these listings.

Sediment

Nontidal

MDE originally listed non-tidal sediment impairments on the 1996/1998 303(d) list based on best professional judgment. In 2012, MDE began listing additional sediment impairments based on results of the biological stressor identification (BSID) analysis. The listing methodology can be found here: https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Documents/Assessment_Methodologies/AM_Solids_2012.pdf There are currently eleven sediment/total suspended solids (TSS) impairment listings on the 2024 IR.

The methodology for addressing sediment impairments in Maryland's nontidal watersheds for TMDLs was first developed starting in 2007 and updated in 2009. The Chesapeake Bay Program Watershed model (CBP 5.2) was used to establish the difference between reference and impaired watersheds. Forty-nine TMDLs were established using this method. The TMDL methodologies can be found here:
2007 - https://mde.maryland.gov/programs/Water/TMDL/ApprovedFinalTMDLs/Documents/NT_Sediment_TMDL_Method_Report_20070728.pdf ;
2009 - https://mde.maryland.gov/programs/Water/TMDL/ApprovedFinalTMDLs/Documents/Methodology_Sed-NT_Addendum_20090505.pdf

A new assessment using the latest CBP model iteration (Phase 6) could not identify significant differences among disturbed and reference watersheds. Furthermore, due to the geographic scale of projects MDE is working on, the latest model resolution might not be appropriate. The Jones Falls Watershed sediment monitoring pilot started in FY 21. This pilot project is intended to

provide a framework to monitor, characterize, and simulate sediment in local watersheds at finer scales. The Field Investigations and Environmental Response Program is tasked with collecting continuous sub-hourly turbidity records, automated storm sediment samples, and sediment samples of upland and streambank sources. Data collection for the Jones Falls watershed is complete. Sampling is ongoing in the Catoctin Creek and the Upper Choptank River watersheds. As a part of this study, United States Geological Survey (USGS) was contracted to analyze upland and streambank sediment samples to conduct a fingerprinting analysis to track and quantify all sources of sediment in the watershed.

In FFY 2023, the Interstate Commission on the Potomac River Basin (ICPRB) was contracted to develop a non-tidal sediment TMDL for Deep Creek Lake watershed that is consistent with the assumptions and results of Chesapeake Bay Watershed Model. In this project, ICPRB will evaluate existing approaches, analyze local monitoring, and develop a non-tidal sediment model and TMDL for the Deep Creek Lake watershed.

Tidal

In 2010, the USEPA established TMDLs for all Chesapeake Bay tidal segments for nutrient and sediment impairments throughout the Chesapeake Bay watershed. These TMDLs addressed all of Maryland's tidal Chesapeake Bay impairment listings for total suspended solids (TSS). There are a total of thirty-two tidal sediment TMDLs. As a requirement of the Chesapeake Bay TMDLs, jurisdictions were required to develop and implement watershed implementation plans (WIPs). These are coordinated efforts in Maryland and are tracked for progress. More information about the Chesapeake Bay WIPs can be found here: https://www.epa.gov/chesapeake-bay-tmdl/chesapeake-bay-watershed-implementation-plans-wips.

Sulfates

MDE has reevaluated all Maryland 8-digit watershed sulfate listings because of issues with the previous Biological Stressor Identification (BSID) listing approach. The BSID compared the data distribution in streams with good and bad Indexes of Biological Integrity (IBI), which led to the development of low sulfate threshold values. This threshold was not based on toxicological impact on aquatic life and did not consider covariance with other contaminants such as chlorides. Based on an extensive literature review, and in consultation with USEPA, MDE replaced the previous BSID threshold with an ultra-conservative screening threshold of 145 mg/L. This threshold is not intended to be used as a surrogate for a water quality criterion, but rather it will indicate where sulfate definitively has no impact on aquatic life. Sulfate thresholds applied in the BSID approach were defined by physiographic eco-region: 25 mg/L for Highland and Coastal, and 15 mg/L for Eastern Piedmont.

An evaluation of historical sulfate data previously used for the BSID analysis (MBSS dataset) and more recently collected data (MD Ion Study, Western MD pH TMDL Data, Marcellus Shale Natural Gas Baseline Data, and DNR Monthly Core Trend Data), found that 22 of the 26 8-digit watersheds currently listed for sulfates have no exceedances using the updated screening threshold. These watersheds will be delisted in the 2024 IR. The four remaining watersheds

(Conococheague Creek, George's Creek, Potomac River Upper North Branch, and Wills Creek) will remain listed as impaired for sulfates.

Three of the four remaining sulfate impairments (Wills Creek, George's Creek, and Upper North Branch Potomac River) are within watersheds with extensive mining operations and historical abandoned mine lands. Acid mine drainage is likely to be the predominant source of sulfates. MDE will need to collect additional data to determine the extent of impairment within these watersheds as sulfate contamination will be localized due to the presence of acid mine seeps and active mining discharges. Existing data is insufficient to make this determination as the previous surveys were designed to characterize water quality at the 8-digit watershed scale using random-probabilistic sampling which does not provide sufficient resolution to define localized impairments.

MDE currently does not have sulfate criteria to assess impairments. The conservative threshold selected for this delisting effort is not applicable as a surrogate for criteria. MDE had previously shared, with USEPA, a State sulfate criteria developed using USEPA's Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses. However, USEPA and Maryland did not come to agreement on this methodology or the derived criteria so it was never formally proposed by MDE during any Triennial Review of Water Quality Standards. MDE will need to determine if a field based method for developing conductivity criteria as a surrogate for sulfates as recommended by USEPA, is applicable or an alternative approach may be applied.

The last remaining sulfate impairment (Conococheague Creek) is due to a single exceedance within a first order stream where there is no active or historical mining activity. MDE will need to collect additional data in this stream to determine whether the data was anomalous or if sources of sulfate other than acid mine drainage (e.g., fertilizer application, atmospheric deposition, natural conditions) are causing an impairment.

Temperature

Maryland has numeric temperature criteria (68°F/20°C) for Use Class III waters. The assessment methodology developed for the IR uses observations taken between June and August, to determine whether water quality standards are being met in Use Class III streams. The 90th percentile temperature of a Use Class III stream must be equal to or less than 68°F/20°C, outside of any mixing zone established by the Department, to be considered not impaired (MDE 2023). The full assessment methodology may be found here: https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Documents/Assessment_Methodologies/Final_Temp_AM_UCIII_12_19_2023.pdf There are 369 temperature impairment listings in Maryland's 2024 IR across forty-one 8-digit watersheds.

Temperature monitoring has been conducted in the Use Class III portions of the following watersheds: Gwynns Falls and Jones Falls (2016 & 2017), Catoctin Creek and Liberty Reservoir (2017 & 2018), Deer Creek and Furnace Bay (2018 & 2019), South Branch Patapsco and Upper Monocacy (2019 & 2020) and Prettyboy Reservoir and Gunpowder Falls (2020 & 2021).

Stream temperature simulations are conducted using both process-based and statistical models, the Soil and Water Assessment Tool (SWAT) and Spatial Stream Network (SSN) models, respectively. These models simulate the combined effects of urbanization and riparian deforestation on hydrology and stream temperature in cold water streams.

In FFY2020, MDE finished a draft TMDL for temperature in the coldwater portions of the Gwynns Falls watershed. Comments were received during interagency review and the project is currently on hold. In FFY22, Prettyboy Reservoir Watershed was selected as the new pilot watershed for the development of a TMDL based on a prioritization exercise that included stakeholder interest, and restorability outcomes. Prettyboy Reservoir Watershed TMDL is under development. A total of six 8-digit watersheds have been identified for TMDL development in the 2025-2032 time period.

Toxics

The tidal waters of Aberdeen Proving Ground (APG) is currently listed for toxics in Maryland's 2024 IR. This listing applies to eight individual tidal waterbodies within the APG 8-digit basin. The USEPA funded a contract with TetraTech in 2012 to conduct a chemical contaminant survey of two tidal waterbodies, Dipper Creek and Spesutie Narrows, within APG, as sufficient funds were not available to monitor all tidal waters. Water column and sediment samples were collected at several tidal stations and analyzed for a suite of chemical contaminants that may be present due to historical releases and ongoing activities at the APG military installation. In addition, ambient bioassays of water column and sediment were conducted to assess toxicity. TetraTech completed the survey in 2012 and submitted the report to the USEPA and MDE in February 2013. MDE has evaluated the information from this study and determined that the water column is not impaired by chemical contaminants within Dipper Creek or Spesutie Narrows. However, sediment bioassay results found toxicity was present at three stations within Dipper Creek and Spesutie Narrows.

Additional benthic community monitoring and sediment bioassays are required in order to determine if sediment organisms are being impacted at these stations. MDE received funding from the USEPA through a Chesapeake Bay Regulatory and Accountability Program (CBRAP) grant in FFY2017 to conduct additional chemical contaminant monitoring in the six remaining tidal waterbodies of APG. The monitoring also included additional benthic community monitoring and sediment bioassays required to assess sediment quality in Dipper Creek and Spesutie Narrows. The MDE Field Office began sample collection in July 2017 and it was completed in October 2017. MDE contracted UMCES CBL and Wye Research and Education Center (WREC) to conduct chemical contaminant analysis of sediment and water column samples, sediment bioassays, and a benthic community analysis, respectively. Laboratory analyses have been completed by UMCES CBL and WREC and the data sets were provided to MDE in March 2018. A preliminary evaluation of the water quality data has determined that the water column and sediment are not impaired within all tidal waters of the APG 8-digit basin. A comprehensive water quality evaluation will be completed by Fall 2024 which will apply guidelines laid out in MDE's Methodology for Determining Impaired Waters by Chemical Contaminants for Maryland's IR https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Documents/Assessment_Methodologies/Toxics_Assessment_Methodology_Final_12_19_23.pdf). It is anticipated that

MDE will develop a water quality analysis (WQA) in FFY 2025 to delist the toxics impairment for tidal waters of APG.

Trash

A Trash TMDL for the Anacostia River Watershed was approved by USEPA in 2010. The TMDL was challenged by the Natural Resources Defense Council (NRDC) in DC Circuit Court in 2016 and the judgment delivered in 2018 required a revision of the TMDL to include a maximum load value. In FFY19 and FFY20, MDE met regularly with USEPA and the DC Department of Energy and Environment (DOEE). In FFY21, MDE pursued a multi-year Memorandum of Understanding (MOU) with Morgan State University Patuxent Environmental & Aquatic Research Laboratory (PEARL) to develop a public survey regarding trash pollution and water recreation. The primary objective of this project is to develop a draft survey that will be administered to the public, in order to determine the level of trash that is acceptable to the public for water recreation. Results from the survey will be used to develop the endpoint of the revised TMDL. In FFY23, the second year of the MOU, PEARL finalized the development of the public survey and administered it. Data from the survey will be analyzed in FFY24 and recommendations from the report will be reviewed.

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