



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION III  
1650 Arch Street  
Philadelphia, Pennsylvania 19103-2029  
12/3/2009

Richard Eskin, Ph.D., Director  
Technical and Regulatory Service Administration  
Maryland Department of the Environment  
1800 Washington Blvd., Suite 540  
Baltimore, Maryland 21230-1718

Dear Dr. Eskin:

The U.S. Environmental Protection Agency (EPA), Region III, is pleased to approve *Total Maximum Daily Loads (TMDLs) for fecal bacteria in the Loch Raven Reservoir Basin in Baltimore, Carroll and Harford Counties, Maryland*. The TMDL report was submitted by the Maryland Department of the Environment (MDE) to EPA to review and approve on July 29, 2009. The TMDL was established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address impairments of water quality as identified in Maryland's Section 303(d) List. The Loch Raven Reservoir watershed (MD02130805) was included on Maryland's Section 303(d) List as impaired by fecal bacteria (2008) and impacts to biological communities (listed in 2002, 2004 and 2008). This TMDL addresses the fecal bacteria impairment only.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) be designed to attain and maintain the applicable water quality standards; (2) include a total allowable loading and as appropriate, wasteload allocations for point sources and load allocations for nonpoint sources; (3) consider the impacts of background pollutant contributions; (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated); (5) consider seasonal variations; (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality); and (7) be subject to public participation. In addition, these TMDLs considered reasonable assurance that the TMDL allocations assigned to the nonpoint sources can be reasonably met. The enclosure to this letter describes how the fecal bacteria TMDLs for the Loch Raven Reservoir watershed satisfy each of these requirements.

As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL wasteload allocation pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please do not hesitate to contact María García, at 215-814-3199.

Sincerely,

John Armstead for

Jon M. Capacasa, Director  
Water Protection Division

Enclosure

cc: Nauth Panday, MDE-TARSA  
Melissa Chatham, MDE-TARSA



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**Decision Rationale**  
**Total Maximum Daily Loads of**  
**Fecal Bacteria for the Loch Raven**  
**Reservoir Basin in Baltimore, Carroll, and**  
**Harford Counties, Maryland**

**John Armstead for**

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**Jon M. Capacasa, Director**  
**Water Protection Division**

**Date:12/3/2009**

**Decision Rationale**  
**Total Maximum Daily Loads of**  
**Fecal Bacteria for the Loch Raven Reservoir Basin in**  
**Baltimore, Carroll, and Harford Counties, Maryland**

**I. Introduction**

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those waterbodies identified as impaired by the State where technology based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a Margin of Safety (MOS), that may be discharged to a waterbody without exceeding water quality standards.

This document sets forth the U.S. Environmental Protection Agency's (EPA) rationale for approving the TMDL for fecal bacteria in the Loch Raven Reservoir watershed. The TMDL was established to address impairments of water quality, caused by fecal bacteria, as identified in Maryland's 2008 Section 303(d) List for water quality limited segments. The Maryland Department of the Environment (MDE) submitted the report, *Total Maximum Daily Loads of Fecal Bacteria for the Loch Raven Reservoir Basin in Baltimore, Carroll, and Harford Counties, Maryland*, submitted to the EPA for review and approval on July 29, 2009. The TMDL in this report addresses the fecal bacteria impairment in the Loch Raven Reservoir watershed as identified on Maryland's Section 303(d) List. The basin identification for the Loch Raven Reservoir watershed is MD02130805.

EPA's rationale is based on the TMDL Report and information contained in the computer files provided to EPA by MDE. EPA's review determined that the TMDLs meet the following seven regulatory requirements pursuant to 40 CFR Part 130.

1. The TMDL is designed to implement applicable water quality standards.
2. The TMDL includes a total allowable load as well as individual wasteload allocations (WLA) and load allocations (LAs).
3. The TMDL considers the impacts of background pollutant contributions.
4. The TMDL considers critical environmental conditions.
5. The TMDL considers seasonal environmental variations.
6. The TMDL includes a MOS.
7. The TMDL has been subject to public participation.

In addition, these TMDLs considered reasonable assurance that the TMDL allocations assigned to nonpoint sources can be reasonably met.

## II. Summary

The TMDL specifically allocates the allowable fecal bacteria loading to the Loch Raven Reservoir watershed. There is one permitted Wastewater Treatment Plant (WWTP) in the watershed and four permitted Municipal Separate Storm Sewer Systems (MS4s), which are included in the WLA. The fact that the TMDL does not assign WLAs to any other sources in the watershed should not be construed as a determination by either EPA or MDE that there are no additional sources in the watershed that are subject to the National Pollutant Discharge Elimination System (NPDES) program. In addition, the fact that EPA is approving this TMDL does not mean that EPA has determined whether some of the sources discussed in the TMDL, under appropriate conditions, might be subject to the NPDES program. The annual average TMDLs and Maximum Daily Load for fecal bacteria are presented in Tables 1 and 2, respectively. Individual annual and a daily WLA for the permitted point sources are provided in Table 3. The TMDLs include an upstream load in Pennsylvania, generated outside of the assessment area (MD 8-digit Loch Raven Reservoir watershed).

**Table 1. Loch Raven Reservoir Watershed Annual Average TMDL**  
**MD 8-Digit Loch Raven Reservoir Fecal Bacteria TMDL**  
**(Billion MPN *E. coli*/year)**

TMDL	=	LA			+	WLA			+	MOS
		LA <sub>PA (1)</sub>	+	LA <sub>LR</sub>		+	SW WLA <sub>LR</sub>	+		
513,894	=	6,200	+	487,750	+	18,377	+	1,567	+	Incorporated
		Upstream Load Allocation		MD 8-digit Loch Raven Reservoir TMDL Contribution (507,694)						

**Table 2. Loch Raven Reservoir Watershed Maximum Daily Load**  
**MD 8-Digit Loch Raven Reservoir Fecal Bacteria TMDL Summary**  
**(Billion MPN *E. coli*/day)**

TMDL	=	LA			+	WLA			+	MOS
		LA <sub>PA (1)</sub>	+	LA <sub>LR</sub>		+	SW WLA <sub>LR</sub>	+		
17,951	=	243	+	16,876	+	819	+	13	+	Incorporated
		Upstream TMDL		MD 8-digit Loch Raven Reservoir TMDL Contribution (17,708)						

(1) Although the upstream load is reported here as a single value, it could include point and nonpoint sources.

**Table 3. Wasteload Allocations for Permitted Point Sources in the Loch Raven Reservoir Watershed**

Facility	NPDES ID Number	TMDL Long Term Annual Average Load (Billion MPN E. Coli/year)	Maximum Daily Load (Billion MPN E. Coli/day)
Hampstead WWTP	MD0022446	1,567	13
NPDES Stormwater Permits	N/A	18,377	819
Baltimore County	MD0068314		
Carroll County	MD0068331		
Hampstead Municipality	MD0068268		
Harford County	MDR055500		

The TMDL is a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically based strategy that considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a MOS value. The option is always available to refine the TMDL for resubmittal to EPA for approval if environmental conditions, new data, or the understanding of the natural processes change more than what was anticipated by the MOS.

### III. Background

The Loch Raven Reservoir watershed is located in both Maryland and Pennsylvania with a drainage area of 224.4 square miles (143,617 acres). The majority of the watershed is in Maryland with a portion in York County, Pennsylvania. The Maryland portion is largely in Baltimore County, with small areas in Carroll and Harford Counties. Maryland’s portion of the watershed can be characterized as primarily forest (36.9%) and agricultural land (30.1%), but with significant urban area as well (24.3%). The Pennsylvania portion is largely pasture (38.3%) and agricultural (30.5%). The total population in the Loch Raven Reservoir watershed is estimated to be 90,345 people.

The tributaries of the Loch Raven Reservoir watershed are listed on Maryland’s Section 303(d) List as impaired by fecal bacteria (2008) and impacts to biological communities (listed in 2002, 2004, and 2008). The Reservoir itself is not listed as impaired by fecal bacteria. This TMDL addresses the bacteria impairment only.

The Surface Water Use Designation for the Loch Raven Reservoir watershed and its tributaries is Use III-P: *Nontidal Cold Water and Public Water Supply* (COMAR) 26.08.02.08J. The Loch Raven Reservoir watershed was listed on Maryland’s Section 303(d) List as impaired by fecal bacteria due to elevated fecal coliform concentrations. As shown in table 2.3.2 of the TMDL report, all but one of the seven monitored subwatersheds of the Loch Raven Reservoir had steady state geometric mean concentrations of *E. coli* above the water quality criterion,

supporting the 2008 listing for fecal bacteria and the conclusion that a TMDL for fecal bacteria is required.

CWA Section 303(d) and its implementing regulations require that TMDLs be developed for waterbodies identified as impaired by the State where technology based and other required controls do not provide for attainment of water quality standards. The fecal bacteria TMDL submitted by MDE is designed to allow for the attainment of the designated uses and to ensure that there will be no bacteria impacts affecting aquatic health in the Maryland 8-digit Loch Raven Reservoir watershed. Refer to Tables 1 and 2 above for a summary of allowable loads.

For this TMDL analysis, the Loch Raven Reservoir watershed has been divided into eight subwatersheds and the pollutant loads established in the TMDL are for those eight subwatersheds. To establish baseline and allowable pollutant loads for this TMDL, a flow duration curve approach was employed, using bacteria from MDE and flow strata estimated from United States Geological Survey (USGS) daily flow monitoring. The sources of fecal bacteria are estimated at seven representative stations in the Loch Raven Reservoir watershed where samples were collected for one year. Multiple antibiotic resistance analysis (ARA) source tracking was used to determine the relative proportion of domestic, human, livestock, and wildlife source categories. Appendix C of the TMDL report includes the Bacteria Source Tracking Report titled *Identifying Sources of Fecal Pollution in Shellfish and Nontidal Waters in Maryland Watersheds* prepared by the Salisbury University, Department of Biological Sciences and Environmental Health Services.

The baseline load is estimated from current monitoring data using a long-term geometric mean and weighing factors from the flow duration curve. The TMDL for fecal bacteria entering the Loch Raven Reservoir watershed is established after considering two different hydrological conditions: an average annual condition and an average seasonal dry weather condition (the period between May 1 and September 30). The allowable load quantified by the TMDL is reported in units of Most Probable Number (MPN)/day and represents a long-term load established over a variety of hydrological conditions.

Two scenarios were developed, with the first assessing if attainment of current water quality standards could be achieved by applying maximum practicable reductions (MPRs), and the second applying higher reductions than MPRs. Scenario solutions were based on an optimization method where the objective was to minimize the overall risk to human health. In six of the eight subwatersheds, it was established that the water quality standards could not be attained with MPRs; thus, higher maximum reductions were applied.

The fecal bacteria long-term annual average TMDL for the Loch Raven Reservoir watershed is 513,894 billion MPN *E. coli*/year, which includes a load allocation for subwatersheds located in Pennsylvania (LA<sub>PA</sub>). The LA<sub>PA</sub> (6,200 billion MPN *E. coli*/year) represents a 13 percent reduction from the Pennsylvania baseline load of 7,106 billion MPN *E. coli*/year. The Maryland TMDL contribution (507,694 billion MPN *E. coli*/year) represents a reduction of 77 percent from the Maryland baseline load contribution of 2,187,202 billion MPN *E. coli*/year. Maryland's TMDL contribution represents the sum of individual TMDLs for the eight subwatersheds or portions thereof within Maryland, and is distributed between a load

allocation ( $LA_{LR}$ ) for nonpoint sources and wasteload allocations ( $WLA_{LR}$ ) for point sources. Point sources include NPDES WWTPs and NPDES regulated SW discharges, including County and MS4s.

#### **IV. Discussion of Regulatory Conditions**

EPA finds that MDE has provided sufficient information to meet all seven of the basic requirements for establishing a fecal bacteria TMDL for the Loch Raven Reservoir watershed. EPA, therefore, approves the fecal bacteria TMDL for the Loch Raven Reservoir watershed. This approval is outlined below according to the seven regulatory requirements.

***1) The TMDLs are designed to implement applicable water quality standards.***

Water Quality Standards consist of three components: designated and existing uses; narrative and/or numerical water quality criteria necessary to support those uses; and an anti-degradation Statement. The Surface Water Use Designation for the Loch Raven Reservoir watershed is Use III-P: *Nontidal Cold Water and Public Water Supply* (COMAR) 26.08.02.08J. Maryland's water quality criteria for bacteria is based on water column limits for either *E. coli* or *enterococci*. The indicator organism used in the Loch Raven Reservoir watershed TMDL analysis was *E. coli* and the state water quality standard used in this study was 126 MPN/100 ml (Maryland Code of Regulations 26.08.02.03-3, *Water Quality Criteria Specific to Designated Uses*). EPA believes this is a reasonable and appropriate water quality goal.

***2) The TMDLs include a total allowable load as well as individual wasteload allocations and load allocations.***

##### **Total Allowable Load**

As described above, the allowable load was determined by first estimating a baseline load from current monitoring data. The baseline loads were calculated by using bacteria data and flow strata based on the flow duration curve. The TMDL for fecal bacteria was established after considering two different hydrological conditions: an average annual condition and an average seasonal dry weather condition (the period between May 1 and September 30, when water contact recreation is more prevalent). This load is considered the maximum allowable load the watershed can assimilate and still attain water quality standards. The fecal bacteria TMDL was developed for the Loch Raven Reservoir watershed based on this endpoint. The allowable load was reported in units of MPN/year for the average annual load and in MPN/day for the long term daily load. Expressing TMDLs using these units is consistent with Federal regulations at 40 CFR §130.2(i), which states that *TMDLs can be expressed in terms of either mass per time, or other appropriate measure*. The average annual and long term daily fecal bacteria TMDLs are presented in Tables 1 and 2, respectively.

EPA regulations at 40 CFR §130.2(i) state that *the total allowable load shall be the sum of individual WLAs for point sources, LAs for nonpoint sources, and natural background concentrations*. The TMDL for fecal bacteria for the Loch Raven Reservoir watershed is



consistent with 40 CFR §130.2(i) because the total loads provided by MDE equal the sum of the individual WLAs for point sources and the land based LAs for nonpoint sources.

### **Wasteload Allocations**

As indicated in the TMDL Report, there is one permitted WWTP point source in this watershed. This point source is an active municipal NPDES permitted facility which treats approximately .94 MGD (million gallons per day). There are no industrial facilities in the Loch Raven Reservoir watershed with NPDES permits regulating the discharge of fecal bacteria. Based on EPA's guidance, the stormwater wasteload allocation (SW-WLA) is presented as one combined load for the entire land area of each jurisdiction in each subwatershed. Within the Maryland portion of the Loch Raven Reservoir watershed, the jurisdictions of Baltimore, Carroll, and Harford Counties have Phase I MS4 permits. The municipality of Hampstead is also covered by a general Phase II MS4 permit. See Table 3 above for the point source WLA.

### **Load Allocations**

The TMDL summary in Table 1 contains the LA for the Loch Raven Reservoir watershed. According to Federal regulations at 40 CFR §130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loadings should be distinguished. As described above, Maryland conducted an Antibiotic Resistance Approach analysis in order to estimate the contributions from domestic animals (pets and human associated animals); human (human waste); livestock (agriculture-related animals); and wildlife (mammals and waterfowl), to the overall nonpoint source loadings. Table 4.7.1, of the TMDL Report, provides a breakdown of the existing average annual fecal bacteria from these four source categories. A similar breakdown was developed for the allocations, which are shown in Table 4.8.2 of the TMDL Report. In this analysis, the upstream load ( $LA_{PA}$ ) was reported as a single value, but it could include point and nonpoint sources. For human sources, the nonpoint source contribution is estimated by subtracting any WWTP loads from the TMDL human load, and is then assigned to the  $LA_{LR}$ . Also, the livestock loads are all assigned to the  $LA_{LR}$ . Wildlife sources were distributed between the  $LA_{LR}$  and the  $SW-WLA_{LR}$ .

Federal regulations at 40 CFR §122.44(d)(1)(vii)(B) require that, for an NPDES permit for an individual point source, the effluent limitations must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA. EPA has authority to object to the issuance of an NPDES permit that is inconsistent with WLAs established for that point source. To ensure consistency with this TMDL, if an NPDES permit is issued for a point source that discharges one or more of the pollutants of concern in the Loch Raven Reservoir watershed, any deviation from the WLAs set forth in the TMDL Report and described herein for a point source, must be documented in the permit Fact Sheet and made available for public review along with the proposed draft permit and the Notice of Tentative Decision. The documentation should: (1) demonstrate that the loading change is consistent with the goals of the TMDL and will implement the applicable water quality standards; (2) demonstrate that the changes embrace the assumptions and methodology of the TMDL; and

(3) describe that portion of the total allowable loading determined in the State's approved TMDL Report that remains for any other point sources (and future growth where included in the original TMDL) not yet issued a permit under the TMDL. It is also expected that Maryland will provide this Fact Sheet for review and comment to each point source included in the TMDL analysis, as well as, any local and State agency with jurisdiction over land uses for which LA changes may be impacted. It is also expected that MDE will require periodic monitoring of the point source(s) for fecal bacteria, through the NPDES permit process, in order to monitor and determine compliance with the TMDL's WLAs.

In addition, EPA regulations and program guidance provides for effluent trading. Federal regulations at 40 CFR §130.2(i) state: "if Best Management Practices (BMP) or other nonpoint source pollution controls make more stringent LAs practicable, then WLAs may be made less stringent. Thus, the TMDL process provides for nonpoint source control tradeoffs." The State may trade between point sources and nonpoint sources identified in the TMDL as long as three general conditions are met: (1) the total allowable load to the waterbody is not exceeded; (2) the trading of loads from one source to another continues to properly implement the applicable water quality standards and embraces the assumptions and methodology of the TMDL; and (3) the trading results in enforceable controls for each source.

Based on the foregoing, EPA has determined that the TMDLs are consistent with the regulations and requirements of 40 CFR Part 130.

***3) The TMDLs consider the impacts of background pollutant contributions.***

The TMDLs consider the impact of background pollutants by considering the bacterial loads from natural sources such as wildlife.

***4) The TMDLs consider critical environmental conditions.***

EPA regulations at 40 CFR §130.7(c)(1) require TMDLs to account for critical conditions for stream flow, loading, and water quality parameters. The intent of the regulations is to ensure that (1) the TMDLs are protective of human health, and (2) the water quality of the waterbodies is protected during the times when they are most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards<sup>1</sup>. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable worst-case scenario condition. For this TMDL, the critical condition was determined by assessing annual and dry weather seasonal conditions (May 1 through September 30). The critical condition requirement is met by determining the maximum reduction per bacteria source

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<sup>1</sup>EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

that satisfies both conditions and meets the water quality standard, thereby minimizing the risk to water contact recreation.

**5) *The TMDLs consider seasonal environmental variations.***

Seasonality was assessed as the time period when water contact recreation was expected, specifically dry weather days during May 1 through September 30.

**6) *The TMDLs include a Margin of Safety.***

The requirement for a MOS is intended to add a level of conservatism to the modeling process in order to account for uncertainty. Based on EPA guidance, the MOS can be achieved through two approaches. One approach is to reserve a portion of the loading capacity as a separate term, and the other approach is to incorporate the MOS as part of the design conditions. MDE adopted an explicit MOS for this TMDL. The MOS was determined by estimating the loading capacity of the stream based on a reduced (more stringent) water quality criterion concentration. The *E. coli* water quality criterion concentration was reduced by 5 percent, from 126 *E. coli* MPN/100 ml to 119.7 *E. coli* MPN/100 ml.

**7) *The TMDLs have been subject to public participation.***

MDE provided an opportunity for public review and comment by publishing a public notice of intent to establish the Loch Raven Reservoir watershed fecal bacteria TMDL. The public comment period was from May 11, 2009 through June 9, 2009. During this comment period, twenty written comments by three commenters were received. MDE responded with a reasonable set of responses to the comments received.

A letter was sent to the U.S. Fish and Wildlife Service pursuant to Section 7(c) of the Endangered Species Act, requesting the Service's concurrence with EPA's findings that approval of this TMDL does not adversely affect any listed endangered and threatened species, and their critical habitats.

## **V. Discussion of Reasonable Assurance**

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR §122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA. Furthermore, EPA has the authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

MDE proposed a staged approach to implementation beginning with the MPR scenario, with regularly scheduled follow-up monitoring to assess the effectiveness of the implementation plan. MDE intends for the required reductions to be implemented in an iterative process that first addresses those sources with the largest impact on water quality and human health risk, with consideration given to ease of implementation and cost.

Potential funding sources for implementation include the Maryland's Agricultural Cost Share Program (MACS), which provides grants to farmers to help protect natural resources, the Environmental Quality and Incentives Program, which focuses on implementing conservation practices and BMPs on land involved with livestock and production, and the 319 Nonpoint Source Management Program, which can provide grant money for states to support nonpoint source implementation projects. Though not directly linked, it is assumed that the nutrient management plans from the Water Quality Improvement Act of 1998 (WQIA) will have some reduction of bacteria from manure application practices.

While a portion of the fecal bacteria loads that contribute to the Loch Raven Reservoir watershed impairment originate in the Pennsylvania portion of the watershed, implementation actions in this area of the watershed are beyond the jurisdictional and regulatory authority of the Maryland Department of the Environment. MDE has stated that it will work with the Commonwealth of Pennsylvania and EPA to ensure that the Upstream Load Allocations presented in this document are achieved to meet Maryland's downstream water quality standards.