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

Dr. Richard Eskin, Director
Technical and Regulatory Services Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 450
Baltimore, MD 21230-1718

DEC - 4 2007

Dear Dr. Eskin:

The U.S. Environmental Protection Agency (EPA) is pleased to approve the *Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Herring Run Watershed in Baltimore City and Baltimore County, Maryland.* The TMDL Report was first submitted by the Maryland Department of the Environment's (MDE) letter dated June 18, 2007, and the revised final draft was received by EPA for review and approval on September 24, 2007. The TMDL was developed and submitted in accordance with Sections 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 of impaired waters. The MDE identified the Herring Run Watershed as impaired by fecal bacteria.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards; (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) 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); (7) be subject to public participation. The Fecal Bacteria TMDLs for the Non-Tidal Herring run satisfied each of these requirements. In addition, the Herring run TMDLs considered reasonable assurance that the allocations assigned to the nonpoint sources can be reasonably met. A copy of EPA's Decision Rationale for approval of these TMDLs has been included with this letter.

As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA 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 Mr. Thomas Henry, TMDL Program Manager, at (215) 814-5752 or Mr. Kuo-Liang Lai at (215) 814-5473.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure

cc: Nauth Panday, MDE-TARSA
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Decision Rationale
Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Herring Run Watershed Baltimore City and Baltimore County Maryland

Jon M. Capacasa, Director
Water Protection Division

Date: 12.4.07

Decision Rationale

Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Herring Run Watershed in Baltimore City and Baltimore County, 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 water quality-limited waterbody.

This document sets forth the U.S. Environmental Protection Agency's (EPA) rationale for approving the TMDLs for fecal bacteria in the Herring Run Watershed. The TMDLs were established to address water quality impairments caused by bacteria as identified in Maryland's 2002 Section 303(d) List of impaired waters. The Maryland Department of the Environment (MDE), submitted[1] the *Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Herring Run in Baltimore City and Baltimore County, Maryland*, dated June 18, 2007, to EPA for final review, which was received on June 28, 2007. The Herring Run Non-Tidal Watershed (02-13-09-01-10-40, 41, 42) was first identified on Maryland's 1996 Section 303(d) list as impaired by nutrients and sediments, with fecal bacteria and impacts to biological communities added to the 2002 Section 303(d) List. The TMDLs described in this document were developed to address fecal bacteria non-tidal water quality impairments.

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 TMDLs are designed to implement applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual wasteload allocations (WLAs) and load allocations (LAs).
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a MOS.
7. The TMDLs have been subject to public participation.

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[1]By letter dated January 31, 2006.

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

II. Summary

There are no National Pollutant Discharge Elimination System (NPDES) permitted sources within the watershed. MDE provided adequate land use and instream bacteria data in the TMDL report and allocated the TMDL loads to specific sources. The TMDL shown in Table 1 requires up to and including 93.4 percent reduction from existing or baseline conditions.

Table 1. Herring Run Bacteria Non-Tidal TMDL Maximum Daily Loads Summary

Subwatershed	TMDL	[3]LA	[2]WLA-MS4
	Billion [1]MPN/day		
Harford Rd.	26,485	3,067	23,418
Pulaski Hwy.	11,292	538	10,754
Biddle & 62nd St.	4,489	1,163	3,326
Total	42,266	4,768	37,498

[1]MPN = Most Probable Number
[2]WLA-MS4 = Wasteload Allocation for MS4 systems
[3]LA = Load Allocation

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 which considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a "MOS" value. Conditions, available data and the understanding of the natural processes can change more than anticipated by the MOS. The option is always available to the State to refine the TMDL for re-submittal to EPA for approval.

III. Background

The Herring Run Watershed is a subwatershed of the Back River basin and comprises approximately 30 square miles (19,198.8 acres). Herring Run Watershed includes Herring Run, West Herring Run, Chinquapin Run, Moores Run and Redhouse Run. Herring Run and all its tributaries are non-tidal. The watershed is located in Southern Baltimore County and Northern Baltimore City, Maryland.

Leonard Mill Pond has a perennial but variable discharge, which flows eventually to the head of Johnson Pond. Johnson Pond is a fairly large impoundment located at the outlet of the Upper Herring Run. The dam at Johnson Pond is the designated dividing line between tidal and non-tidal waters in the Herring Run. Discharge from the pond is to the Herring Run, which flows southwest to the Chesapeake Bay.

The 2000 Maryland Department of Planning (MDP) land use/land cover data show that the watershed can be characterized as primarily urban development. The Herring Run Watershed is one of the most densely populated watersheds within the Chesapeake Bay drainage basin. The land use percentage distribution for Herring Run is shown in Table 2.

Table 2. Land Use Area and Percentages in Herring Run Watershed (TMDL Report Table 2.1.1)

Land Type	Acreage	Percentage
Forest	1.523	8 %
Residential	11.678	60 %
Commercial	5.872	31 %
Water	126	1 %
Totals	**19,199**	**100%**

MDE estimated the total population in the Herring Run Watershed to be 75,372 people, based on a weighted average from the Geographic Information System (GIS) 2000 Census Block and the MDP 2002 Land Use/Land Cover that includes the Herring Run Watershed. Since the Herring Run Watershed is a sub-area of the Census Block, percentages of each land use within the watershed were used to extract the areas from the 2000 Census Block within the watershed.

IV. Computational Procedure

The length of Herring Run within this TMDL is non-tidal or free flowing. MDE developed the method described below to determine non-tidal TMDLs.

General

In addition to the TMDL Report provided during the public notice period, MDE provided EPA with computer files in Microsoft Excel® for review. MDE's procedure uses a variation of the load-duration curve method which is also used by several states and by EPA. MDE uses stream flow data from U.S. Geological Survey (USGS) gauges and available sampling data from the Baltimore City Department of Public Works to determine the bacteria load reductions necessary to meet water quality standards. MDE then uses bacteria source tracking (BST) results to allocate the TMDL loads to various sources (i.e., domestic animals, human sources, livestock, and wildlife).

The load-duration curve method uses sampling data combined with a long-term stream flow record, frequently from a USGS gauging station, to provide insight into the flow condition under which exceedances of the water quality standard occur. Exceedances that occur under low-flow conditions are generally attributed to loads delivered directly to the stream such as straight pipes, sanitary sewer overflows, livestock with access to the stream, and wildlife. Exceedances that occur under high-flow conditions are typically attributed to loads that are delivered to the stream in stormwater runoff. The flow duration interval shown across the bottom (TMDL Report Figure 3) is the percent of time that a given flow is exceeded.

The flow-duration curve is converted to a load-duration curve by multiplying the flow by the bacteria count and the appropriate unit conversion factor (100 ml to cubic feet).

Frequently, the target load (TMDL report Figure 4) is based on the single-sample maximum value from the State's water quality standards. The required load reduction at all flows is equal to the difference between the target load and a line parallel to the target load line which passes through the highest sample value. However, MDE's water quality standards do not contain a single-sample maximum number; and therefore modified the above procedure.

Herring Run Computational Method

In order for EPA to conduct a thorough review of MDE's method, MDE provided EPA with Microsoft Excel® files; and therefore, the following description of MDE's computational method refers to information not necessarily contained in the TMDL Report.

There is one USGS gauging station located within the Herring Run Watershed which was used to estimate the surface flow. The monitoring USGS station (01585200) has observations from October 1, 1996 to September 30, 2005.

MDE then used a hydrograph separation program, the USGS HYSEP, to analyze the daily flow record to separate surface water flow to Herring Run from interflow[2] and groundwater to the stream. MDE determined that flows below the 25 percent daily flow interval (high stream flow) represent surface water flow and are likely to have higher bacteria loads than interflow or groundwater. Instead of calculating the geometric mean using all data, MDE calculates a geometric mean using the monitoring data taken when the stream flow is high, and a geometric mean using the monitoring data taken when the stream flow is not high. An example plot from the TMDL Report is in Appendix B.

The representative geometric mean for the station is equal to 0.25 times the $\log_{10}$ high-flow geometric mean plus 0.75 times the $\log_{10}$ low-flow geometric mean changed back into a geometric mean. The high-flow, low-flow, and representative geometric means are shown in Table 3 below. Note that geometric means in the table exceed the 126 MPN/100ml criterion for *E. coli*.

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[2] Interflow is that portion of infiltrated rainfall that discharges to a waterbody prior to reaching the groundwater table.

Table 3. Existing/Baseline Conditions (TMDL Report Table 2.3.3)
Annual Steady State Geometric Mean by Stratum per Subwatershed

Station	Flow Stratum	# Samples	*E. coli* Minimum (MPN/100ml)	*E. coli* Maximum (MPN/100ml)	Annual Steady-state Geometric Mean (MPN/100ml)	Annual Overall Geometric Mean (MPN/100ml)
Harford Rd	High	9	299	170,789	6,471	1,063
	Low	33	36	5,967	582	
Pulaski Hwy	High	9	187	63,367	3,500	644
	Low	32	7	2,479	366	
Biddle St	High	9	111	106,800	2,016	1,462
	Low	33	23	86,997	1,313	

Table 4. Existing Seasonal Period Steady State Geometric Mean by Stratum per Subwatershed (TMDL Report Table 2.3.4)

Station	Flow Stratum	# Samples	*E. coli* Minimum (MPN/100ml)	*E. coli* Maximum (MPN/100ml)	Seasonal Steady-state Geometric Mean (MPN/100ml)	Seasonal Overall Geometric Mean (MPN/100ml)
Harford Rd	High	5	1,215	86,997	9,129	1,176
	Low	12	49	5,967	594	
Pulaski Hwy	High	5	187	42,473	4,326	1,003
	Low	12	146	2,479	616	
Biddle St	High	5	528	106,800	3,840	2,283
	Low	12	299	12,868	1,920	

The seasonal period uses only data from May 1 through September 30, a critical period for the recreational use.

Using the average flow for the high-flow and low-flow regimes, and the high-flow and low-flow regime bacteria concentrations, the baseline loads were estimated as explained in Section 4.3 and shown in Table 4.3.1 of the TMDL Report.

In order to analyze the flow record for periods that might produce higher overall geometric means and loads (critical conditions), and to account for seasonality, each day of the flow record was assigned to either the high-flow or low flow-regime. If the flow record covers more than a year, MDE used a rolling one-year period to find a year with the most high-flow days and a year with the most low-flow days, and examined each year's swimming season to find the one with the most high-flow days and most low-flow days.

Three subwatersheds were used in the analysis. The upper subwatershed's fecal bacteria load's contribution to the total fecal bacteria load at the end point was estimated by determining the travel time between the two points and applying a die-off factor.

BST was used to identify the relative contribution of the various sources to the instream water samples. The TMDL Report, Appendix C, is the Salisbury University, Department of Biological Sciences and Environmental Health Services, BST report, *Identifying Sources of Fecal Pollution in Shellfish and Nontidal Waters in Maryland Watersheds.* For purposes of the TMDL, the sources were separated into domestic animals, human, livestock, and wildlife. A fifth classification of "unknown" results from the analysis when the source could not be identified. The source percentage for each sample is shown in TMDL Report, Appendix C, Table C-8, Percentage of Sources per Station by Date.

Table 5. Distribution of Fecal Bacteria Source Loads in the Herring Run Watershed for the Annual Condition (TMDL Report Table 2.4.3)

Station	Domestic		Human		Livestock		Wildlife	
	%	Load (Billion *E. coli* MPN/year)	%	Load (Billion *E. coli* MPN/year)	%	Load (Billion *E. coli* MPN/year)	%	Load (Billion *E. coli* MPN/year)
Harford Rd	18.9	1,190,425	70.7	4,446,259	0.0	0.0	10.4	652,126
Pulaski Hwy	18.9	377,170	70.7	1,408,735	0.0	0.0	10.4	206,617
Biddle & 62nd St.	18.9	297,115	70.7	1,109,729	0.0	0.0	10.4	162,762

Table 6. Distribution of Fecal Bacteria Source Loads in the Herring Run Basin for the Seasonal Period May 1 - September 30 (TMDL Report Table 2.4.4)

Station	Domestic		Human		Livestock		Wildlife	
	%	Load Billion *E. coli* MPN/season	%	Load Billion *E. coli* MPN/season	%	Load Billion *E. coli* MPN/season	%	Load Billion *E. coli* MPN/season
Harford Rd	14.2	526,236	72.6	2,690,476	0.0	0.0	13.2	489,178
Pulaski Hwy	14.2	146,798	72.6	750,529	0.0	0.0	13.2	136,460
Biddle & 62nd St.	14.2	174,090	72.6	890,067	0.0	0.0	13.2	161,830

The target reduction for each condition is the reduction necessary in the geometric mean from Table 3 to meet the criterion. In determining the initial reduction scenario, two additional factors were considered: risk and practicability.

Bacteria from human sources are presumed to present a larger risk to humans than bacteria from other sources, and bacteria from wildlife presents the lowest risk to humans. TMDL Report, Section 4.7, Practicable Reduction Targets, page 35, identified the assumed risk factors shown in Table 7 below. Table 8, Maximum Practical Reduction Targets, shown below, identifies the practicable reductions and the rationale for selecting them.

Table 7. Relative Risk Factors

	Human	Domestic Animal	Livestock	Wildlife
Relative Risk to Humans	5	3	3	1

Table 8. Maximum Practical Reduction Targets (TMDL Report, Table 4.6.1)

Max Practicable Reduction per Source	Human	Domestic Animals	Livestock	Wildlife
	95%	75%	75%	0%
Rationale	(1) Direct source inputs. (2) Human pathogens more prevalent in humans than animals. (3) Enteric viral diseases spread from human to human.[1]	Target goal reflects uncertainty in effectiveness of urban BMPs[2] and is also based on best professional judgment	Target goal based on sediment reductions from BMPs[3] and best professional judgment	No programmatic approaches for wildlife reduction to meet water quality standards. Waters contaminated by wild animal wastes presents a public health risk that is orders of magnitude less than that associated with human waste.[4]

1. EPA. 1984. Health Effects Criteria for Fresh Recreational Waters. EPA-600/1-84-004. U.S. Environmental Protection Agency, Washington, DC.
2. EPA. 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices. EPA-821-R-99-012. U.S. Environmental Protection Agency, Washington, DC.
3. EPA. 2004. Agricultural BMP Descriptions as Defined for The Chesapeake Bay Program Watershed Model. Nutrient Subcommittee Agricultural Nutrient Reduction Workshop.
4. Environmental Indicators and Shellfish Safety. 1994. Edited by Cameron, R., Mackeney and Merle D. Pierson. Chapman & Hall.

The required reductions were determined by analyzing each of the critical time periods individually for each subwatershed, together with the results of the BST analysis, to minimize the final risk. First, the reductions were not allowed to exceed the practicable reductions in the above table. The water quality criterion for *E. coli* could not be achieved.

Table 9. Practical Reductions Results (TMDL Report Table 4.6.2)

Station	Applied Reductions				WQS Achievable
	Domestic %	Human %	Livestock %	Wildlife %	
Harford Rd	75.0%	95.0%	75.0%	0.0%	No
Pulaski Hwy	75.0%	95.0%	75.0%	0.0%	No
Biddle & 62^{nd} St.	75.0%	95.0%	75.0%	0.0%	No

Next, the analysis was performed allowing greater reductions for each fecal bacteria source until the water quality criterion for *E. coli* was achieved.

Table 10. Required Reductions to Achieve Water Quality Criterion up to 98% Reductions (TMDL Report, Table 4.6.3)

Station	Domestic %	Human %	Livestock %	Wildlife %	Target Reduction %
Harford Rd	98.0	98.0	0.0	54.7	93.5
Pulaski Hwy	98.0	98.0	0.0	33.3	91.3
Biddle & 62^{nd} St.	98.0	98.0	0.0	73.8	95.5

The TMDL load is then divided into WLA, WLA-MS4 and LA portions. MDE developed allocation rules summarized in Table 11 below. The "unknown" BST source category is deleted and the other categories increased.

Table 11. Source Contributions for TMDL Allocations (TMDL Report, Table 4.8.1)

Allocation Category	LA	WLA		
		WWTPs	MS4s	CSOs
Human		N/A	X	N/A
Domestic			X	
Livestock	X			
Wildlife	X		X	

Baltimore City and Baltimore County are covered by individual Phase I MS4 permits; therefore, the total domestic pet load is assigned to the WLA-MS4. For the same reason, wildlife is also assigned to the WLA-MS4. MS4 permits do not cover livestock and it will also be part of the LA when it is not designated as a concentrated animal feeding operation.

V. Discussion of Regulatory Conditions

EPA finds that Maryland has provided sufficient information to meet all of the seven basic requirements for establishing bacteria TMDLs for Herring Run. Therefore, EPA approves the

TMDLs for the Herring Run Watershed. EPA's approval is outlined according to the regulatory requirements listed below.

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

The Maryland water quality standards Surface Water Use Designation for this watershed includes Use I – Water Contact Recreation and Protection of Non-Tidal Warm Water Aquatic Life (COMAR 26.08.02.08D).

The standards for bacteria used for Use I water – Water Contact Recreation and Protection of Non-Tidal Warm Water Aquatic Life – are contained in COMAR 26.08.02.03-3. For waters not designated natural bathing areas the applicable criteria from Table 1, COMAR 26.08.02.03-3.A.(1)(a) is as follows:

Table 12. Water Quality Criteria

Indicator	**Steady State Geometric Mean Indicator Density**
Freshwater	
E. coli	126 MPN[1]/100ml
Enterococci	33 MPN/100ml
Marine Water	
Enterococci	35 MPN/100ml

[1]MPN - Most Probable Number

The standards do not specify either a minimum number of samples required for the geometric mean or timeframe such as the commonly used 30-day period. However, the *2006 List of Impaired Surface Waters [303(d) List] and Integrated Assessment of Water Quality In Maryland*, dated April 2006, Section B.3.2.1.3.1, Recreational Waters, contains MDE's interpretation of how bacteria data will be used for assessing waters for general recreational use. A steady state geometric mean will be calculated with available data where there are at least five representative sampling events. The data shall be from samples collected during steady State conditions and during the beach season (Memorial Day through Labor Day) to be representative of the critical condition. Furthermore, according to Section B.3.2.1.3.2, Beaches, "(t)he single sample maximum criteria applies only to beaches and is to be used for closure decisions based on short-term exceedances of the geometric mean portion of the standard." Since warm temperatures can occur early in May and last until the end of September or early October, a longer seasonal period than the official beach season (Memorial Day through Labor Day) was used for the water quality assessment as a conservative assumption in the analysis.

In 1986, EPA published "Ambient Water Quality Criteria for Bacteria" whereby three indicator organisms, fecal coliform, *E. coli* and *Enterococci*, were assessed to determine their correlation with swimming-associated illnesses. Fecal coliform are a subgroup of total coliform bacteria and *E. coli* are a subgroup of fecal coliform. *Enterococci* are a subgroup of bacteria in the fecal streptococcus group. Fecal coliform, *E. coli* and *Enterococci* can all be classified as fecal bacteria. The statistical analysis found that the highest correlation to gastrointestinal illness was linked to elevated levels of *E. coli* and *Enterococci* in fresh water (*Enterococci* in salt water), leading EPA to propose that States use *E. coli* or *Enterococci* as pathogen indicators. Maryland has adopted the EPA recommended bacterial indicators, *E. coli* and Enterococcus. Although the criteria numbers are different, the risk to the recreational bathers at the criteria levels are the same.

Estimation of annual and seasonal condition loads in the Herring Run TMDL was determined by assessing monitoring data for all stations located in the Herring Run Watershed over a sufficient temporal span (at least one year).

EPA finds that the TMDLs for bacteria will ensure that the designated use and water quality criteria for Herring Run are met and maintained.

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

The TMDL is expressed as MPN per day and is based on meeting the instream long-term geometric mean of *E. coli* bacteria. EPA's regulations at 40 CFR §130.2(i), also define "total maximum daily load (TMDL)" as the "sum of individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background." As the total loads provided by Maryland equal the sum of the individual WLAs for point sources and the land-based LAs for nonpoint sources set forth below, the TMDLs for fecal bacteria for Herring Run are consistent with 40 CFR §130.2(i). Pursuant to 40 CFR §130.6 and §130.7(d)(2), these TMDLs and supporting documentation, should be incorporated into Maryland's current water quality management plan.

The WLAs are assigned to permitted point sources. Baltimore City and Baltimore County are covered by individual MS4 permits; therefore, the total domestic pet load is assigned to the WLA-MS4. For the same reason, wildlife is also assigned to the WLA-MS4. MS4 permits do not cover livestock and it will also be part of the LA when it is not designated as a CAFO. There is no municipal Wastewater Treatment Plant (WWTP) and only one industrial NPDES point source (Taylor Avenue Association). This industrial facility does not discharge effluent containing fecal bacteria, and therefore has no permit limits regulating the discharge of fecal bacteria into Herring Run Watershed or its tributaries.

EPA realizes that the bacteria allocations shown in Table 1 is only one allocation scenario designed to meet instream water quality standards. As implementation of the established TMDLs proceed or more detailed information becomes available, Maryland may find that other combinations of dividing the TMDL loads between WLA-MS4 and LA allocations are feasible and/or cost effective. Any subsequent changes, however, must ensure that the instream water quality standards are met.

Based on the foregoing, EPA has determined that the Herring Run TMDLs for fecal bacteria are consistent with the regulations and requirements of 40 CFR Section 130.

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

Maryland's Herring Run Watershed is comprised of three distinct subwatersheds. While the monitoring data used in developing the TMDL is from instream sampling which integrates the effects of all loads, the effects of the upstream subwatersheds are considered on the downstream subwatersheds. A decay factor and estimated time of travel was used to estimate the effect of the upstream subwatersheds on the downstream subwatersheds.

4. The TMDLs consider critical environmental conditions.

EPA regulations at 40 CFR §130.7(c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that Herring Run's water quality is protected at all times.

MDE's water quality standards do not specify a time period for which the geometric mean is calculated. For the designated recreational use, the critical period for exposure is the summer months during the swimming season. To identify critical periods resulting from flow and rainfall conditions, MDE developed a procedure to examine the 9-year (October 1996 to October 2005) flow record for critical high and low-flow periods of one year and for seasonal (May 1 to September 30) conditions. MDE's 2006 Section 303(d) listing methodology identifies the swimming period as Memorial Day to Labor Day; however, MDE used May through September because May and September may be warm and swimming may occur. The corresponding critical period dates are shown in the TMDL Report, Table 4.4.1.

5. The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flow normally occurs during the colder period of winter and in early spring from snow melt and spring rain, while low flow typically occurs during warmer summer and early fall drought periods[3]. MDE's statistical method analyzed flows in Herring Run by dividing them into high and low-flow regimes and calculated geometric mean bacteria concentrations for each regime in order to evaluate seasonal differences.

6. The TMDLs include a margin of safety.

A MOS is required as part of a TMDL in recognition of many uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural waterbodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection.

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[3] Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2, Part 1, Section 2.33, (EPA 823-B-97-002, 1997)

Based on EPA guidance, the MOS can be achieved through two approaches.[4] One approach is to reserve a portion of the loading capacity as a separate term in the TMDL. The second approach is to incorporate the MOS as conservative assumptions used in the TMDL analysis.

MDE chose an implicit MOS (i.e., the known low bias of the back transformed concentrations will provide an environmentally conservative estimate of the load required to attain water quality standards).

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

MDE conducted a public review of the Herring Run TMDLs. The public comment period was April 26, 2007 to May 25, 2007. MDE received no written comments during the comment period. A set of written comments from EPA was sent after the public comment period. EPA received MDE's responses during August and September 2007, and with the final submittal received on October 10, 2007.

VI. Discussion of Reasonable Assurance

There is a reasonable assurance that the TMDLs can be met. 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 which is prepared by the state and approved by EPA. Therefore, any WLAs will be implemented through the NPDES permit process. Based on the point source permitting information, there are two NPDES stormwater permits that are required to regulate the stormwater discharge of fecal bacteria directly into the Herring Run Watershed. These jurisdiction-wide permit-required management programs are being implemented in Baltimore City and Baltimore County to meet locally established watershed protection and restoration goals and to control stormwater discharges to the maximum extent practical.

In the Herring Run Watershed, MDE's analysis indicates that required reductions to meet the water quality criteria are extremely large and are not feasible by implementing cost-effective and reasonable best management practices (BMP) to nonpoint sources. Therefore, MDE intends to implement an iterative approach that addresses those sources with the largest impact on water quality and human health risk, with consideration given to ease of implementation and cost.

Maryland has several well established programs that will be drawn upon such as the NPDES permit limits that will be based on the TMDL loadings, MDE's Managing for Results work plan, and MDE procedures adopted to assure that future evaluations are conducted for all established TMDLs.

MDE's implementation plan is not only based on reductions to total fecal bacteria, it is based on reductions by sources of bacteria. MDE used the results of its BST monitoring from November 2002 through October 2003 to estimate the required reduction in sources of bacteria. MDE does not consider it practical to require wildlife source reductions.

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[4] *Guidance for Water Quality-based Decisions: The TMDL Process,* (EPA 440/4-91-001, April 1991)

MDE identifies the maximum practicable reduction (MPR) per source as:

- Human - 95 percent
- Domestic Animal - 75 percent
- Livestock - 75 percent
- Wildlife - 0 percent

The following reductions (Table 13) are necessary to achieve water quality standards.

Table 13. TMDL Reduction Results: Optimization Model up to 98% (TMDL Report, Table 4.7.1)

Station	Baseline Load *E. coli* (Billion MPN/year)	Long Term Average TMDL Load *E. coli* (Billion MPN/year)	% Target Reduction
Harford Rd	6,288,811	408,147	93.5%
Pulaski Hwy	1,992,522	173,532	91.3%
Biddle & 62nd St	1,569,606	70,781	95.5%
Total	9,850,939	652,459	93.4%

The TMDLs must specify LAs that will meet the water quality standards. In the practicable reduction targets scenarios, all three subwatersheds (Harford Rd, Pulaski Hwy, and Biddle & 62nd St.) did not meet water quality standards based on MPRs during both annual and seasonal conditions.

To further develop the TMDLs, in those subwatersheds not meeting criteria, the constraints on MPRs were relaxed in those subwatersheds where the water quality attainment was not achievable with the MPRs. In these three subwatersheds, the maximum allowable reduction was increased to 98% for all sources, including wildlife.

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, with consideration given to ease of implementation and cost. The iterative implementation of BMPs in the watershed has several benefits: tracking of water quality improvements following BMP implementation through follow-up stream monitoring; providing a mechanism for developing public support through periodic updates on BMP implementation; and helping to ensure that the most cost-effective practices are implemented first.

Finally, Maryland has recently adopted a five-year watershed cycling strategy to manage its waters. Pursuant to this strategy, the State is divided into five regions and management activities will cycle through those regions over a five-year period. The cycle begins with intensive monitoring; followed by computer modeling, TMDL development, implementation activities, and follow-up evaluation. This follow-up monitoring will allow Maryland to determine whether the second stage TMDL implementation can be implemented successfully or whether an alternate action should be pursued.