UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029
12/4/2007

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

Dear Dr. Eskin:

The U.S. Environmental Protection Agency (EPA), Region III, is pleased to approve the *Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Gwynns Falls Basin in Baltimore City and Baltimore County, Maryland.* The TMDL Report was submitted by the Maryland Department of the Environment's (MDE) letter dated September 22, 2006, to EPA for review and approval. 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. MDE identified the Gwynns Falls Basin as impaired by fecal bacteria.

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 (WLAs) for point sources and load allocations (LAs) 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. The non-tidal fecal bacteria TMDLs for the Gwynns Falls Watershed satisfied each of these requirements. In addition, the non-tidal fecal bacteria 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 is included with this letter.

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 Mr. Thomas Henry, TMDL Program Manager, at (215) 814-5752 or Mr. Kuo-Liang Lai at (215) 814-5473.

Sincerely,

John Armstead for

Jon M. Capacasa, Director
Water Protection Division

Enclosure

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

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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1650 Arch Street
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Decision Rationale
Total Maximum Daily Loads of Fecal Bacteria
For the Non-Tidal Gwynns Falls Basin
Baltimore City and Baltimore County, Maryland

John Armstead for

Jon M. Capacasa, Director
Water Protection Division

Date: 12/4/2007

Decision Rationale

Total Maximum Daily Loads of Fecal Bacteria
For the Non-Tidal Gwynns Falls Basin
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 Gwynns Falls 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 Gwynns Falls Basin in Baltimore City and Baltimore County, Maryland*, dated September 2006 (TMDL Report), to EPA for final review, which was received on September 26, 2006. The Gwynns Falls Non-Tidal Watershed (02-13-09-05) was first identified on Maryland's 1996 Section 303(d) List as impaired by nutrients and sediments. Bacteria (fecal coliform) and impacts to biological communities were 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 TMDL is designed to implement applicable water quality standards.
2. The TMDL includes a total allowable load as well as individual wasteload allocations (WLAs) 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 allocation assigned to nonpoint sources can be reasonably met.

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[1]By letter dated August 10, 2006.

II. Summary

Gwynns Falls Watershed is located in Baltimore City and Baltimore County; both watershed locations are Phase I National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit jurisdictions. 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 100 percent reduction from existing or baseline conditions.

Table 1. Gwynns Falls Watershed Non-Tidal TMDL Summary

Subwatershed	Baseline	TMDL	WLA-PS[2]	WLA-MS4[3]	WLA-CSO[4]	LA[5]
	Billions MPN[1]/day *E. coli*					
GWN0160	2,539.6	172.5	0	110.0	0	62.6
GWN0115sub	314.8	103.4	0	69.6	0	33.8
GWN0026sub	17,990.7	629.9	0	551.3	0	78.6
GWN0015sub	90,620.3	11.5	0	10.5	0	1.0
TOTAL	111,465.5	917.4	0	741.4	0.0	176.0

[1]MPN = Most Probable Number
[2]WLA-PS = Wasteload Allocation for non MS4 systems (municipal or industrial)
[3]WLA-MS4 = Wasteload Allocation for MS4 systems
[4] WLA-CSO = Wasteload Allocation for Combined Sewer Overflow
[5] 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. For this TMDL, the MOS was incorporated as conservative assumptions used in the TMDL analysis. The loading capacity of the stream was estimated based upon a reduced (more stringent) water quality criterion concentration. The *E.coli* water quality criterion concentration was reduced by 5%, from 126 *E. coli* MPN/100 ml to 119.7 *E. coli* MPN/100 ml.

III. Background

The Gwynns Falls Watershed comprises approximately 61 square miles (41,710 acres) within Baltimore City and Baltimore County, Maryland. The headwaters of Gwynns Falls begin in Glyndon, Maryland. The mainstem of Gwynns Falls flows southeast until its confluence with the Middle Branch of the Potapsco River near downtown Baltimore.

The Gwynns Falls Basin lies within the Piedmont and Atlantic Coastal Plain Provinces of Central Maryland. The Gwynns Falls Watershed lies predominantly in the Baile and Lehigh soil series. Baile soils are deep, poorly drained soils (with high available moisture capacity and water table that is seasonally at or near the surface). Lehigh soils are somewhat poorly drained to moderately well-drained, rather shallow soils.

The 2002 Maryland Department of Planning (MDP) land use/land cover data shows that the watershed is primarily a residential and commercial region. The land use percentage distribution for Gwynns Falls Basin is shown in Table 2.

Table 2. Land Use Area and Percentages in Gwynns Falls Basin (TMDL Report, Table 2.1.1)

Land Type	Acreage	Percentage
Forest	7,068	16.9%
Residential	23,860	57.2%
Commercial	9,367	22.5%
Crops	921	2.2%
Pasture	333	0.8%
Water	161	0.4%
Totals	**41,710**	**100%**

MDE estimated the total population in the Gwynns Falls Watershed to be 315,828 people, based on a weighted average from the Geographic Information System (GIS) 2000 Census Block and the 2002 MDP land use cover that includes the Gwynns Falls Watershed.

IV. Computational Procedure

The length of Gwynns Falls within Maryland 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) gages and sampling data 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 gaging 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 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, shown in the load-duration curve, 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.

Gwynns Falls Basin 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.

MDE conducted bacteria monitoring at four stations throughout Gwynns Falls. There is one USGS gaging station, located within the Gwynns Falls Watershed, which was used to estimate surface flow in Gwynns Falls.

The analysis to define daily flow duration intervals (flow regions, strata) includes the bacteria monitoring data. Bacteria (*enterococci* or *E. coli*) monitoring data are "placed" within the regions (stratum) based on the daily flow duration percentile of the date of sampling. An example plot of the Gwynns Falls *E. coli* monitoring data is shown in the TMDL Report, 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 mean are shown in Table 3 below. Note that geometric means in the table exceed the 126 MPN/100 ml criterion for *E. coli*.

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 Concentration (MPN/100ml)	*E. coli* Maximum Concentration (MPN/100ml)	Annual Steady State Geometric Mean (MPN/100ml)	Annual Weighted Geometric Mean (MPN/100ml)
GWN0015	High	7	15,530	86,600	40,086	32,470
	Low	19	5,800	77,000	30,267	
GWN0026	High	6	280	38,700	3,633	753
	Low	17	60	4,350	446	
GWN0115	High	7	320	16,700	1,009	321
	Low	19	20	5,790	219	
GWN0160	High	6	110	23,800	1,611	508
	Low	17	60	2,050	345	

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 Concentration (MPN/100ml)	*E. coli* Maximum Concentration (MPN/100ml)	Seasonal Steady State Geometric Mean (MPN/100ml)	Seasonal Weighted Geometric Mean (MPN/100ml)
GWN0015	High	3	43,500	86,600	62,529	40,716
	Low	9	5,800	77,000	35,290	
GWN0026	High	3	280	38,700	1,498	528
	Low	9	60	2,600	373	
GWN0115	High	3	620	16,700	1,954	842
	Low	9	310	5,790	636	
GWN0160	High	3	820	23,800	3,102	1,062
	Low	9	360	2,050	743	

The seasonal period (Table 4) uses only data from May 1st through September 30th, 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 and below.

Table 5. Baseline Load Calculations (TMDL Report, Table 4.3.1)

Station		GWN0160	GWN0115sub	GWN0026sub	GWN0015sub
Area (mi^2)		19.2	13.4	24.8	4.0
High Flow	Daily Average Flow (cfs)	74.9	52.3	96.7	15.5
	E. coli Concentration (MPN/100ml)	1611.3	302.3	8109.8	740277.0
	Bias Correction Factor	3.2	2.9	3.6	1.2
Low Flow	Daily Average Flow (cfs)	14.0	9.8	18.1	2.9
	E. coli Concentration (MPN/100ml)	345.4	65.2	1271.1	156243.6
	Bias Correction Factor	1.6	2.6	1.7	1.2
Baseline Load (Billion *E. coli* MPN/day)		2539.6	314.8	17990.7	90620.3

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. 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.

Table 6. Critical Time Periods (TMDL Report, Table 4.4.1)

Hydrological Condition		Averaging Period	Water Quality Data Used	Fraction High-Flow	Fraction Low-Flow	Condition Period
Annual	Average	365 Days	All	0.25	0.75	Long-term Average
	Wet	365 Days	All	0.56	0.44	Jan. 1997-Jan. 1998
	Dry	365	All	0.06	0.94	May 1994-May 1995
Seasonal	Wet	May 1st-Sept. 30th	May 1st-Sept. 30th	0.46	0.54	May 1996-Sept. 1996
	Dry	May 1st-Sept. 30th	May 1st-Sept. 30th	0.00	1.00	May 1993-Sept. 1993

Bacteria source tracking (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 the Gwynns Falls Watershed, Maryland. Enterococci* isolates were obtained from known sources, which included human, dog, cow, beaver, deer, coyote, rabbit, fox, and goose. 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 the TMDL Report, Appendix C, Table C-8, Percentage of Sources per Station per Date.

Table 7. Distribution of Fecal Bacteria Source Loads in the Gwynns Falls Basin for the Annual Condition (TMDL Report, Table 2.4.3)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
GWN0015	High Flow	10	73	0	4	13
	Low Flow	21	66	0	2	11
	Weighted	18	68	0	2	12
GWN0026	High Flow	14	66	0	12	8
	Low Flow	27	47	0	10	16
	Weighted	24	52	0	10	14
GWN0115	High Flow	11	48	0	16	25
	Low Flow	14	44	0	31	11
	Weighted	14	45	0	27	14
GWN0160	High Flow	10	65	0	15	10
	Low Flow	8	59	0	21	12
	Weighted	8	60	0	20	12

Table 8. Distribution of Fecal Bacteria Source Loads in the Gwynns Falls Basin for the Seasonal Period May 1 - September 30 (TMDL Report, Table 2.4.4)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
GWN0015	High Flow	10	61	0	4	25
	Low Flow	17	65	0	2	16
	Weighted	16	63	0	3	18
GWN0026	High Flow	3	55	0	26	16
	Low Flow	23	43	0	16	18
	Weighted	18	45	0	19	18
GWN0115	High Flow	2	45	0	14	39
	Low Flow	9	53	0	27	11
	Weighted	7	51	0	24	18
GWN0160	High Flow	12	54	0	22	12
	Low Flow	7	60	0	22	11
	Weighted	8	58	0	22	12

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 38, identified the assumed risk factors shown in Table 9, below. Table 10, Maximum Practicable Reduction Targets, shown below, identifies the practicable reductions and the rationale for selecting them.

Table 9. Relative Risk Factors

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

Table 10. Maximum Practicable Reduction Targets (TMDL Report, Table 4.7.2)

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 (Table 6) 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 11).

Table 11. Practical Reductions Results (TMDL Report, Table 4.7.3)

Station	Applied Reductions				WQS Achievable
	Domestic %	Human %	Livestock %	Wildlife %	
GWN0160	75.0%	95.0%	75.0%	0.0%	No
GWN0115sub	75.0%	95.0%	75.0%	0.0%	No
GWN0026sub	75.0%	95.0%	75.0%	0.0%	No
GWN0015sub	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 12).

Table 12. Required Reductions to Achieve Water Quality Criterion up to 100% Reductions (TMDL Report, Table 4.7.4)

Station	Domestic %	Human %	Livestock %	Wildlife %	Target Reduction
GWN0160	98.0%	98.0%	0.0%	76.5%	93.2%
GWN0115sub	96.0%	98.0%	0.0%	2.3%	67.2%
GWN0026sub	98.0%	98.0%	0.0%	85.5%	96.5%
GWN0015sub	99.9989%	99.9998%	0.0%	99.6%	99.987%

The TMDL load is then divided into WLA-MS4, CSO, and LA portions. MDE developed allocation rules summarized in Table 13 below. The "unknown" BST source category is deleted and the other categories increased.

Table 13. Source Contributions for TMDL Allocations (TMDL Report, Table 4.8.1)

Allocation Category	LA	WLA		
		WWTP	MS4	CSOs
Human			X	
Domestic			X	
Livestock				
Wildlife	X		X	

The load reduction scenario results in a load allocation that will achieve water quality standards. The state reserves the right to revise these allocations provided such allocations are consistent with the achievement of water quality standards.

Because the entire Gwynns Falls Watershed is covered by an MS4 permit, the final human load is allocated entirely to WLA-MS4. Domestic pets are also allocated entirely to WLA-MS4. There are no livestock contributions in the Gwynns Falls watershed. Wildlife is distributed between LA and WLA-MS4, based on a ratio of the amount of urban land compared to pasture and forest land in the watershed.

Baltimore County and Baltimore City have developed long term control plans (LTCPs) which require elimination of all CSOs by March 2020 and January 2016, respectively; therefore a zero allocation will be assigned to WLA-CSOs.

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 Gwynns Falls. Therefore, EPA approves the

TMDLs for the Gwynns Falls 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 include Use III (Non-tidal Cold Water) for Gwynns Falls and tributaries above Reiterstown Road, Use IV (Recreational Trout Waters) for Dead Run and tributaries, and Use I – (Water Contact Recreation and Protection of Nontidal Warmwater Aquatic Life) for all remaining waters (COMAR 26.08.02.08R(3)(e) &(4)(e)).

The standard for bacteria used in this study is as follows (COMAR 26.08.02.03-3):

Table 14. Water Quality Criteria

Indicator	**Steady State Geometric Mean Indicator Density**
Freshwater	
E. coli	126 MPN/100ml

The standards do not specify either a minimum number of samples required for the geometric mean or time frame 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.

EPA finds that the TMDLs for bacteria will ensure that the designated use and water quality criteria for Gwynns Falls 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 (WLAs) for point sources and load allocations (LAs) 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 Gwynns Falls are consistent with §130.2(i).

The WLAs are assigned to MS4 systems. Because the entire Gwynns Falls Watershed is covered by an MS4 permit, the final human load is allocated entirely to WLA-MS4. Domestic pets are also allocated entirely to WLA-MS4. There are no livestock contributions in the Gwynns Falls watershed. Wildlife is distributed between LA and WLA-MS4, based on a ratio of the amount of urban land compared to pasture and forest land in the watershed.

Baltimore County and Baltimore City have developed long term control plans (LTCPs) which require elimination of all CSOs (see Table 1) by March 2020 and January 2016, respectively; therefore a zero allocation will be assigned to WLA-CSOs.

Table 15. Locations of Combined Sewer Overflows in Gwynns Falls Watershed (TMDL Report, Table 2.4.2)

Treatment Plant	NPDES ID	CSO/SSO Structure ID	Type	Latitude	Longitude	Receiving Water
Back River WWTP	MD0021555	79	SSO	39.277	-76.663	Gwynns Falls
		81	SSO	39.277	-76.662	Gwynns Falls
		55	SSO	39.345	-76.672	Gwynns Run
		56	SSO	39.339	-76.671	Gwynns Run
		57	SSO	39.340	-76.671	Gwynns Run
		60	SSO	39.325	-76.674	Gwynns Run
		63	SSO	39.323	-76.666	Gwynns Run
		103	SSO	39.327	-76.675	Gwynns Run
		106	SSO	39.306	-76.664	Gwynns Run
		107	SSO	39.307	-76.663	Gwynns Run
		126	SSO	39.332	-76.675	Gwynns Run
		127	SSO	39.331	-76.675	Gwynns Run
		128	SSO	39.333	-76.676	Gwynns Run
		130	SSO	39.328	-76.664	Gwynns Run
		131	SSO	39.340	-76.670	Gwynns Run
Patapsco WWTP	MD0021601	10P	CSO	39.326	-76.695	Gwynns Falls
		11P	CSO	39.323	-76.700	Gwynns Falls
		13P	CSO	39.319	-76.704	Gwynns Falls
		18P	CSO	39.329	-76.686	Gwynns Falls
		19P	CSO	39.327	-76.688	Gwynns Falls
		21P	CSO	39.308	-76.680	Gwynns Falls
		31P	CSO	39.326	-76.692	Gwynns Falls
		16P	SSO	39.295	-76.709	Dead Run
		17P	SSO	39.297	-76.702	Dead Run
		84	SSO	39.267	-76.632	Gwynns Falls
		12P	SSO	39.320	-76.700	Gwynns Falls
		22P	SSO	39.306	-76.679	Gwynns Falls
		25P	SSO	39.325	-76.700	Gwynns Falls
		26P	SSO	39.324	-76.701	Gwynns Falls
		27P	SSO	39.325	-76.687	Gwynns Falls
		6	SSO	39.274	-76.666	Maidens Choice Run
		23P	SSO	39.286	-76.713	Maidens Choice Run
		24P	SSO	39.279	-76.709	Maidens Choice Run
		32P	SSO	39.274	-76.675	Maidens Choice Run
		28P	SSO	39.342	-76.694	Powder Mill
		29P	SSO	39.342	-76.692	Powder Mill
		30P	SSO	39.342	-76.692	Powder Mill
		33P	SSO	39.343	-76.702	Powder Mill

EPA realizes that the bacteria allocations shown in Table 1 is 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 other combinations of dividing the TMDL loads between WLA-PS 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 Gwynns Falls 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 Gwynns Falls Watershed is comprised of four 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 Gwynns Falls' 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 10-year (October 1, 1996 to January 17, 2006) 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.) and Table 6 of this document.

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[2]. MDE's statistical method analyzed flows in Gwynns Falls by dividing them into high and low-flow regimes and calculated geometric mean bacteria concentrations for each regime in order to evaluate seasonal differences.

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

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 water bodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection.

Based on EPA guidance, the MOS can be achieved through two approaches.[3] 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.

For this TMDL, the MOS was incorporated as conservative assumptions used in the TMDL analysis. The loading capacity of the stream was estimated based upon a reduced (more stringent) water quality criterion concentration. The *E.coli* water quality criterion concentration was reduced by 5%, 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 conducted a public review of the proposed TMDL of Fecal Bacteria for Gwynns Falls. The public comment period was open from August 4, 2006 through September 5, 2006. MDE received one set of written comments.

VI. Discussion of Reasonable Assurance

In addition to the seven outlined elements above, 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, Baltimore County and Baltimore City are Phase I NPDES MS4 permit jurisdictions. CSOs are not given a WLA within the TMDLs for Gwynns Falls.

In Gwynns Falls 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.

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

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 October 2002 through October 2003 to estimate the required reduction in sources of bacteria. MDE does not propose elimination of wildlife to allow for the attainment of water quality standards, although managing the overpopulation of wildlife is an option for state and local stakeholders. MDE identifies the maximum practicable reduction (MPR) per source as:

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

The TMDLs specify LAs that will meet the water quality standards. In the practicable reduction targets scenario, no subwatersheds met water quality standards.

To further develop the TMDLs, the constraints were relaxed in all subwatersheds. The maximum allowable reduction was increased to 100% 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, MDE 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 MDE to determine whether the second stage TMDL implementation can be implemented successfully or whether an alternate action should be pursued.