UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029
2/12/2008

Mr. Richard Eskin, Ph.D.
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 Jones 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 Jones 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 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. The non-tidal fecal bacteria TMDLs for the Jones 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. 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

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REGION III
1650 Arch Street
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Decision Rationale

Total Maximum Daily Loads
Of Fecal Bacteria for the Non-Tidal Jones Falls Basin
Baltimore City and Baltimore County, Maryland

John Armstead For

Jon M. Capacasa, Director
Water Protection Division

Date:2/12/2008

Decision Rationale

Total Maximum Daily Loads
of Fecal Bacteria For the Non-Tidal Jones 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 Jones 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 Jones 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 Jones Falls Non-Tidal Watershed (02-13-09-04) was first identified on Maryland's 1996 Section 303(d) List as impaired by metals (copper and lead), nutrients and sediments. Bacteria (fecal coliform), and polychlorinated biphenyls (PCBs) were added to the 2002 Section 303(d) List; impacts to biological communities were added to the 2004 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

Jones 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 97.8 percent reduction (see Table 4.6.1 in TMDL report) from existing or baseline conditions.

Table 1. Jones Falls Watershed Non-Tidal TMDL Summary

Subwatershed	TMDL	LA	WLA WWTP	WLA MS4	WLA CSOs
	Billion MPN *E. coli*/day				
JON0184	250.16	122.17	0.05	127.95	0.0
UQQ0005	29.07	5.62	0.00	23.44	0.0
JON0082sub	114.54	24.70	0.00	89.84	0.0
JON0039sub	428.36	57.37	0.00	370.99	0.0
SRU0005	37.77	2.07	0.00	35.70	0.0
TOTAL	859.90	211.93	0.05	647.92	0.0

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 Jones Falls Watershed comprises approximately 58.3 square miles (37,290 acres) within Baltimore City and Baltimore County, Maryland. The Jones Falls Watershed is located in the Patapsco River region of the Chesapeake Bay Watershed within Maryland. The watershed covers a portion of Baltimore County and Baltimore City, Maryland. Jones Falls flows east and south from its headwaters in Garrison, Maryland, to its discharge into the Inner Harbor in Baltimore City. Several tributaries drain to the Jones Falls mainstem, including Moores Branch, Roland Run, Towson run, Western Run, and Stoney Run.

The Jones Falls Basin lies within the Piedmont and Atlantic Coastal Plain Provinces of Central Maryland. The fall line represents the transition between the Atlantic Coastal Plain province and the Piedmont province. The Jones 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 Jones Falls Basin is shown in Table 2.

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

Land Type	Acreage	Percentage
Forest	5,901	17.3
Residential	20,080	60.9
Commercial	4,486	13.1
Crops	2,326	6.8
Pasture	547	1.6
Water	54	0.2
Totals	**34,122**	**100%**

MDE estimated the total population in the Jones Falls Watershed to be 152,195 people, based on a weighted average from the Geographic Information System (GIS) 2000 Census Block and the 2002 MDP land use/land cover that includes the Jones Falls Watershed.

IV. Computational Procedure

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

General

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 bacteria 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.

Jones Falls Basin Computational Method

The following description of MDE's computational method refers to information not necessarily contained in the TMDL Report.

MDE conducted bacteria monitoring at five stations throughout Jones Falls. There are two USGS gaging stations, located within the Jones Falls Watershed, which were used to estimate surface flow in Jones 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 Jones Falls *Flow Duration Curves* 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 (MPN/100ml)	*E. coli* Maximum (MPN/100ml)	Annual Steady-state Geometric Mean (MPN/100ml)	Annual Overall Geometric Mean (MPN/100ml)
JON0184	High	6	40	36,500	532	306
	Low	18	40	1,260	254	
UQQ0005	High	6	40	14,400	593	406
	Low	18	30	2,600	358	
JON082	High	6	40	22,800	619	141
	Low	18	10	3,450	86	
JON0039	High	9	210	43,500	2,679	712
	Low	15	70	3,260	458	
SRU0005	High	9	450	54,800	4,545	2,392
	Low	15	240	24,190	1,931	

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)	Annual Steady-state Geometric Mean (MPN/100ml)	Annual Overall Geometric Mean (MPN/100ml)
JON0184	High	4	420	36,500	1,545	664
	Low	8	150	1,210	501	
UQQ0005	High	4	460	14,400	1,368	976
	Low	8	300	2,600	872	
JON082	High	4	230	22,800	1,152	236
	Low	8	10	3,260	139	
JON0039	High	5	210	43,500	1,164	495
	Low	7	140	2,050	372	
SRU0005	High	5	750	54,800	9,105	3343
	Low	7	530	24,190	2,394	

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		JON0184	UQQ0005	JON0082sub	JON0039sub	SRU0005
Area (mi^2)		26.03	5.81	6.43	11.79	4.53
High Flow	Daily Average Flow (cfs)	80.9	18.1	20.0	77.8	17.8
	E. coli Concentration (MPN/100ml)	532.6	592.9	2,952.6	5,211.2	4,544.6
	Bias Correction Factor	12.0	4.7	6.7	3.6	3.0
Low Flow	Daily Average Flow (cfs)	19.1	4.4	4.9	5.5	3.1
	E. coli Concentration (MPN/100ml)	254.5	357.7	637.2	1,270.6	1,931.5
	Bias Correction Factor	1.6	2.0	5.7	1.8	2.3
Baseline Load (Billion *E. coli* MPN/day)		3,305	367	2,431	9,152	1,744

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	Subwatershed	Fraction High Flow	Fraction Low Flow	Period
Annual	High	365 days	All	JON0184, UQQ0005, JON0082sub	0.80	0.20	April 1996 to March 1997
				JON0039sub, SRU0005	0.59	0.41	April 1996 to March 1997
	Low	365 days	All	JON0184, UQQ0005, JON0082sub	0.02	0.98	September 2001 to August 2002
				JON0039sub, SRU0005	0.08	0.92	August 2001 to July 2002
Seasonal	High	May 1^{st} – Sept 30^{th}	May 1^{st} – Sept 30^{th}	JON0184, UQQ0005, JON0082sub	0.78	0.22	May 1^{st}, 1996 to September 30^{th}, 1996
				JON0039sub, SRU0005	0.53	0.47	May 1st 2003 to September 30^{th}, 2003
	Low	May 1^{st} – Sept 30^{th}	May 1^{st} – Sept 30^{th}	JON0184, UQQ0005, JON0082sub	0.01	0.99	May 1^{st}, 2002 to September 30^{th}, 2002
				JON0039sub, SRU0005	0.10	0.90	May 1st 1997 to September 30^{th}, 1997

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 Nontidal waters in Maryland Watersheds. Enterococci* isolates were obtained from 982 known-source isolates, 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. There is 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 Jones Falls Basin for the Annual Condition (TMDL Report, Table 2.4.4)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
UQQ0005	High Flow	16	40	14	7	23
	Low Flow	14	67	4	4	12
	Weighted	14	60	6	5	15
SRU0005	High Flow	9	74	3	1	13
	Low Flow	11	57	4	1	27
	Weighted	10	61	4	1	23
JON0184	High Flow	16	44	17	9	14
	Low Flow	26	46	13	2	12
	Weighted	24	45	14	4	13
JON0082	High Flow	9	56	13	3	20
	Low Flow	23	44	10	4	19
	Weighted	19	48	11	4	19
JON0039	High Flow	20	62	2	1	15
	Low Flow	17	58	10	4	11
	Weighted	17	59	8	3	12

Table 8. Distribution of Fecal Bacteria Source Loads in the Jones Falls Basin for the Seasonal Period May 1 - September 30 (TMDL Report, Table 2.4.5)

STATION	Flow Stratum	% Domestic Animals	% Human	% Livestock	% Wildlife	% Unknown
UQQ0005	High Flow	17	45	14	6	17
	Low Flow	14	66	4	4	13
	Weighted	15	61	7	4	14
SRU0005	High Flow	15	73	6	0	6
	Low Flow	10	67	8	1	14
	Weighted	11	68	7	1	12
JON0184	High Flow	19	53	15	8	4
	Low Flow	28	45	11	1	14
	Weighted	26	47	13	3	11
JON0082	High Flow	13	66	7	2	11
	Low Flow	20	52	11	2	13
	Weighted	18	56	10	2	13
JON0039	High Flow	23	55	3	0	18
	Low Flow	21	51	12	4	12
	Weighted	22	52	10	3	13

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 %	
JON0184	75.0%	95.0%	75.0%	0.0%	No
UQQ0005	75.0%	95.0%	75.0%	0.0%	No
JON0082sub	75.0%	95.0%	75.0%	0.0%	No
JON0039sub	75.0%	95.0%	75.0%	0.0%	No
SRU0005	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 98% Reductions (TMDL Report, Table 4.7.4)

Station	Domestic %	Human %	Livestock %	Wildlife %	Target Reduction
JON0184	97.7%	98.0%	90.1%	0.0%	92.4%
UQQ0005	96.6%	98.0%	90.8%	0.0%	92.1%
JON0082sub	98.0%	98.0%	98.0%	42.5%	95.3%
JON0039sub	98.0%	98.0%	98.0%	23.0%	95.3%
SRU0005	98.0%	98.0%	98.0%	75.7%	97.8%

The TMDL load is then divided into WLA-MS4, combined sewer overflow (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		
		WWTPs (N/A)	MS4s	CSOs
Human		X	X	
Domestic			X	
Livestock	X			
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 Jones Falls Watershed is covered by two individual Phase I MS4 permits (Baltimore City and Baltimore County), the final WLA-MS4 is presented as two WLA-MS4 loads for the jurisdictions. The MS4-WLA is currently presented as one combined load for the entire land area of each jurisdiction. In the future, when more detailed data and information become available, it is anticipated that MDE will revise the WLA into appropriate WLAs and LAs, with these revised WLAs distributed on an outfall-specific basis. Note that the overall reductions in the TMDL will not change. The WLA-MS4 distribution between Baltimore City and Baltimore County is calculated in Table 13a below.

Table 13a. MS4 Stormwater Allocations (TMDL Report, Table 4.8.2)

Station	WLA – MS4 Loads (Billion MPN/day)		
	Baltimore City	Baltimore County	Total
JON0184	N/A	127.95	127.95
UQQ0005	N/A	23.44	23.44
JON0082sub	N/A	89.84	89.84
JON0039sub	278.24	92.75	370.99
SRU0005	35.70	0.0	35.70
Total	313.94	333.98	647.92

N/A – not applicable

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 Jones Falls. Therefore, EPA approves the TMDLs for the Jones 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 Jones 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 risks 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 Jones 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 Jones Falls are consistent with §130.2(i).

There are two NPDES Wastewater Treatment Plants (WWTP) in the Jones Falls Watershed, but only the Villa Julie College WWTP (NPDES Permit No. MD0066001) will receive a WLA of 0.05 billion MPN/day as *E. coli*. There is no allocation given to St Timothy's WWTP because MDE has contacted the facility and confirmed that the WWTP was "officially terminated" as of December 20, 2006.

The WLAs are assigned to MS4 systems. Because the entire Jones Falls Watershed is covered by two MS4 permits, the final human load is allocated between WLA-WWTPs and WLA-MS4. Domestic pets are also allocated entirely to WLA-MS4. Livestock contribution is allocated to entirely to LA in the Jones Falls Watershed. Wildlife is distributed between WLA-MS4 and LA, 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 Jones 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	20	SSO	39.372	-76.701	Western Run
		21	SSO	39.365	-76.700	Western Run
		22	SSO	39.365	-76.697	Western Run
		23	SSO	39.363	-76.688	Western Run
		24	SSO	39.362	-76.683	Western Run
		29	SSO	39.367	-76.662	Western Run
		31	SSO	39.356	-76.688	Western Run
		32	SSO	39.353	-76.693	Western Run
		33	SSO	39.367	-76.649	Jones Falls
		34	SSO	39.367	-76.649	Jones Falls
		36	SSO	39.370	-76.649	Jones Falls
		67	SSO	39.313	-76.622	Jones Falls
		68	SSO	39.311	-76.621	Jones Falls
		69	SSO	39.307	-76.618	Jones Falls
		72	SSO	39.305	-76.611	Jones Falls
		125	SSO	39.308	-76.618	Jones Falls
		129	SSO	39.355	-76.617	Stoney Run

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 Jones 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 Jones Falls Watershed is comprised of five 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 Jones 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 approximately10-year (1992-2003) 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 melts and spring rain, while low flow typically occurs during warmer summer and early fall drought periods[2]. MDE's statistical method analyzed flows in Jones 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.

6. The TMDLs include a margin of safety.

An 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.

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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)

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 Jones Falls. The public comment period was open from August 4, 2006 through September 5, 2006. MDE received two sets of written comments. MDE included the Comment Response Document in the TMDL report.

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 Jones Falls.

In Jones 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.

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:

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

- 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.