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

SEP 25 2013

Mr. D. Lee Currey. Director
Science Services Administration
Maryland Department of the Environment
1800 Washington Blvd., Suite 540
Baltimore, Maryland 21230-1718

Dear Mr. Currey:

The U.S. Environmental Protection Agency (EPA), Region III, is pleased to approve the report, *Total Maximum Daily Loads of Phosphorus in the Antietam Creek Watershed, Washington County, Maryland.* The TMDL report was submitted by the Maryland Department of the Environment (MDE) to EPA for final review on September 18, 2012 and received on September 21, 2012. The TMDL was established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address impairments of water quality as identified in Maryland's Section 303(d) List.

MDE has identified the waters of Antietam Creek (MD-02140502) on the State's 2010 Integrated Report as impaired by nutrients (1996), impacts to biological communities (2002), and Poly Chlorinated Biphenyl (PCB) in fish tissue (2008) (MDE 2010a). Because scientific research supports that phosphorus is generally the limiting nutrient in freshwater aquatic systems, the 1996 nutrients listing was refined in Maryland's 2008 Integrated Report to identify phosphorus as the specific impairing nutrient substance (MDE, 2008). A TMDL for carbonaceous biochemical oxygen demand and nitrogenous biochemical oxygen demand was approved by EPA in 2002. A Water Quality Analysis for eutrophication for the Greenbrier Lake impoundment was approved by EPA in 2005. A TMDL for sediment was approved by EPA in 2008, and a TMDL for bacteria was approved by EPA in 2009. The listings for impacts to biological communities and PCB in fish tissue will be addressed separately at a future date.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) be designed to attain and maintain the applicable water quality standards; (2) include a total allowable loading and as appropriate, wasteload allocations for point sources and load allocations for nonpoint sources; (3) consider the impacts of background pollutant contributions; (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated); (5) consider seasonal variations; (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and

instream water quality); and (7) be subject to public participation. In addition, these TMDLs considered reasonable assurance that the TMDL allocations assigned to the nonpoint sources can be reasonably met. The enclosure to this letter describes how the Phosphorus TMDL for the Antietam Creek Watershed satisfies each of these requirements.

As you know, any new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL's 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 Ms. Helene Drago, TMDL Program Manager at 215-814-5796.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure

cc: Melissa Chatham, MDE-SSA
Jay Sakai, MDE-WMA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
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Decision Rationale
Total Maximum Daily Load of Phosphorus in the Antietam Creek Watershed Washington County, Maryland

Jon M. Capacasa, Director
Water Protection Division

Date: 9/25/2013

Decision Rationale
Total Maximum Daily Load of Phosphorus
in the Antietam Creek Watershed
Washington 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 TMDL for Phosphorus in the Antietam Creek watershed. The TMDL was established to address impairments of water quality, caused by phosphorus, as identified in Maryland's Section 303(d) List for water quality limited segments. The Maryland Department of the Environment (MDE) submitted the report, *Total Maximum Daily Load of Phosphorus in the Antietam Creek Watershed, Washington County, Maryland,* dated August 2012, to EPA for final review on September 18, 2012 and was received on September 21, 2012. The TMDL in this report addresses the Phosphorus impairment in the Antietam Creek watershed as identified on Maryland's Section 303(d) List. The basin identification for the Antietam Creek watershed is MD-02140502.

EPA's rationale is based on the TMDL Report and information in the computer files provided to EPA by MDE. EPA's review determined that the TMDL meets 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, this TMDL considered reasonable assurance that the TMDL allocations assigned to nonpoint sources can be reasonably met.

II. Summary

The TMDL specifically allocates the allowable Phosphorus loading to the Antietam

Creek watershed. There are fifty permitted point sources and an allocation for general permit for Concentrated Animal Feeding Operations (CAFOs) which are included in the WLA. The fact that the TMDL does not assign WLAs to any other sources in the watershed should not be construed as a determination by either EPA or MDE that there are no additional sources in the watershed that are subject to the National Pollutant Discharge Elimination System (NPDES) program. In addition, the fact that EPA is approving this TMDL does not mean that EPA has determined whether some of the sources discussed in the TMDL, under appropriate conditions, might be subject to the NPDES program. The Phosphorus TMDL is presented as an average annual load in pounds per year because it was calculated so as to not cause any Phosphorus related impacts to aquatic life. The maximum daily Phosphorus Load is presented in pounds per day. The calculation of the maximum daily loads is explained in Appendix B of the TMDL report. The average annual Antietam Creek watershed TMDL is summarized in Table 1 below. The TMDL is the sum of the LAs (an Upstream Load Allocation (LA_{PA}) and Antietam Creek Watershed LA (LA_{AC})), CAFO WLA_{AC} NPDES Stormwater WLA_{AC}, Process Water WLA_{AC}, and MOS. The LA_{AC} include nonpoint source loads generated within the Antietam Creek watershed. The maximum daily load is presented in Table 2. Individual annual average and maximum daily WLAs for permitted point sources are provided in Table 3.

Table 1. Antietam Creek Watershed Average Annual TMDL of Phosphorus (lbs/yr)

TMDL (lbs/yr)		LA		+	WLA					+	MOS
	=	LA_{PA}[1,2]	LA_{AC}		CAFO WLA_{AC}	+	NPDES Stormwater WLA_{AC}	+	Process Water WLA_{AC}		
181,380		79,044	67,598		92		12,694		21,951		Implicit

Table 2. Antietam Creek Watershed Maximum Daily Loads of Phosphorus (lbs/day)

MDL (lbs/day)		LA			+	WLA					+	MOS
	=	LA_{PA}[1,2]	+	LA_{AC}		CAFO WLA_{AC}	+	NPDES Stormwater WLA_{AC}	+	Process Water WLA_{AC}		
2,747		1,269		1,085		1		204		187		Implicit

[1] LA_{PA} includes both (1) the PA load entering Maryland through the mainstem, which is receiving an allocation based on current loads, and (2) the load from those sections of PA which require phosphorus reductions because they drain to MD small order streams.

[2] Although for the purpose of this analysis the upstream load is referred to as an LA, it could include loads from point and nonpoint sources.

Table 3. Wasteload Allocations for Point Sources in the Antietam Creek Watershed

Facility	NPDES ID Number	WLA (lbs/yr)	MDL (lbs/day)
Process Water Point Source			
Hagerstown WWTP (mainstem)	MD0021776	7,309	62.1
Maryland Correctional Institute (mainstem)	MD0023957	1,462	12.4
BoonsboroWWTP	MD0020231	457	7.8
Winebrenner Water Reclamation Facility	MD0003221	914	3.9
Antietam WWTP (mainstem)	MD0062308	11,809	100.4
Funkstown WWTP (mainstem)	MD0020362		
Brook Lane Psychiatric Center WWTP	MD0053198		
Fahrney-Keedy Memorial Home	MD0053066		
Greenbrier State Park	MD0023868		
Highland View Academy WWTP	MD0024627		
Hunter Hill Apartments WWTP	MD0022926		
Smithsburg WWTP	MD0024317		
Holcim (US) Inc. (mainstem)	MD0002151		
Beaver Creek Golf Course	MDG766259		
C. William Hetzer, Inc. - Hot Mix Asphalt Plan	MDG498022		
Camp Louise	MDG766220		
Fountain Head Country Club	MDG766301		
Hesco, Inc.	MD0060267		
L.W. Wolfe Enterprises, Inc.	MDG498020		
Lafarge Beaver Creek Concrete Plant	MDG491387		
Martin Marietta - Boonsboro Quarry	MDG490588		
Mt. Lena Recreation Club	MDG766209		
Newstech MD, LP	MD0066974		
Thomas Bennett Hunter Inc - Hagerstown Concrete Plant	MDG493125		
NPDES Regulated Stormwater Permits			
Washington County Phase II	MD0068306	6,427	103.2
Municipal Phase II MS4	MDR055500	3,903	62.7
SHA Phase I MS4	MD0055501	1,158	18.6
Other NPDES Regulated Stormwater[1]	--	1,206	19.4
NPDES Regulated Animal Feeding Operations	--	92	1

1 See Table 4 below for the list of Other NPDES Regulated Stormwater Facilities

Table 4. NPDES Regulated Stormwater Permits in the Antietam Creek Watershed

Permit Number	Facility	NPDES Group
MS4-WA-001	City of Hagerstown MS4	Municipal Phase-II
MS4-WA-002	Town of Smithsburg MS4	Municipal Phase-II
MS4-WA-003	Washington County MS4	County Phase-II
MDR055500	State Highway Administration MS4	SHA Phase I
--	MDE General Permit to Construct	Other NPDES Reg SW
02SW0061	Jamison Door Company	Other NPDES Reg SW
02SW0168	Rocky Top Wood Preservers, Inc.	Other NPDES Reg SW
02SW0237	Hagerstown block Company	Other NPDES Reg SW
02SW0332	Maryland Correctional Institution	Other NPDES Reg SW
02SW0479	Clean Earth of Maryland, Inc.	Other NPDES Reg SW
02SW0598	Roadway Express, Inc. – Hagerstown	Other NPDES Reg SW
02SW0715	Conservit, Incorporated	Other NPDES Reg SW
02SW0748	Maryland Metals, Inc.	Other NPDES Reg SW
02SW0749	Maryland Metals, Inc. – Antietam Drive	Other NPDES Reg SW
02SW0854	United Parcel Service – Hagerstown	Other NPDES Reg SW
02SW0907	Hagerstown Regional Airport	Other NPDES Reg SW
02SW1046	Federal Express Corp. – Hagerstown	Other NPDES Reg SW
02SW1114	Elwoods Auto Exchange	Other NPDES Reg SW
02SW1337	SHA - Hagerstown Shop	Other NPDES Reg SW
02SW1374	Northrop Grumman - California Microwave Systems	Other NPDES Reg SW
02SW1450	Eastern Section Highway Building	Other NPDES Reg SW
02SW1466	Southern Section Highway Facility	Other NPDES Reg SW
02SW1467	Washington County Highway Department	Other NPDES Reg SW
02SW1686	Fedex Freight East, Inc. Hagerstown CC	Other NPDES Reg SW
02SW1803	Philip H. Rohrer, JR.	Other NPDES Reg SW
02SW1877	Hagerstown WWTP	Other NPDES Reg SW

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

III. Background

The Antietam Creek watershed is located in the Potomac River sub-basin within Washington County, Maryland. Antietam Creek is a free-flowing stream that originates in Pennsylvania and empties into the Potomac River in Maryland downstream of Shepherdstown, WV; but upstream from Harpers Ferry, WV. It is approximately 54 miles in length, with 37 miles in Maryland and 17 miles in Pennsylvania. The total watershed area covers 186,203 acres, with approximately 118,667 acres in Maryland and 67,536 acres in Pennsylvania.

Antietam Creek watershed landuse was evaluated separately for Maryland and Pennsylvania. The landuse distribution in Maryland consists mostly of forest (34.1%) and crop (32.1%), followed by regulated urban (24.3%), and pasture (8.9%). Water (0.6%), animal feeding operations (0.1%), and nurseries (< 0.1) make up the remaining landuse acres. All developed land in Maryland is

regulated. In Pennsylvania, the landuse consists mainly of crop (40.6%) and forest (33.7%) land-use, with smaller amounts of non-regulated urban (16.0%), pasture (7.0%), and regulated urban (2.5%), Water, animal feeding operations, and nurseries contribute about 0.1% each to the landuse acres.

The Maryland Department of the Environment (MDE) has identified the waters of Antietam Creek on the State's 2010 Integrated Report as impaired by nutrients (1996), impacts to biological communities (2002), and Poly Chlorinated Biphenyl in fish tissue (2008) (MDE 2010a). Because scientific research supports that phosphorus is generally the limiting nutrient in freshwater aquatic systems, the 1996 nutrients listing was refined in Maryland's 2008 Integrated Report to identify phosphorus as the specific impairing nutrient substance (MDE, 2008). A TMDL for carbonaceous biochemical oxygen demand (CBOD) and nitrogenous biochemical oxygen demand (NBOD) was approved by the EPA in 2002. A Water Quality Analysis (WQA) of eutrophication for the Greenbrier Lake impoundment was approved by the EPA in 2005. A TMDL for sediment was approved by EPA in 2008, and a TMDL for bacteria was approved by EPA in 2009. The listings for impacts to biological communities and PCB in fish tissue will be addressed separately at a future date.

The Maryland Surface Water Use Designation in the Code of Maryland Regulations (COMAR) for the waters of Antietam Creek and its tributaries is Use IV-P (Water Contact Recreation, Protection of Aquatic Life, Recreational Trout Waters and Public Water Supply); except for Beaver Creek, Marsh Run, and Little Antietam Creek, which are classified as Use III-P (Water Contact Recreation and Protection of Nontidal Cold Water Aquatic Life, and Public Water Supply) (COMAR 2012a,b,c,d,e).

The Antietam Creek watershed aquatic health scores, consisting of the Benthic Index of Biotic Integrity (BIBI) and Fish Index of Biotic Integrity (FIBI), indicate that the biological metrics for the watershed exhibit a negative deviation from reference conditions (Roth *et al.* 2005). The Biological Stressor Identification (BSID) analysis for the Antietam Creek watershed (MDE 2012a) identified both phosphorus and nitrogen as potential stressors. Both total phosphorus and orthophosphate show a significant association with degraded biological conditions; as much as 20% of the biologically impacted stream miles in the watershed may be degraded due to high total phosphorus and 19% degraded due to high orthophosphate. Similarly, according to the BSID analysis, 31% of the biologically impacted stream miles in the Antietam Creek watershed are associated with high total nitrogen concentrations. An analysis of observed TN:TP ratios shows, however, that phosphorus is the limiting nutrient in Antietam Creek. Because nitrogen generally exists in quantities greater than necessary to sustain algal growth, excess nitrogen *per se* is not the cause of the biological impairment in Antietam Creek, and the reduction of nitrogen loads would not be an effective means of ensuring that the Antietam Creek watershed is free from impacts on aquatic life from eutrophication. Therefore, load allocations for the Antietam Creek Nutrient TMDL will apply only to total phosphorus.

Currently in Maryland, there are no specific numeric criteria that quantify the impact of nutrients on the aquatic health of non-tidal stream systems; therefore, a reference watershed TMDL approach was used and resulted in the establishment of a *phosphorus loading threshold.* This threshold is based on a detailed analysis of phosphorus loads from watersheds that are

identified as supporting aquatic life (*i.e.*, reference watersheds) based on Maryland's biocriteria (Roth *et al.* 1998, 2000; Stribling *et al.* 1998; MDE 2010). This threshold is then used to determine a watershed-specific phosphorus TMDL. The resulting loads are considered the maximum allowable loads the watershed can receive without causing any nutrient related impacts to aquatic health.

A data solicitation for information pertaining to pollutants, including nutrients, in the Antietam Creek watershed was conducted by MDE in November 2009 and all readily available data from 1998 up to the time of the TMDL development were considered. All available resources, including Department of Natural Resources (DNR), U.S. Geological Survey (USGS), and the Chesapeake Bay Program (CBP), were also investigated to determine if there were other available data in the Antietam Creek watershed. MDE conducted surveys along the Antietam Creek from November 1999 through December 2005. DNR collected data in the watershed from January 1998 through June 2007. Data from Maryland Biological Stream Survey (MBSS) sampling conducted in April, 2000; March, 2001; April through May, 2003; and March, 2004 were also used. A total of 61 monitoring stations were used to characterize the Antietam Creek watershed. There were 33 biological/physical habitat monitoring stations from the MBSS program and four biological monitoring stations from the Maryland CORE/TREND monitoring network, three of which also collect water quality data. MDE also monitored water quality at three CORE/TREND Stations and at 24 additional locations.

Low levels of dissolved oxygen are sometimes associated with the decay of excess primary production and therefore nutrient over-enrichment. The dissolved oxygen (DO) concentration to protect Use I-P waters "may not be less than 5 milligrams per liter (mg/l) at any time" and to protect Use III-P waters "may not be less than 5 mg/l at any time, with a minimum daily average of not less than 6 mg/l" (COMAR 2012e). The monitoring data indicate that the water quality standard for DO is being met in the Antietam Creek and its tributaries.

CWA Section 303(d) and its implementing regulations require that TMDLs be developed for waterbodies identified as impaired by the State where technology based and other required controls do not provide for attainment of water quality standards. The objective of the phosphorus TMDL established herein is to reduce phosphorus loads, and subsequent effects on aquatic health, in the Antietam Creek watershed to levels that support the Use III-P and Use IV-P designations.

The computational framework chosen for the Antietam Creek watershed TMDL was the Chesapeake Bay Program Phase 5.3.2 (CBP P5.3.2) Watershed Model. The spatial domain of the CBP P5.3.2 Watershed Model segmentation aggregates to the Maryland 8-digit watersheds, which is consistent with the impairment listing.

In order to quantify the impact of nutrients on the aquatic health of non-tidal stream systems, a reference watershed TMDL approach was used, which resulted in the establishment of a *phosphorus loading threshold* for watersheds within the Highland and Piedmont physiographic regions. Reference watersheds were determined based on Maryland's biocriteria methodology. The biocriteria methodology assesses biological impairment at the 8-digit watershed scale based on the percentage of MBSS monitoring stations, translated into watershed stream miles, which

are degraded. Individual monitoring station impairment is determined based on BIBI/FIBI scores lower than the Minimum Allowable IBI Limit (MAL), which is calculated based on the average annual allowable IBI value of 3.0 (on a scale of 1 to 5). Applying the MAL threshold helps avoid classification errors when assessing biological impairment (Roth *et al.* 1998, 2000; Stribling *et al.* 1998; MDE 2010).

Comparison of watershed phosphorus loads to loads from reference watersheds requires that the watersheds be similar in physical and hydrological characteristics. To satisfy this requirement, Currey *et al.* (2006) selected reference watersheds only from the Highland and Piedmont physiographic regions. This region is consistent with the non-coastal region that was identified in the 1998 development of FIBI and subsequently used in the development of BIBI (Roth *et al.* 1998, Stribling *et al.* 1998).

To reduce the effect of the variability within the Highland and Piedmont physiographic regions, the watershed phosphorus loads were then normalized by a constant background condition: the all forested watershed condition. This new normalized term, defined as the *forest normalized phosphorus load*, represents how many times greater the current watershed phosphorus load is than the *all forested phosphorus load.* The *forest normalized phosphorus load* for this TMDL is calculated as the current watershed phosphorus load (calculated using the CBP P5.3.2 2009 Scenario) divided by the *all forested phosphorus load.* The *forest normalized phosphorus load* for the Antietam Creek watershed is 7.37.

Twelve reference watersheds were selected from the Highland/Piedmont region. Reference watershed *forest normalized phosphorus loads* were calculated using CBP P5.3.2 2009 Progress Scenario landuse and phosphorus loads. The median and 75th percentile of the reference watershed *forest phosphorus loads* were calculated and found to be 7.18 and 8.71 respectively. The median value of 7.18 was established as the *phosphorus loading threshold* as an environmentally conservative approach to develop this TMDL. Antietam Creek's forest normalized load exceeds the *forest normalized reference phosphorus load* (also referred to as the *phosphorus loading threshold*), indicating that the Antietam Creek watershed is receiving loads above the maximum allowable load the watershed can sustain without causing any phosphorus related impacts to aquatic health.

The Antietam Creek watershed baseline nutrient loads are estimated using the landuse and EOS phosphorus loading rates from the CBP P5.3.2 2009 Progress Scenario. The 2009 Progress Scenario represents current land-use, loading rates, and BMP implementation simulated using precipitation and other meteorological inputs from the period 1990-2000 to represent variable hydrological conditions, thereby addressing annual changes in hydrology and capturing wet, average and dry years. The period 1991-2000 is the baseline hydrological period for the Chesapeake Bay TMDL. Watershed loading calculations, based on the CBP P5.3.2 segmentation scheme, are represented by multiple CBP P5.3.2 model segments within each MD 8-digit watershed. The phosphorus loads from these segments are combined to represent the baseline condition. The Maryland point source phosphorus loads are estimated based on the existing permit information. The total baseline phosphorus load from the PA portion of the Antietam Creek watershed is 88,815 lbs per year while the load from the Maryland portion is 94,363 lbs per year, excluding the loads from point sources discharging directly to the mainstem.

Mainstem point sources account for 10,187 lbs per year phosphorus under baseline conditions.

The allowable load for the impaired watershed is calculated as the product of the *phosphorus loading threshold* (determined from watersheds with a healthy biological community) and the Antietam Creek watershed *all forested phosphorus load.* The resulting load is considered the maximum allowable load the watershed can sustain without causing any nutrient related impacts to aquatic health. The Antietam Creek watershed average annual TMDL of Phosphorus is 181,380 lbs/yr. The TMDL consists of allocations attributed to loads generated outside the assessment unit referred to as Upstream Load Allocations, represented by a Pennsylvania Upstream Load Allocation (LA_{PA}) of 79,044 lbs/yr and allocations attributed to loads generated within the assessment unit consisting of an MD 8-digit Antietam Creek Watershed TMDL Contribution of 102,335 lbs/yr. The MD 8-digit Antietam Creek TMDL Contribution is further subdivided into point and nonpoint source allocations and is comprised of a Load Allocation (LA_{AC}), a CAFO Wasteload Allocation (CAFO WLA_{AC}), an NPDES Stormwater Wasteload Allocation (NPDES Stormwater WLA_{AC}), and a Process Water Wasteload Allocation (Process Water WLA_{AC}).

IV. Discussion of Regulatory Conditions

EPA finds that MDE has provided sufficient information to meet all seven of the basic requirements for establishing a Phosphorus TMDL for the Antietam Creek watershed. EPA, therefore, approves this Phosphorus TMDL for the Antietam Creek watershed. This approval is outlined below according to the seven regulatory requirements.

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

Water Quality Standards consist of three components: designated and existing uses; narrative and/or numerical water quality criteria necessary to support those uses; and an anti-degradation Statement. The Maryland Surface Water Use Designation in the Code of Maryland Regulations (COMAR) for the waters of Antietam Creek and its tributaries is Use IV-P (Water Contact Recreation, Protection of Aquatic Life, Recreational Trout Waters and Public Water Supply); except for Beaver Creek, Marsh Run, and Little Antietam Creek, which are classified as Use III-P (Water Contact Recreation and Protection of Nontidal Cold Water Aquatic Life, and Public Water Supply) (COMAR 2012a,b,c,d,e).

Currently in Maryland, there are no specific numeric criteria that quantify the impact of nutrients on the aquatic health of non-tidal stream systems; therefore, a reference watershed TMDL approach was used. Phosphorus loads compatible with water quality standards are determined by comparing current phosphorus loading rates (lbs/ac/yr) in the Antietam Creek watershed with the nutrient loading rates in unimpaired watersheds in the Piedmont and Highland ecoregions of Maryland. The Chesapeake Bay Program's (CBP) Phase 5.3.2 Watershed Model (P5.3.2) was used to determine the phosphorus loads in both Antietam Creek and the unimpaired watersheds that were used to set the phosphorus TMDL for Antietam Creek.

Low levels of dissolved oxygen are sometimes associated with the decay of excess primary production and therefore nutrient over-enrichment. The dissolved oxygen (DO)

concentration to protect Use I-P waters "may not be less than 5 milligrams per liter (mg/l) at any time" and to protect Use III-P waters "may not be less than 5 mg/l at any time, with a minimum daily average of not less than 6 mg/l" (COMAR 2012e).

Low levels of dissolved oxygen are sometimes associated with the decay of excess primary production and therefore nutrient over-enrichment. The dissolved oxygen (DO) concentration to protect Use I-P waters "may not be less than 5 milligrams per liter (mg/l) at any time" and to protect Use III-P waters "may not be less than 5 mg/l at any time, with a minimum daily average of not less than 6 mg/l" (COMAR 2012e). The BSID analysis indicates that none of the biologically impacted stream miles are associated with low DO concentrations. The monitoring data indicate that the water quality standard for DO is being met in the Antietam Creek and its tributaries.

This TMDL will establish phosphorus loads that will be protective of the Use III-P/IV-P designations for the Antietam Creek watershed, and more specifically, these loads will be at a level the watershed can sustain without causing nutrient related impacts to aquatic health. The TMDL, however, will not completely resolve the impairment to biological communities within the watershed. Because the BSID watershed analysis identifies other possible stressors (*i.e.*, high conductivity) as impacting the biological conditions, this impairment remains to be fully addressed through the Integrated Report listing process and the TMDL development process, such that all impairing substances or stressors identified as impacting biological communities in the watershed are reduced to levels that will meet water quality standards, as established in future TMDLs for those substances (MDE 2009a).

The objective of this TMDL is to establish phosphorus loads that will be protective of the Use III-P/Use IV-P designations for the Antietam Creek watershed, and more specifically, these loads will be at a level the watershed can sustain without causing nutrient related impacts to aquatic health. EPA believes these are reasonable and appropriate water quality goals.

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

Total Allowable Load

EPA regulations at 40 CFR §130.2(i) state that *the total allowable load shall be the sum of individual WLAs for point sources, LAs for nonpoint sources, and natural background concentrations.* The TMDL for Phosphorus for the Antietam Creek watershed is consistent with 40 CFR §130.2(i) because the total loads provided by MDE equal the sum of the individual WLAs for point sources and the land based LAs for nonpoint sources.

Monitoring data show that the Antietam Creek mainstem is supporting its aquatic life and wildlife use and based on this information, it was concluded that WWTPs directly discharging into the mainstem of Antietam Creek do not have a negative impact on the aquatic health of the Antietam Creek mainstem. Therefore, permitted facilities that discharge directly to the Antietam mainstem will be given an informational TMDL based on their allocations under the Chesapeake Bay TMDL.

Similarly, PA loads entering Maryland from the Antietam Creek mainstem are not having a negative impact on aquatic life in the mainstem, and therefore, load reductions are not required for the section of Pennsylvania's portion of the watershed upstream of ANT0336 (See TMDL Report Figure 3). This section of Pennsylvania's portion of the watershed is assigned an informational TMDL equivalent to its current baseline load. On the other hand, in addition to the phosphorus load reductions required within the MD 8-digit Antietam Creek watershed, reductions are also required for the remaining sections of the watershed in Pennsylvania which flow into Maryland's low order streams. Baseline loads in the Antietam Creek watershed include loads from both sections of Pennsylvania's portion of Antietam Creek watershed. Therefore, the upstream load TMDL allocation will include (1) the informational allocation to Pennsylvania portion of the watershed that drains directly into Antietam Creek as well as (2) the section of Pennsylvania's portion of the watershed which drains into Maryland's lower other streams and requires a load reduction.

As discussed above, the allowable load for the impaired watershed is calculated as the product of the *phosphorus loading threshold* (determined from watersheds with healthy biological communities) and the Antietam Creek *all forested phosphorus load.* The Phosphorus TMDL for the Antietam Creek watershed was calculated to be 181,380 lbs/yr. This load is considered the maximum allowable load the watershed can sustain and support aquatic life. The Phosphorus TMDL and allocations are presented as mass loading rates of pounds per year for the average annual load and pounds per day for the maximum daily load. Expressing TMDLs as annual average and maximum daily mass loading rates is consistent with Federal regulations at 40 CFR §130.2(i), which states that *TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure.* The annual average and maximum daily Phosphorus loads are presented in Tables 1 and 2, respectively.

In order to attain the TMDL loading cap calculated for the watershed, reductions to phosphorus baseline loads will be applied to the controllable sources. It is worth noting that significant phosphorus reductions will be required in the Antietam Creek watershed to meet the phosphorus allocations assigned to the Potomac Tidal Fresh Bay Water Quality Segment by the Chesapeake Bay TMDL, established by the EPA on December 29, 2010. To ensure consistency with the Bay TMDL, and therefore efficiency in the reduction of phosphorus loads, reductions will be applied to the same controllable sources identified in Maryland's Watershed Implementation Plans (WIPs) for the Bay TMDL. The controllable sources include: (1) regulated developed land; (2) high till crops, low till crops, hay, and pasture; (3) harvested forest; (4) unregulated animal feeding operations and CAFOs; and (5) industrial process sources and municipal wastewater treatment plants. Additional sources might need to be controlled in order to ensure that the water quality standards are attained in Chesapeake Bay as well as Antietam Creek.

The baseline and TMDL scenarios for Antietam Creek watershed are presented in Table 5.

Table 5. Antietam Creek Watershed TMDL for Phosphorus

	Baseline Load (lbs/Yr)	TMDL Scenario Load (lbs/yr)	Reduction (%)
PA[1]	88,815	79,044	11%
MD 8-digit	94,363	91,907	3%
Mainstem[2]	10,187	10,428	0%
Total	**193,364**	**181,380**	**6%**

Notes: [1] Includes all PA loads in the Antietam Creek watershed.
[2] Mainstem comprises WWTPs discharging directly to Antietam Creek.
TMDL is for informational purposes only.
Note: Individual baseline loads may not add to total load due to rounding.

Load Allocations

According to Federal regulations at 40 CFR §130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loadings should be distinguished. The TMDL summary in Table 1 contains the LA for the Antietam Creek watershed.

The nonpoint source nutrient loads generated within the Antietam Creek watershed are calculated as the sum of corresponding land-use edge-of-stream (EOS) loads within the watershed and represent a long-term average loading rate. Individual land-use EOS loads are calculated as a product of the land-use acreage and the average annual simulated phosphorus loading rates (lbs/ac/yr) from the 2009 Progress Scenario (US EPA 2010). The 2009 Scenario represents current land-use, loading rates, and BMP implementation simulated using precipitation and other meteorological inputs from the period 1991-2000 to represent variable hydrological conditions. The 1991-2000 simulation period represents the baseline loading rates in the TMDL for Chesapeake Bay segments.

In the Antietam Creek watershed, crop, pasture, animal feeding operations, and nurseries were identified as the predominant controllable nonpoint sources. Forest is the primary non-controllable source, as it represents the most natural condition in the watershed. Direct atmospheric deposition on water is a minor source which to a large extent originates outside the watershed. Atmospheric deposition will be reduced by existing state and federal programs and will not be addressed in this TMDL. Stormwater loads from developed land are regulated under the National Pollutant Discharge Elimination System (NPDES) and are considered a point source that must be included in the Waste Load Allocation (WLA) portion of a TMDL (US EPA 2002).

The Antietam Creek Phosphorus TMDL requires a 4% reduction in phosphorus loads from nonpoint sources (See Table 6). The source categories in this table represent aggregates of multiple sources (e.g., crop source is an aggregate of high till, low till, and hay sources).

Table 6. Antietam Creek Phosphorus TMDL Allocation by Nonpoint Source Category

General Category	Nonpoint Source Category	Baseline Load (lbs/yr)	TMDL (lbs/yr)	Reduction (%)
Forest	Forest	4,298	4,298	0%
	Harvested Forest	167	167	0%
AFOs	Animal Feeding Operations	9,469	7,840	17%
Pasture	Pasture	10,999	9,882	10%
Crop	Crop	43,537	43,537	0%
Nursery	Nursery	1,593	1,475	7%
Septic	Septic	0	0	0%
Atmospheric Deposition	Non-tidal Atmospheric Deposition[1]	398	398	0%
Total		**70,461**	**67,598**	**4%**

[1] No reduction – based on 2025 federal atmospheric deposition strategies.

Wasteload Allocations

There are fifty permitted point sources in this watershed. Detailed allocations are provided for those point sources included within the NPDES process WLA and the regulated stormwater WLA. The WLA also includes an allocation to CAFOs. The types of permits identified include NPDES regulated individual industrial, individual municipal, individual municipal separate storm sewer systems (MS4s), general industrial stormwater, and general MS4 permits in the Antietam Creek watershed. The permits can be grouped into two categories, process water and stormwater.

The NPDES process water category includes those loads from major publically-owned Wastewater Treatment Plants (facilities with flow of 0.5 MGD or more) that are slated for Enhanced Nutrient Removal (ENR), minor municipal WWTPs and industrial facilities whose permits have total phosphorus limits, minor municipal WWTPs with no phosphorus permit limits, and industrial facilities which based on the process involved are expected to discharge nutrients

The WLAs for process water sources are based on the WLAs assigned to each facility under the Chesapeake Bay TMDL (EPA, 2010) and Maryland's Phase I and Phase II Watershed Implementation Plans (WIPs) (MDE 2010 and 2012, respectively). These WLAs are designed to meet the Phase II 2025 final implementation goal for the Bay TMDL. The WLAs are loading caps which are designed to accommodate future growth after full implementation of the Bay TMDL in 2025. The WLAs for major and minor municipal facilities with nutrient permit limits are calculated based on their phosphorus limits and design flow. The WLAs for the remainder of the minor municipal facilities are calculated based on their design flow or their projected 2020 flow, whichever is less, and expected maximum phosphorus concentrations of 3 mg/l. Twelve minor industrial facilities discharging process water in the Antietam Creek watershed have the capacity to discharge TP in their process water. Under the Chesapeake Bay TMDL, industrial facilities capable of discharging phosphorus in their process water were given WLAs based on

the results of monitoring required by their permits and professional judgment. These WLAs were adopted for the Antietam Creek Phosphorus TMDL. There are twelve municipal WWTPs permitted to discharge phosphorus in the Antietam Creek watershed. These include four major WWTPs slated for Enhanced Nutrient Removal (Boonsboro WWTP (MD0020231), MD Correctional Institute (MD0023957), Winebrenner Water Treatment Plant (MD003221), and Hagerstown WWTP (MD0021776)).

The stormwater category includes all NPDES regulated stormwater discharges. There are 26 NPDES Phase I and Phase II stormwater permits identified throughout the Antietam Creek watershed. These include both general Phase I and II stormwater permits. These stormwater permits are regulated based on Best Management Practices (BMPs) and do not include nutrient limits. In the absence of nutrient limits, the baseline loads for these NPDES regulated stormwater discharges are calculated using phosphorus loading rates and acreages from developed land-uses within the watershed.

Individual WLAs have been calculated for the Washington County Phase II NPDES permit and the SHA Phase I MS4 permit. An aggregate WLA has been calculated for the general municipal Phase II NPDES stormwater permits for the towns of Hagerstown and Smithburg. Other NPDES regulated stormwater permits include state and federal regulated developed land, all industrial facilities permitted for stormwater discharges, and general construction permits.

The Antietam NPDES stormwater WLA is based on reductions applied to the controllable phosphorus loads from the regulated developed landuse in the watershed, with credit provided to existing BMPs in place. The Antietam Creek NPDES stormwater WLA requires an overall reduction of 21% for phosphorus.

Table 7. Antietam Creek Watershed Phosphorus TMDL Allocations for NPDES Regulated Stormwater Point Sources

NPDES Regulated Stormwater Point Source	NPDES Permit #	Baseline Load (lbs/yr)	TMDL (lbs/yr)	Reduction %
Washington County Phase II	MD0068306	8,228	6,427	21.9%
Municipal Phase II MS4	MDR055500	4,880	3,903	20.0%
SHA Phase I MS4	MD0055501	1,473	1,158	21.4%
Other NPDES Regulated Stormwater		1,457	1,206	17.2%
Total		16,037	12,694	20.8%

Note: Individual load contributions may not add to total load due to rounding.

Under the Clean Water Act, concentrated animal feeding operations (CAFOs) require NPDES permits for their discharges or potential discharges (CFR 2010c). In January 2009, Maryland implemented new regulations governing CAFOs (COMAR 26.08.01, 26.08.03, and 26.08.04), which were approved by the EPA in January 2010. Under these regulations, CAFOs are required to fulfill the conditions of a general permit. These conditions include instituting a Comprehensive Nutrient Management Plan which meets the Nine Minimum Standards to Protect Water Quality. The general permit also prohibits the discharge of pollutants, including nutrients, from CAFO production areas except as a result of event greater than the 25-year, 24-hour storm. Based on the TMDL methodology approach of applying an equal percent reduction to all

controllable loads, the Antietam Creek Phosphorus TMDL does not require a reduction in phosphorus loads from CAFOs.

Federal regulations at 40 CFR §122.44(d)(1)(vii)(B) require that, for an NPDES permit for an individual point source, the effluent limitations must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA. There is no express or implied statutory requirement that effluent limitations in NPDES permits necessarily be expressed in daily terms. The CWA definition of "effluent limitation" is quite broad (effluent limitation is "any restriction on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources ...)." See CWA 502(11). Unlike the CWA's definition of TMDL, the CWA definition of "effluent limitation" does not contain a "daily" temporal restriction. NPDES permit regulations do not require that effluent limits in permits be expressed as maximum daily limits or even as numeric limitations in all circumstances, and such discretion exists regardless of the time increment chosen to express the TMDL. For further guidance, refer to Benjamin H. Grumbles memo (November 15, 2006) titled *Establishing TMDL Daily Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA, et al., No. 05-5015 (April 25, 2006) and implications for NPDES Permits.*

EPA has authority to object to the issuance of an NPDES permit that is inconsistent with WLAs established for that point source. It is expected that MDE will require periodic monitoring of the point source(s), through the NPDES permit process, in order to monitor and determine compliance with the TMDL's WLAs. Based on the foregoing, EPA has determined that the TMDLs are consistent with the regulations and requirements of 40 CFR Part 130.

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

The TMDLs consider the impact of background pollutants by considering the Phosphorus load from natural sources such as forested land. The CBP P5.3.2 model also considers background pollutant contributions by incorporating all land uses.

4) The TMDLs consider critical environmental conditions.

EPA regulations at 40 CFR §130.7(c)(1) require TMDLs to account for critical conditions for stream flow, loading, and water quality parameters. The intent of the regulations is to ensure that: (1) the TMDLs are protective of human health, and (2) the water quality of the waterbodies is protected during the times when they are most vulnerable. Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[1]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable worst-case scenario condition.

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

Since the premise of the reference watershed approach is that the reference watershed is meeting water quality standards even under critical conditions, then the phosphorus loading rates derived from the reference watershed protects water quality standards under critical conditions. Moreover, the loading rates used in the TMDL were determined using the Hydrological Simulation Program-FORTRAN (HSPF) model, which is a continuous simulation model with a simulation period 1991-2000. The ten year simulation period encompasses seasonal variations and a range of hydrological and meteorological conditions. Also, the biological monitoring data used to determine the reference watersheds integrates the stress effects over the course of time and thus inherently addresses critical conditions.

5) The TMDLs consider seasonal environmental variations.

In the Antietam Creek watershed Phosphorus TMDL, seasonality is captured in two respects. First, it is implicitly included through the use of the biological monitoring data. Second, the MBSS dataset included benthic sampling collected in the spring and fish sampling collected in the summer. Thus, this analysis has captured both spring and summer flow conditions.

6) The TMDLs include a Margin of Safety.

The requirement for a MOS is intended to add a level of conservatism to the modeling process in order to account for uncertainty. Based on EPA guidance, the MOS can be achieved through two approaches. One approach is to reserve a portion of the loading capacity as a separate term, and the other approach is to incorporate the MOS as part of the design conditions. MDE has adopted an implicit MOS for this TMDL.

It is proposed that the estimated variability around the reference watershed group used in this analysis already accounts for such uncertainty. Analysis of the reference watershed group *forest normalized phosphorus loads* indicates that approximately 75% of the reference watersheds have a value less than 8.71. Also, 50% of the reference watersheds have a value less than 7.18. Based on this analysis the *forest normalized reference phosphorus load* (also referred to as the *phosphorus loading threshold*) was set at the median value of 7.18. This is considered an environmentally conservative estimate, since 50% of the reference watersheds have a load above this value (7.18), which when compared to the 75% value (8.71), results in an implicit MOS of approximately 18%.

7) The TMDLs have been subject to public participation.

MDE provided an opportunity for public review and comment on the Phosphorus TMDL for the Antietam Creek watershed. The public review and comment period was open from July 16, 2012 through August 30, 2012. MDE received three sets of written comments. The comments were considered and addressed appropriately.

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

critical habitats. US FWS's response to EPA's letter stated that except for occasional transient individuals, no federally proposed or listed endangered or threatened species are known to exist within the project impact area and therefore, no biological assessment or further Section 7 consultation with US FWS was required.

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V. Discussion of Reasonable Assurance

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

The Antietam Creek phosphorus TMDL is expected to be implemented as part of a staged process recently developed by Maryland. This staged process is designed to achieve both the nutrient reductions needed within the Antietam Creek watershed and to meet target loads consistent with the Chesapeake Bay TMDL, established by EPA in 2010 (US EPA 2010a) and scheduled for full implementation by 2025. The Bay TMDL requires reductions of nitrogen, phosphorus and sediment loads throughout the Bay watershed to meet water quality standards that protect the designated uses in the Bay and its tidal tributaries. The nutrient reductions for the Bay TMDL are independent of those needed to implement any TMDLs developed to address nutrient-related impairments in Maryland's non-tidal waterbodies, although their reduction goals and strategies do overlap. For example, the implementation planning framework, developed by the Bay watershed jurisdictions in partnership with EPA, provides a staged approach to achieving Bay TMDL nutrient reduction goals that is also applicable to implementation of nutrient TMDLs in local non-tidal watersheds. In short, nutrient reductions required to meet the Chesapeake Bay TMDL will also support the restoration and protection of local water quality.

Once the Bay TMDL nutrient target loads for the Antietam Creek watershed have been met, MDE will revisit the status of nutrient impacts on aquatic life in Antietam Creek, based on any additional monitoring data available and any improvements in the scientific understanding of the impacts of nutrients on aquatic life in free-flowing streams. The results of this reassessment will determine whether additional phosphorus reductions are needed in the watershed, or whether the Antietam Creek phosphorus TMDL goals have in fact been met.

In addition, MDE plans to use a series of legislative actions and funding programs to support TMDL implementation. Some of these include:

- Maryland recently enacted significant new legislation that requires Phase I MS4 jurisdictions to establish, by July 1, 2013, an annual stormwater remediation fee and a

local watershed protection and restoration fund to support implementation of local stormwater management plans. Maryland has made a commitment to include provisions in Phase I and II MS4 permits, due for issuance in 2012, to implement the State's WIP strategies to reduce nutrient and sediment loads from urban stormwater sources.

- Maryland has also enacted significant new legislation to increase the Bay Restoration Fund to provide financing for wastewater treatment plant upgrades and on-site septic system improvements, as well as legislation to guide growth of central sewer and septic systems.

- In response to the WIP and the increased burden on local governments to achieve nutrient reduction goals, Maryland has continued to increase funding in the Chesapeake and Atlantic Coastal Bays Trust Fund.

- Additional potential funding sources for implementation include Maryland's Agricultural Cost Share Program (MACS) which provides grants to farmers to help protect natural resources, and the Environmental Quality and Incentives Program, which focuses on implementing conservation practices and BMPs on land involved with livestock and production.

For more details about these and other legislative actions and funding programs, refer to Section 5.0 of the TMDL report.