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

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

MAY 2 2 2013

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 Lower Monocacy River Watershed, Frederick, Carroll, and Montgomery Counties, Maryland.* The TMDL report was submitted by the Maryland Department of the Environment (MDE) to EPA for final review on September 27, 2012 and received on October 2, 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.

The Maryland Department of the Environment (MDE) has identified the waters of the Lower Monocacy River on the State's 303(d) List as impaired by nutrients (1996) and impacts to biological communities (2002, 2004, 2006) (MDE 2010a). All impairments are listed for non-tidal streams. Because scientific research supports that phosphorus is generally the limiting nutrient in freshwater aquatic systems, the 1996 nutrient listing was refined in the 2008 Integrated Report to identify phosphorus as the specific impairing substance (MDE 2008). A TMDL for fecal coliform to address the 2002 bacteria listing was approved by the EPA in 2009. A TMDL for sediment to address the 1996 sediment listing was also approved by the EPA in 2009. A TMDL of sediments and phosphorus for the Lake Linganore impoundment was approved by the EPA in 2003. The listing for impacts to biological communities 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 Lower Monocacy River 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
Philadelphia, Pennsylvania 19103-2029

Decision Rationale
Total Maximum Daily Load of Phosphorus in the Lower Monocacy River Watershed Frederick, Carroll, and Montgomery Counties, Maryland

Jon M. Capacasa, Director
Water Protection Division

Date: 5/22/13

Decision Rationale
Total Maximum Daily Load of Phosphorus
in the Lower Monocacy River Watershed
Frederick and Carroll Counties, Maryland

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those waterbodies identified as impaired by the State where technology based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a Margin of Safety (MOS), that may be discharged to a 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 Lower Monocacy River 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 Lower Monocacy River Watershed, Frederick, Carroll, and Montgomery Counties, Maryland,* dated August 2012, to EPA for final review on September 27, 2012 and was received on October 2, 2012. The TMDL in this report addresses the Phosphorus impairment in the Lower Monocacy River watershed as identified on Maryland's Section 303(d) List. The basin identification for the Lower Monocacy River watershed is MD-02140302.

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 Lower Monocacy River watershed. There are eighty five 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 Lower Monocacy River watershed TMDL is summarized in Table 1 below. The TMDL is the sum of the LAs (an Upper Monocacy River Upstream Load Allocation (LAUMR), and Lower Monocacy River Watershed LA (LALMR)), CAFO WLALM, NPDES Stormwater WLA_{LM}, Process Water WLA_{LM}, and MOS. The LA_{LMR} include nonpoint source loads generated within the Lower Monocacy River 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. Lower Monocacy River Watershed Average Annual TMDL of Phosphorus (lbs/yr)

TMDL (lbs/yr)		LA			WLA							MOS
843,903	=	LA_{UMR}[1,2]	LA_{LMR}	+	CAFO WLA_{LMR}	+	NPDES Stormwater WLA_{LMR}	+	Process Water WLA_{LMR}	+		Implicit
		606,530	152,804		170		52,926		31,473			

Table 2. Lower Monocacy River Watershed Maximum Daily Loads of Phosphorus (lbs/day)

MDL (lbs/day)		LA				WLA							MOS
5,592	=	LA_{UMR}[1,2]	+	LA_{LMR}	+	CAFO WLA_{LMR}	+	NPDES Stormwater WLA_{LMR}	+	Process Water WLA_{LMR}	+		
		3,883		1,069		1		370		268			Implicit

[1] 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.

[2] For Upper Monocacy River watershed WLA and LA characterization please refer to the "Total Maximum Daily Load of Phosphorus in the Upper Monocacy River Watershed, Frederick, Carroll, and Montgomery Counties, Maryland" (MDE 2012c).

Table 3. Wasteload Allocations for Point Sources in the Lower Monocacy River Watershed

Facility	NPDES ID Number	WLA (lbs/yr)	MDL (lbs/day)
Process Water Point Source			
Fort Detrick WWTP	MD0020877	1,827	139.8
Frederick City WWTP	MD0021610	7,309	15.5
Ballenger- McKinney	MD0021822	16,446	62.1
Ellie May LLC Buckeystown Mine	MDG499704	5,890	50.1
Vulcan	MD0002038		
Old Reichs Ford Municipal Landfill	MD0061093		
Stup's Garage/Used Cars, Inc.	MD0068853		
John C. Grimberg Company, Inc.	MD0070319		
Horseshoe Point LLC	MD0070700		
Griffith Energy Services, Inc.	MDG344184		
Lafarge – Frederick Concrete Plant	MDG490621		
Frederick Asphalt Co., L.C. At Essroc	MDG490674		
Legore Quarry	MDG490994		
S.W. Barrick & Sons, Inc. - Barrick Quarry	MDG491429		
Superior Plus, LLC	MDG492695		
Aggregate Industries – Woodsboro Ready-MIX	MDG498001		
CJ Miller, LLC	MDG498017		
John Eyler Pit #2	MDG499732		
Thomas, Bennett & Hunter, Inc. - Frederick Concrete	MDG499818		
South Street Plant	MDG499893		
Tamko Building Products, Inc.- Grinding Mill	MDG499899		
VFW Country Club, Inc.	MDG766968		
New Market WWTP	MD0020729		
Springview Mobile Home Park	MD0022870		
Concord Trailer Park	MD0023060		
Dan-Dee Motel & Country Inn	MD0023710		
Kemptown School WWTP	MD0056481		
New Life Foursquare Church and School	MD0057100		
Woodsboro WWTP	MD0058661		
Monrovia WWTP	MD0059609		
Pleasant Branch WWTP	MD0065269		
Mill Bottom WWTP	MD0065439		
Libertytown WWTP	MD0060577		
Lewistown Mills Treatment Plant	MD0067237		
Hyattstown WWTP	MD0067768		
Lewistown Mills WWTP No.2	MD0067989		
NPDES Regulated Stormwater Point Sources			
Carroll County Phase I	MD0068331	806	5.6
Frederick County Phase I	MD0068357	22,766	159.4
Montgomery County Phase I	MD0068306	1,305	9.1
SHA Phase I MS4	MD0068276	4,222	29.6
Municipal Phase II MS4	MDR055500	10,124	70.9
Other NPDES Regulated Stormwater		13,703	95.9
NPDES Regulated Animal Feeding Operations		170	1

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

Table 4. NDES Regulated Stormwater Permits in the Lower Monocacy River Watershed

Permit Number	Facility	NPDES Group
MD0068331	Carroll CountyMS4	County Phase-I
MD0068306	Montgomery County MS4	County Phase-I
MD0068357	Frederick County MS4	County Phase-I
MD0068276	State Highway Administration MS4	SHA Phase-I
MDR055500	Frederick City MS4	Municipal Phase-II
02SW0124	Fort Detrick - Area A	Other NDPES Reg SW
02SW0212	Allied Waste Services of Frederick	Other NDPES Reg SW
02SW0285	Morningstar Foods, Inc.	Other NDPES Reg SW
02SW0336	M-NCPPC - Little Bennett Maintenance Yard	Other NDPES Reg SW
02SW0518	Accubid Excavation, Inc.	Other NDPES Reg SW
02SW0547	Precision Autobody, Inc.	Other NDPES Reg SW
02SW0674	Frederick Asphalt Co., L.C. At Essroc	Other NDPES Reg SW
02SW0696	Richard B. Rudy, Inc.	Other NDPES Reg SW
02SW0699	Frederick City WWTP	Other NDPES Reg SW
02SW0726	D.M. Bowman, Inc. - Frederick	Other NDPES Reg SW
02SW0850	United Parcel Service - Frederick	Other NDPES Reg SW
02SW0987	Entenmann's, Inc.	Other NDPES Reg SW
02SW1066	Richard F. Kline, Inc. - Frederick	Other NDPES Reg SW
02SW1067	McCormick Paint Works Company -Frederick	Other NDPES Reg SW
02SW1099	Hahn Transportation Inc.	Other NDPES Reg SW
02SW1100	Frederick Municipal Airport	Other NDPES Reg SW
02SW1162	Reliable Junk Company Inc.	Other NDPES Reg SW
02SW1163	Frederick Auto Parts, Inc.	Other NDPES Reg SW
02SW1199	BP Solar International, LLC	Other NDPES Reg SW
02SW1226	Fort Detrick - Area B	Other NDPES Reg SW
02SW1343	SHA - Frederick Shop	Other NDPES Reg SW
02SW1349	Rinker Materials Hydro Conduit- Frederick	Other NDPES Reg SW
02SW1564	York Building Products - Frederick	Other NDPES Reg SW
02SW1571	MTA - Train Storage Yard	Other NDPES Reg SW
02SW1654	Pleasants Construction Inc.	Other NDPES Reg SW
02SW1707	Waste Management of Maryland - Frederick County	Other NDPES Reg SW
02SW1767	Invitrogen Corporation	Other NDPES Reg SW
02SW1773	Dairy Maid Dairy, Inc.	Other NDPES Reg SW
02SW1775	Schwerman Trucking Company - Frederick Terminal	Other NDPES Reg SW
02SW1780	Grimes Properties, LLC	Other NDPES Reg SW
02SW1799	Altec Industries, Inc.	Other NDPES Reg SW
02SW1851	Country Side Used Auto Parts	Other NDPES Reg SW
02SW1866	Rolling Frito-Lay Sales - Frederick DC	Other NDPES Reg SW
02SW1878	Ballenger Creek WWTP	Other NDPES Reg SW
02SW1887	Frederick County Public Schools - Hayward Bus Lot	Other NDPES Reg SW
02SW1888	Frederick	Other NDPES Reg SW
02SW1890	Frederick County Highways - Frederick HQ	Other NDPES Reg SW
02SW1891	Frederick County Highways – Johnsville	Other NDPES Reg SW
02SW1893	Frederick County Highways - Urbana	Other NDPES Reg SW
02SW1942	Frederick County Law Enforcement Complex	Other NDPES Reg SW
02SW1950	Tamko Building Products, Inc.	Other NDPES Reg SW
02SW1975	Medimmune, Inc.	Other NDPES Reg SW
02SW1994	SFA Defense Products Division	Other NDPES Reg SW
--	MDE General Permit to Construct	Other NDPES 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 Monocacy River is a free-flowing stream that originates in Pennsylvania and flows 58 miles within Maryland where it finally empties into the Potomac River. The watershed covers approximately 970 square miles (620,496 acres), with approximately 228 square miles (145,679 acres) located in Pennsylvania and 742 square miles (478,817 acres) in Maryland. The basin can be subdivided into three distinct watersheds: the Upper Monocacy River, Lower Monocacy River, and Double Pipe Creek. The Upper Monocacy River drains into the Lower Monocacy River, which flows southward through Frederick and eventually empties into the Middle Potomac River near the town of Dickerson, MD. Double Pipe Creek drains into the Upper Monocacy River.

Upper Monocacy River and Double Pipe Creek are distinct Maryland 8-digit watersheds, and phosphorus TMDLs have been prepared for each of them. The phosphorus TMDL for the Upper Monocacy River, which includes the TMDL for Double Pipe Creek, is included as an upstream load in the Lower Monocacy River TMDL. Several major tributaries contribute to the Lower Monocacy River, including Bennett Creek, Bush Creek, Israel Creek, Linganore Creek, Ballenger Creek, and Carroll Creek.

The Lower Monocacy River watershed is situated primarily in Frederick County but includes small portions of Carroll and Montgomery Counties as well. The watershed covers approximately 3,142 square miles (194,790 acres) and is characterized by a moderately steep to flat terrain. There is a significant amount of agriculture within the watershed, which consists mostly of row crops, but also includes dairy production. The watershed contains numerous urban centers including Frederick, the largest city in the watershed, Woodsboro, New Market, and parts of Walkersville and Mount Airy. The major land uses in the Lower Monocacy River watershed, excluding the Lake Linganore watershed, consist of forest (32.7%), crop (31.6%), developed land (28.0%), and pasture (6.9%). The total population within the watershed is estimated to be approximately 96,000 (MDE 2007).

The Maryland Department of the Environment (MDE) has identified the waters of the Lower Monocacy River on the State's 303(d) List as impaired by nutrients (1996) and impacts to biological communities (2002, 2004, 2006) (MDE 2010a). All impairments are listed for non-tidal streams. Because scientific research supports that phosphorus is generally the limiting nutrient in freshwater aquatic systems, the 1996 nutrient listing was refined in the 2008 Integrated Report to identify phosphorus as the specific impairing substance (MDE 2008). A TMDL for fecal coliform to address the 2002 bacteria listing was approved by the EPA in 2009. A TMDL for sediment to address the 1996 sediment listing was also approved by the EPA in 2009. A TMDL of sediments and phosphorus for the Lake Linganore impoundment was approved by the EPA in 2003. The listing for impacts to biological communities will be addressed separately at a future date.

The Lower Monocacy River, upstream of US Route 40, and its tributary Israel Creek are designated as Use IV-P waterbodies (*Water Contact Recreation, Protection Of Aquatic Life, Recreational Trout Waters and Public Water Supply*); downstream of US Route 40, the Lower Monocacy River is designated as a Use I-P waterbody (*Water Contact Recreation, Protection of Nontidal Warm Water Aquatic Life, and Public Water Supply*). Additional tributaries of the Lower Monocacy River – Ballenger Creek, Bear Branch, Carroll Creek, Furnace Branch, Little Bennett Creek, and Rocky Fountain Run – are designated as Use III-P waterbodies (*Water Contact Recreation, Protection of Nontidal Cold Water Aquatic Life and Public Water Supply*) (COMAR 2012a,b,c,d). The Lake Linganore watershed is designated as Use IV-P.

The Lower Monocacy River 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 significant negative deviation from reference conditions (Roth *et al.* 2005). The Biological Stressor Identification (BSID) analysis for the Lower Monocacy River watershed identified both phosphorus and nitrogen as a potential stressors. Orthophosphate shows a significant association with degraded biological conditions. As much as 14% of the biologically impacted stream miles in the watershed are associated with high orthophosphate. Similarly, according to the BSID analysis, 37% of the biologically impacted stream miles in the Lower Monocacy River watershed are associated with high total nitrogen concentrations, and 36% of impacted stream miles are associated with high dissolved nitrogen concentrations. An analysis of observed TN: TP ratios imply, however, that phosphorus is the limiting nutrient in Lower Monocacy River. 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 Lower Monocacy River, and the reduction of nitrogen loads would not be an effective means of ensuring that the Lower Monocacy River watershed is free from impacts on aquatic life from eutrophication. Therefore, load allocations for the Lower Monocacy River Nutrient TMDL will apply only to total phosphorus.

Currently, in Maryland there are not specific numeric criteria that quantify the impact of nutrients on the aquatic health of nontidal streams systems; therefore, a reference watershed TMDL approach was used, which 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 2008). 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 was conducted in November 2009 and all readily available water quality data from 1998 up to the time of the TMDL development were considered. Water quality data from MDE surveys conducted in the Lower Monocacy River watershed from October 2000 through December 2005 were used. DNR data used in the analysis were from January 1998 through June 2007. Data from Maryland Biological Stream Survey (MBSS) sampling conducted in the spring and summer of 2000, 2003, and 2004 were also used. A total of 71 water quality monitoring stations were used to characterize the Lower Monocacy River watershed. There were 50 biological/physical habitat monitoring stations from the MBSS program and two biological monitoring stations from the Maryland CORE/TREND monitoring network. MDE sampled at 19 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 BSID analysis indicates that none of the biologically impacted stream miles are associated with low DO concentrations. The analysis of DO monitoring data confirms that DO criteria are currently met in the watershed.

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 TMDL is to ensure that there will be no Phosphorus impacts affecting aquatic life, thereby establishing a Phosphorus load that supports the Use I-P/Use III-P/Use IV-P designations for the Lower Monocacy River watershed.

The computational framework chosen for the Lower Monocacy River 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 phosphorus on the aquatic health of non-tidal stream systems, a reference watershed TMDL approach was used, that 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 Progress Scenario) divided by the *all forested phosphorus load.* The *forest normalized phosphorus load* for the Lower Monocacy River watershed is 8.58.

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. The Lower Monocacy River's forest normalized load exceeds the *forest normalized reference phosphorus load* (also referred to as the *phosphorus loading threshold*), indicating that the Lower Monocacy River watershed is receiving loads above the maximum allowable load the watershed can sustain without causing any phosphorus related impacts to aquatic health.

The Lower Monocacy River 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 1991-2000 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 point source nutrient loads are estimated based on discharge monitoring data and existing permit information. The total baseline phosphorus load for the Lower Monocacy River watershed is 252,974 lbs/yr, excluding the loads from main stem point sources and upstream loads. Main stem point sources account for 27,506 lbs/yr phosphorus under baseline conditions. Baseline loads from Upper Monocacy River account for 716,507 lbs/yr 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 Lower Monocacy River 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 Lower Monocacy River watershed average annual TMDL of Phosphorus is 843,903 lbs/yr. The TMDL consists of allocations attributed to a load generated outside the assessment unit referred to as Upstream Load Allocations (an Upper Monocacy River Upstream Load Allocation (LA_{UM}) of 606,530 lbs/yr); and loads generated within the assessment unit: a Lower Monocacy River Watershed TMDL Contribution of 237,373 lbs/yr. The Lower Monocacy River Watershed TMDL Contribution is further subdivided into point and nonpoint source allocations and is comprised of a Load Allocation (LA_{LM}), a CAFO Waste Load Allocation (WLA_{LM}), an NPDES Stormwater Waste Load Allocation (NPDES Stormwater WLA_{LM}), and a Process Water Waste Load Allocation (NPDES Process Water WLA_{LM}).

The Lake Linganore average annual phosphorus TMDL of 5,288 lb/yr, which was developed by MDE to be protective of water quality standards within the impoundment and

approved by EPA in 2003, still applies as the target phosphorus loading capacity within the pond's drainage area, located in the north-eastern portion of the Lower Monocacy River watershed (MDE 2003). The attainment of water quality standards within the MD 8-digit Lower Monocacy River watershed and Lake Linganore impoundment can only be achieved by meeting the average annual TMDL of phosphorus specified for the MD 8-digit watershed within this report as well as the specific TMDL for the Lake Linganore drainage basin established by MDE in 2003. Furthermore, both the baseline phosphorus loading and TMDL for the impoundment are implicitly included within the Lower Monocacy River nonpoint source baseline loads and TMDL load allocation, respectively, due to the spatial resolution of the CBP P5.3.2 Watershed Model segmentation.

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 Lower Monocacy River watershed. EPA, therefore, approves this Phosphorus TMDL for the Lower Monocacy River 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 Lower Monocacy River, upstream of US Route 40, and its tributary Israel Creek are designated as Use IV-P waterbodies (*Water Contact Recreation, Protection Of Aquatic Life, Recreational Trout Waters and Public Water Supply*); downstream of US Route 40, the Lower Monocacy River is designated as a Use I-P waterbody (*Water Contact Recreation, Protection of Nontidal Warm Water Aquatic Life, and Public Water Supply*). Additional tributaries of the Lower Monocacy River – Ballenger Creek, Bear Branch, Carroll Creek, Furnace Branch, Little Bennett Creek, and Rocky Fountain Run – are designated as Use III-P waterbodies (*Water Contact Recreation, Protection of Nontidal Cold Water Aquatic Life and Public Water Supply*) (COMAR 2012a,b,c,d). The Lake Linganore watershed is designated as Use IV-P.

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 Lower Monocacy River 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 Lower Monocacy River and the unimpaired watersheds that were used to set the phosphorus TMDL for Lower Monocacy River.

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 analysis of DO monitoring data confirms that DO criteria are currently met in the watershed.

This TMDL will establish phosphorus loads that will be protective of the Use I-P/ Use III-P/Use IV-P designations for the Lower Monocacy River 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.*, conductivity, sediment, in-stream habitat, and riparian habitat) 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 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 I-P/Use III-P/Use IV-P designations for the Lower Monocacy River 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 Lower Monocacy River 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.

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 Lower Monocacy River *all forested phosphorus load.* The Phosphorus TMDL for the Lower Monocacy River watershed was calculated to be 843,903 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. Significant phosphorus reductions will be required in the Lower Monocacy River 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 were 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 Lower Monocacy River.

The baseline and TMDL scenarios for Lower Monocacy River watershed are presented in Table 5.

Table 5: Lower Monocacy River Watershed TMDL for Phosphorus

	Baseline Load (lbs/yr)	TMDL Scenario Load (lbs/yr)	Reduction
Upper Monocacy	716,507	606,530	15%
MD 8-digit	252,974	211,791	16%
Mainstem[1]	27,506	25,583	7%
Total	**996,987**	**843,903**	**15%**

Note: [1]Mainstem comprises WWTPs discharging directly to Lower Monocacy River. The Lower Monocacy River TMDL is for informational purposes only, since the reduction shown is required under the Chesapeake Bay TMDL.
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 Lower Monocacy River watershed.

The nonpoint source nutrient loads generated within the Lower Monocacy River 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 Lower Monocacy River watershed, crop, pasture, nurseries, and animal feeding operations, were identified as the largest 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.

The Lower Monocacy River Phosphorus TMDL requires a 14% reduction in phosphorus loads from nonpoint sources. Table 6 provides one possible scenario for the distribution of the annual phosphorus nonpoint source loads between different land use categories in the Lower Monocacy River watershed. The source categories in Table 1 represent aggregates of multiple sources (e.g., crop source is an aggregate of high till, low till, hay, animal feeding operations, and nursery sources).

Table 6: Lower Monocacy River Phosphorus TMDL Allocation by Nonpoint Source Category

General Category	Nonpoint Source Category	Baseline Load (lbs/yr)	TMDL (lbs/yr)	Reduction (%)
Forest	Forest	9,572	9,572	0%
	Harvested Forest	398	398	0%
AFOs	Animal Feeding Operations	9,302	6,389	31%
Pasture	Pasture	24,340	19,651	19%
Crop	Crop	106,779	91,360	14%
Nursery	Nursery	26,535	24,730	7%
Septic	Septic	0	0	0%
Atmospheric Deposition	Non-tidal Atmospheric Deposition[1]	703	703	0%
Total		177,630	152,804	14%

[1] No reduction – based on 2025 federal atmospheric deposition strategies.
Note: Individual load contributions may not add to total load due to rounding.

Wasteload Allocations

There are eighty five 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 Lower Monocacy River 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 (WWTPs), 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.

There are seventeen municipal WWTP in the Lower Monocacy watershed, of which three discharge to the main stem. Municipal WWTPs were assigned phosphorus WLAs as follows: (1) if the design flow of a facility is greater than 0.5 MGD and therefore is slated for upgrade to 'Enhanced Nutrient Reduction' (ENR), then the facility is given a WLA based on its design flow and the anticipated average annual ENR concentrations of 0.3 mg/l TP; (2) if the design flow of the facility is 0.5 MGD or less and has TP concentration limits, then that facility is assigned a WLA based on its Maryland Tributary Strategy Cap flow and the permit limit; and (3) if the facility does not have permit limits, it is assigned a WLA based on its Maryland Tributary Strategy Cap flow and an assumed maximum average annual concentration of 3 mg/l TP. The Tributary Strategy Cap flow is the design flow of the facility or the projected 2020 flow (projected from 2003 discharge flows and Maryland Department of Natural Resources growth rates by county), whichever is less.

There are nineteen industrial process water sources in the Lower Monocacy River watershed which are judged to have the capacity to discharge TP in their process water. All of these facilities are minor, and one discharges into the main stem. Under the Chesapeake Bay TMDL, industrial facilities capable of discharging phosphorus in their process water were given a WLA based on the results of monitoring required by their permits or professional judgment. These WLAs were adopted for the Lower Monocacy River Phosphorus TMDL. In addition, allocations for minor municipal WWTPs (with design flows less than 0.5 MGD) and for minor industrial facilities are presented in the Chesapeake Bay TMDL as a watershed-wide aggregate WLA.

An overall 7% reduction in phosphorus loads from process water sources will result from the Maryland Tributary Strategy Cap flow and permit limits or the allocations under the Chesapeake Bay TMDL applied to the Lower Monocacy River Phosphorus TMDL.

The stormwater category includes all NPDES regulated stormwater discharges. There are 49 NPDES Phase I and Phase II stormwater permits identified throughout the Lower Monocacy River 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 each of the Carroll County, Frederick County, and Montgomery County Phase I MS4 permits and the SHA Phase I MS4 permit. An aggregate WLA has been calculated for the general municipal Phase II NPDES stormwater permits, including the City of Frederick. Other NPDES permits include stormwater from federal, state, mining and extractive operations, and land under construction, which are aggregated into one WLA referred to as the "Other NPDES regulated stormwater" WLA.

The Lower Monocacy 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 Lower Monocacy River NPDES stormwater WLA requires an overall reduction of 23% for phosphorus.

Under the Clean Water Act, concentrated animal feeding operations (CAFOs) require NPDES permits for their discharges or potential discharges (CFR 2011c). 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 (CNMP) 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 Lower Monocacy River 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.

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 Lower Monocacy River 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%.

[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.

7) The TMDLs have been subject to public participation.

MDE provided an opportunity for public review and comment on the Phosphorus TMDL for the Lower Monocacy River watershed. The public review and comment period was open from August 1, 2012 through August 30, 2012. MDE received five 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.

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 Lower Monocacy River 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 Lower Monocacy 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 Lower Monocacy River watershed have been met, MDE will revisit the status of nutrient impacts on aquatic life in Lower Monocacy River, 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 Lower Monocacy River 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.