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

SEP 30 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 Non-tidal Upper Pocomoke River Watershed, Wicomico and Worcester Counties, Maryland.* The TMDL report was submitted by the Maryland Department of the Environment (MDE) to EPA for final review on September 26, 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 Upper Pocomoke River on the State's 303(d) List as impaired by nutrients (1996), suspended sediments (1996), and impacts to biological communities (2002) (MDE 2010). The 1996 suspended sediment listing was refined in the 2008 Integrated Report to a listing for total suspended solids. Similarly, the 1996 nutrient listing was refined in the 2008 Integrated Report and phosphorus was identified as the specific impairing substance. A TMDL for sediments and phosphorus for the Adkins Pond impoundment was approved by EPA in 2002. A TMDL for total suspended sediments was submitted to EPA concurrently with the Phosphorus TMDL. The listing for impacts to biological communities will be addressed separately at a future date. This TMDL addresses the Phosphorus listing only.

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 Upper Pocomoke 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

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Decision Rationale
Total Maximum Daily Load of Phosphorus in the Non-tidal Upper Pocomoke River Watershed, Wicomico and Worcester Counties, Maryland

Jon M. Capacasa, Director
Water Protection Division

Date: 9/30/2013

Decision Rationale
Total Maximum Daily Load of Phosphorus
in the Non-tidal Upper Pocomoke River Watershed,
Wicomico and Worcester 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 non-tidal Upper Pocomoke 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 Non-tidal Upper Pocomoke River Watershed, Wicomico and Worcester Counties, Maryland,* dated September 2012, to EPA for final review on September 26, 2012 and was received on October 2, 2012. The TMDL in this report addresses the Phosphorus impairment in the Upper Pocomoke River watershed as identified on Maryland's Section 303(d) List. The basin identification for the Upper Pocomoke River watershed is MD-02130203.

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 non-tidal Upper Pocomoke River watershed. There are six point sources 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 C of the TMDL report. The average annual Upper Pocomoke River watershed TMDL is summarized in Table 1 below. The TMDL is the sum of the Load Allocations (Delaware Upstream LA (LA_{DE})), Upper Pocomoke River Watershed Load Allocation (LA_{UPR}), a CAFO Wasteload Allocation (CAFO WLA_{UPR}), NPDES Stormwater Waste Load Allocation (NPDES WLA_{UPR}), Process Water Waste Load Allocation (Process Water WLA (Process Water WLA_{UPR}), and a Margin of Safety (MOS). The LA_{UPR} includes nonpoint source loads generated within the Upper Pocomoke River watershed. The maximum daily load is presented in Table 2. Active permitted point sources are shown in table 3.

Table 1: MD 8-digit Upper Pocomoke River Average Annual TMDL of Phosphorus (lbs/yr)

		LA					WLA						
TMDL (lbs/yr)	+	**LA_{DE}**[1,2]	+	**LA_{UPR}**	+	**$Septic_{UPR}$**	+	**CAFO WLA_{UPR}**	+	**NPDES Stormwater WLA_{UPR}**	+	**Process Water WLA_{UPR}**	+	**MOS**
43,592	=	2,227		35,494	+	0	+	4,339	+	11	+	1,520	+	Implicit
		Upstream Load Allocation[2]		MD 8-digit Upper Pocomoke River Watershed TMDL Contribution										

[1] The LA_{DE} was determined based on a DE TMDL that is expressed in lbs/day and converted herein to an annual loading by multiplying by 365 (DNREC 2005). The LA_{DE} meets Maryland water quality standards within the MD 8-digit Upper Pocomoke River watershed. It accounts for the upstream load from DE entering MD waters.

[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 2: MD 8-digit Upper Pocomoke River Maximum Daily Load of Phosphorus (lbs/day)

TMDL (lbs/day)		LA						WLA							MOS
	+	LA_{DE}[1,2]	+	LA_{UPR}	+	$Septic_{UPR}$	+	CAFO WLA_{UPR}	+	NPDES Stormwater WLA_{UPR}	+	Process Water WLA_{UPR}	+		
392.2	=	6.1		370.02	+	0	+	11.9	+	0.03	+	4.2	+		Implicit

Upstream Load Allocation[2]

MD 8-digit Upper Pocomoke RiverWatershed TMDL Contribution

[1] The LA_{DE} is based on the DE TMDL (DNREC 2005).

[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: Active Permitted Point Source in Upper Pocomoke River Watershed

Permit #	NPDES	Facility	County	City	Type	Category
10DP3688	MD0070742	DEER RUN CAMPGROUND & RECREATION FACILITY	WORCESTER	BERLIN	Process Water	Industrial
10DP2085	MD0060348	PITTSVILLE WWTP	WICOMICO	PITTSVILLE	Process Water	Municipal
09DP1058	MD0051632	WILLARDS WWTP	WICOMICO	WILLARDS	Process Water	Municipal
10M9796	MDG499796	HARKINS READY MIX	WICOMICO	PITTSVILLE	Process Water	Industrail
08DP3601	MD0069957	CROPPER BROTHERS LUMBER COMPANY, INC.	WICOMICO	WILLARDS	Storm Water	Industrail
02SW1672	N/A	FOREST PRODUCTS, INC.	WICOMICO	PITTSVILLE	Storm Water	Industrail
TBA	N/A	NEWARK VOLUNTEER FIRE COMPANY, INC.	WORCESTER	NEWARK	Storm Water	Industrail

Note: Deer Run Campground is not included in wasteload allocations because it has no nutrient discharge

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 Pocomoke River originates in the Great Cypress Swamp on the Delaware-Maryland border and flows for approximately sixty miles through Maryland into Pocomoke Sound at the Chesapeake Bay (LESHC 1994). Streams are mostly non-tidal, with some tidal influence in the lowest reach of the Upper Pocomoke mainstem. The watershed is situated in Wicomico and Worcester Counties and drains approximately 122 stream miles. The largest towns within the watershed are Willards and Pittsville.

The Upper Pocomoke River watershed land use distribution was developed using the Chesapeake Bay Program Phase 5.3.2. The land use distribution consists primarily of forest (62.6%) and crop (29.1%), followed by non-regulated urban (5.4%), pasture (1.7%), and harvested forest (0.6%), regulated urban (0.38%), nurseries (0.12%), water (0.02%), concentrated animal feeding operations (0.02%) and animal feeding operations (<0.01%) make up the remaining land use.

The Maryland Department of the Environment (MDE) has identified the non-tidal waters of the Upper Pocomoke River on the State's 303(d) List as impaired by nutrients (1996 listing), suspended sediments (1996 listing) and impacts to biological communities – 1st through 4th order

streams (2002 listing) (MDE 2010). The 1996 suspended sediment listing was refined in the 2008 Integrated Report to a listing for total suspended solids. Similarly, the 1996 nutrient listing was refined in the 2008 Integrated Report and phosphorus was identified as the specific impairing substance. Consequently, for the purpose of this report, the terms "nutrient and "phosphorus" will be used interchangeably. A TMDL for sediments and phosphorus for the Adkins Pond impoundment was approved by EPA in 2002. A TMDL for total suspended sediments was submitted to EPA concurrently with the Phosphorus TMDL. The listing for impacts to biological communities will be addressed separately at a future date. This TMDL addresses the Phosphorus listing only.

The Maryland Surface Water Use Designation in the Code of Maryland Regulations (COMAR) for the non-tidal Upper Pocomoke River is Use I (*Water Contact Recreation, and Protection of Non-tidal Warmwater Aquatic Life*).

A data solicitation for nutrients in the Upper Pocomoke River watershed was conducted by MDE in April 2011 and all readily available data from 1997 to 2010 have been considered. MDE conducted water quality data in the Upper Pocomoke River from 1997 to 2005 and in 2010 at different sets of stations. Data from Maryland Biological Stream Survey (MBSS) samplings conducted by the Department of Natural Resources (DNR) were in 1997 and 2001. DNR's CORE/TREND program also collected data from 1976 to 2006. A total of 60 water quality monitoring stations were used to characterize the Upper Pocomoke River watershed.

The Biological Stressor Identification (BSID) analysis for the Upper Pocomoke River watershed identified phosphorus as a potential stressor. Both total phosphorus and orthophosphate show a significant association with degraded biological conditions. As much as 37% of the biologically impacted stream miles in the watershed are associated with high total phosphorus and 68% are associated with high orthophosphate. An analysis of observed TN:TP ratios show, however, that phosphorus is the limiting nutrient in Upper Pocomoke River.

Biological data for the Upper Pocomoke River were also obtained from DNR CORE/TREND program. The program collected benthic macroinvertebrate data between 1976 and 2006. The data were used to calculate four benthic community measures: total number of taxa, Shannon-Weiner diversity index, modified Hilsenhoff biotic index, and percent *Ephemeroptera*, *Plecoptera*, and *Trichoptera* (EPT). DNR has extensive monitoring data at one station (POK0527) on the non-tidal waters of the Upper Pocomoke River through the CORE/TREND program. Statistical analysis of the DNR long-term CORE/TREND biological data at the non-tidal Upper Pocomoke River station indicates that water quality has improved since 1976 and the non-tidal water is ranked as having good water quality based on percent EPT, taxa number, biotic index, and diversity index. However, Station POK0527 is the only CORE/TREND station in the non-tidal Upper Pocomoke River and is located in the mainstem of the River. CORE/TREND stations are not intended to assess 1^{st}- 4^{th} order streams.

Currently, there are no specific numeric criteria for nutrients in Maryland's water quality standards for the protection of aquatic life in free-flowing non-tidal waters. Therefore, the evaluation of potentially eutrophic conditions due to nutrient over-enrichment will be based on whether nutrient-related parameters (i.e., dissolved oxygen (DO) levels and chlorophyll *a* concentrations) are found to impair the designated uses of the non-tidal Upper Pocomoke River.

Maryland's water quality standards include general narrative criteria prohibiting the pollution of waters of the State by any material in amounts sufficient to create a nuisance or interfere directly or indirectly with designated uses (COMAR 2012g) and a numeric DO criterion for Use I waters that require a minimum DO concentration of 5.0 mg/l at any time (COMAR 2012a). The monitoring data show that about 17% of the DO values are below 5.0 mg/l, indicating DO criterion is not met in the non-tidal waters of the Upper Pocomoke River.

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 designation for the Upper Pocomoke River watershed.

The computational framework chosen for the Upper Pocomoke 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.

The Environmental Fluid Dynamics Code (EFDC) water quality model was used to simulate the eutrophication processes in the non-tidal waters of Upper Pocomoke River. The EFDC model is a general 3-Dimensional (3-D) model for environmental studies. The model simulates density and topographically induced circulation as well as tidal and wind-driven flows, and spatial and temporal distributions of salinity, temperature, and suspended sediment concentration, conservative tracers, eutrophication processes, and fecal bacteria. For a detailed model description, the reader is referred to Hamrick (1992a, 1992b) and Park *et al.* (1995).

The model domain encompasses the mainstem of the Upper Pocomoke River and the tributaries where low DO and elevated levels of nutrients were observed. The model simulates water transport and eutrophication processes in the receiving river as a function of flow and loading discharges from the surface and sub-surface of adjacent watersheds. Modeled variables include algae, DO, nitrogen, phosphorus, and organic carbon. The model simulates algal and DO dynamics, and nutrients transport, settling, uptake, and recycling. The in stream eutrophication model is coupled with a sediment process model, which simulates minimization of nutrients, nutrient fluxes and sediment oxygen demand (SOD). Details of the model development, model calibration, and verification are presented in Appendix A.

MDE 2010 in-stream water quality data was chosen for the water quality model calibration. There is one monitoring station located within each 12-digit watershed. These stations are located in the mainstem and some of the tributaries. Monthly water quality data were collected in each station through the year 2010. Because the current CBP watershed model simulation period ends in 2005, the 2010 watershed loads were estimated based on the USGS flow and the load-flow regression relationship derived from the P5.3.2 2010 scenario watershed model outputs. The MDE 2010 water quality dataset was selected for the calibration because the data were collected in both the mainstem and tributaries.

The non-tidal Upper Pocomoke River watershed baseline nutrient loads are estimated using the CBP P5.3.2 2010 Progress Scenario model outputs. The 2010 Progress Scenario

represents current land use (2010 land use), loading rates, and BMP implementation simulated using actual precipitation and other meteorological inputs from the period 1991-2000 to represent variable hydrological conditions. The period 1991-2000 is the baseline hydrological period for the Chesapeake Bay TMDL. For this study, loading outputs for the period of 1996 to 1998 from the 2010 Progress Scenario were used as the baseline loads. The years 1996, 1997 and 1998 represent very wet, dry and mean hydrological conditions, respectively. Watershed loading calculations were based on the CBP P5.3.2 segmentation scheme within each MD 8-digit watershed and corresponding 12-digit MD segments by redistributing Bay watershed model loads for each landuse category to small MD 12-digit watersheds based on the proportion of different land uses within each subwatershed. The phosphorus loads from these segments are combined to represent the baseline condition. The MD point source phosphorus loads are estimated based on the point source facilities loads included in CBP P5.3.2 model. The total baseline phosphorus load from the DE portion of the Upper Pocomoke River watershed is 20,105 lbs per year; the load from the MD portion is 55,163 lbs per year.

The phosphorus TMDL was set at a level that will meet the stated DO criterion. The resulting load is considered the maximum allowable load the watershed can sustain without causing any nutrient related impacts to aquatic health. The MD 8-digit Upper Pocomoke River watershed average annual TMDL of Phosphorus is 43,592 lbs/yr. The TMDL consists of allocations attributed to loads generated outside the assessment unit (Upstream Load Allocations): a Delaware Upstream Load Allocation (LA_{DE}) of 2,227 lbs/yr; and allocations attributed to loads generated within the assessment unit - an MD 8-digit Upper Pocomoke River watershed TMDL contribution of 41,365 lbs/yr. The MD 8-digit Upper Pocomoke River TMDL contribution is further subdivided into point and nonpoint source allocations and is comprised of a LA_{UPR} of 35,494 lbs/yr, a CAFO WLA_{UPR} of 4,339 lbs/yr, an NPDES Stormwater WLA_{UPR} of 11 lbs/yr, and a Process Water $WLA_{UPR)}$ of 1,520 lbs/yr.

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 Upper Pocomoke River watershed. EPA, therefore, approves this Phosphorus TMDL for the Upper Pocomoke River watershed. This approval is outlined below according to the seven regulatory requirements.

1) The TMDL is 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 non-tidal Upper Pocomoke River is Use I (*Water Contact Recreation, and Protection of Non-tidal Warmwater Aquatic Life*).

Currently in Maryland, there are no specific numeric criteria that quantify the impact of phosphorus on the aquatic health of non-tidal stream systems. Therefore, the evaluation of potentially eutrophic conditions due to nutrient over-enrichment will be based on whether nutrient related parameters (i.e. dissolved oxygen levels and chlorophyll *a* concentrations) are found to impair designated uses in the non-tidal Upper Pocomoke River. Maryland's water

quality standards include general narrative criteria for prohibiting the pollution of waters of the State by any material in amounts sufficient to create a nuisance or interfere directly or indirectly with designated uses (COMAR 2012g) and a numeric DO criterion for Use I waters that require a minimum DO concentration of 5.0 mg/l at any time (COMAR 2012a). Attainment of the numeric DO criterion, as assessed in this study, is the TMDL endpoint. The CBP P5.3.2 Watershed Model was used to determine the phosphorus loads from non-tidal Upper Pocomoke River watershed and the EFDC water quality model is used to simulate the eutrophication processes in the main channel and tributaries to establish this phosphorus TMDL for the non-tidal Upper Pocomoke River.

The non-tidal waters of the Upper Pocomoke River are located upstream of the tidal waters, and both portions of the river have in common a surrounding wetland/marsh environment. It is worth noting that, because of seasonal lower DO concentrations due to natural oxygen-depleting processes present in the extensive surrounding tidal wetlands, Maryland adopted a site-specific criterion of a 30-day mean DO greater than or equal to 4 mg/1 in the tidal waters of the Upper and Middle Pocomoke River, approved by EPA on December 27, 2010. This site-specific criterion, which is lower than the general Use I criterion (DO not less than 5 mg/1 at any time), underscores the need to consider the influence of natural conditions in forest and wetland dominated environments like the Upper Pocomoke watershed.

This TMDL will establish phosphorus loads that will be protective of the Use designation for the Upper Pocomoke 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.*, sediments) 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 I designation for the Upper Pocomoke 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 TMDL includes 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 non-tidal Upper Pocomoke 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 phosphorus load for the impaired watershed was set at a level that will meet the DO criterion. The Phosphorus TMDL for the non-tidal Upper Pocomoke River watershed was calculated to be 43,592 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.

The established phosphorus TMDLs in the upstream Delaware (DE) portion of the Upper Pocomoke River and in the Adkins Pond sub-watershed are both applied to this TMDL scenario. In 2005, DE developed nutrient TMDLs in the Pocomoke River watershed within their state, which requires 55% reductions of TN and TP loads to meet DE's DO criteria (5.5 mg/l daily average and 4mg/l minimum at all time) and a TP target value of 0.2mg/l (DNREC 2005). Because the DE phosphorus TMDL is more stringent than the DE loading estimated in this study as necessary to meet water quality in the MD portion of the River, and because the drainage area of the DE TMDL is identical to the DE portion of the Upper Pocomoke watershed in this study, the MD phosphorus TMDL load allocation for the upstream DE portion of the watershed is based on the DE TMDL.

The long-term average annual TMDL was calculated for the MD 8-digit watershed based on model simulations and the DO criterion. In order to attain the TMDL loading cap calculated for the watershed, reductions will be applied to the controllable sources. According to the Chesapeake Bay TMDL established by the EPA on December 31, 2010, a 24% reduction of phosphorus will be required in the Upper Pocomoke River watershed in Maryland to meet the phosphorus allocations assigned to the Pocomoke Tidal Fresh Bay Water Quality Segment. However, the phosphorus TMDL presented in this report was developed to meet DO water quality criteria in the non-tidal portion of the River, and requires a higher reduction of phosphorus loads. To ensure consistency with the Bay TMDL, and efficiency in the reduction of phosphorus loads, reductions will be applied to the same controllable sources identified in Maryland's Watershed Implementation Plan (WIP) for the Bay TMDL. The predominant controllable sources typically include: (1) regulated and non-regulated developed land; (2) high till crops, low till crops, hay, and pasture; and (3) municipal and industrial wastewater treatment plants. Additional sources might need to be controlled in order to ensure that water quality standards are attained in the Chesapeake Bay as well as in the non-tidal Upper Pocomoke River.

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 Upper Pocomoke River watershed.

The nonpoint source nutrient loads in the Upper Pocomoke River watershed are estimated

based on the edge-of-stream (EOS) loading rates from the CBP P5.3.2 Model for the simulation period 1991-2000. Individual land-use EOS loads are determined by three factors: (1) the median of land use-specific loading rates found in the scientific literature; (2) the adjustment of the median loading rate based on the excess nutrient inputs applied to agricultural land use to determine EOS targets by land segment and land use; and (3) the application of regional factors in the river calibration. The 2010 Progress Scenario represents current (2010) 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 period 1991-2000 is the baseline hydrological period for Chesapeake Bay TMDL.

In the Upper Pocomoke River watershed, crop, pasture, nursery, urban land, CAFOs and AFOs, and municipal WWTPs were identified as the predominant controllable sources. Forest is the primary non-controllable source, as it represents the most natural condition in the watershed. Atmospheric deposition will be reduced by existing state and federal programs and thus is not addressed in this TMDL.

The Upper Pocomoke River Phosphorus TMDL requires a 25% reduction in phosphorus loads from nonpoint sources. Table 4 provides one possible scenario for the distribution of the annual phosphorus nonpoint source loads between different land use categories in the Upper Pocomoke River watershed. The source categories in Table 4 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 4: MD 8-digit Upper Pocomoke River TMDL Phosphorus TMDL by Source

	Baseline Load Source Categories		Baseline Load (lbs/yr)	TMDL Components	TMDL (lbs/yr)	Reduction (%)
Upper Pocomoke RiverContribution	**Nonpoint Source**	Forest	2,935	LA	2,935	0%
		AFOs	126		91	28%
		Pasture	2,231		1,607	28%
		Crop	35,247		25,378	28%
		Nursery	4,760		3,427	28%
		Septic	0		0	0%
		Non-Regulated Urban	2,766		1,991	28%
		Atmospheric Deposition	66		66	0%
		Sub-total	**48,130**		**35,494**	26%
	Point Source	CAFOs	6,027	WLA	4,339	28%
		Regulated Urban	15		11	28%
		WWTP	991		1,520	-53%**
		CSO	0		0	0%
		Sub-total	**7,033**		**5,870**	17%
	Total MD 8-digit		**55,163**		**41,364**	**25%**
Upstream	**Delaware***		**20,102***	**Upstream**	**2,227***	**NA**

* The DE TMDL shown here is based on DE's 2005 phosphorus TMDL (DNREC 2005) and the baseline load is from CBP P5.3.2 model output. Therefore, the reduction is not applicable.

** The phosphorus WLA for process waters are larger than the baseline load because WLAs for the municipal facilities were calculated using their design flows, which are the maximum flow capacities these facilities could discharge. This is represented by the negative reduction.

Wasteload Allocations

There are seven permitted point sources in this watershed, however, there are only six point sources included in the WLA because one permitted source does not discharge nutrients. 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 individual industrial, individual municipal, general mineral mining, general industrial stormwater, and general Concentrated Animal Feeding Operations (CAFOs). The permits can be grouped into two categories, process water and stormwater.

The NPDES process water category includes those loads from minor municipal WWTPs

and a minor industrial facility judged to have the capacity to discharge phosphorus in their process water.

There are two municipal WWTPs in the Upper Pocomoke River watershed. Minor municipal WWTPs are assigned phosphorus WLAs based on their Maryland Tributary Strategy Cap flow and the permit limit; or 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.

One active minor industrial facility discharging process water in the Upper Pocomoke River watershed was judged to 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 a WLA based on the results of the monitoring required by their permits or professional judgment. In addition, allocations for minor municipal WWTPs (with design flow less than 0.5 MGD) and for minor industrial facilities are presented in the Chesapeake Bay TMDL as a watershed-wide aggregate WLA. A similar approach was adopted for the Upper Pocomoke River TMDL and all minor municipal and minor industrial process water facilities allocations are represented as a watershed-wide WLA.

Per EPA requirements, "stormwater discharges that are regulated under Phase I or Phase II of the National Pollutant Discharge Elimination System (NPDES) stormwater program are point sources that must be included in the WLA portion of a TMDL" (US EPA 2002). Phase I and II permits can include the following types of discharges:

- small, medium, and large MS4s – these can be owned by local jurisdictions, municipalities, and state and federal entities (i.e., departments of transportation, hospitals, military bases, etc.);
- general industrial stormwater permitted facilities; and.
- small and large construction sites.

There are three minor industrial regulated stormwater facilities included in the WLA (11 lbs/yr). However, most urban stormwater in the Upper Pocomoke River watershed are unregulated and the loads are included in the LA (1,991 lbs/yr).

Under the Clean Water Act, 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 (CNMP) that 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 an event greater than the 25-year, 24-hour storm. The Upper Pocomoke River Phosphorus TMDL requires a 50% reduction in the 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 TMDL considers 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 TMDL considers 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.

To ensure that the attainment of the DO criterion in the non-tidal Upper Pocomoke River is met during critical conditions, a three-year period from 1996-1998 was selected for the model simulations upon which the TMDL was based. 1996 was a very wet year, 1997 a dry year, and

[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.

1998 was a typical mean flow year. The selection of this three-year period represents variable hydrological conditions and captures high and low flow events. It inherently includes critical conditions.

5) The TMDL considers seasonal environmental variations.

Seasonality is captured in two components. First, it is implicitly included through the use of monitoring data for water quality assessment and model calibration. For example, MDE's 2010 water quality monitoring data was collected once every month throughout 2010. Second, the loading rates used in the TMDL were determined using the HSPF model, which is a continuous simulation model based on daily perception. The three dimensional receiving water model simulation spans a three-year period which covers wet-, dry-, and mean-flow years. This 3-year simulation encompasses seasonal variations and a range of hydrological and meteorological conditions.

6) The TMDL includes 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.

For this TMDL, the MOS is incorporated in the analysis by accounting for critical conditions captured in the hydrological return period selected for the dynamic model long term simulation. The simulation period selected for establishing the phosphorus allowable loads, includes a very wet year (1996), a dry year (1997), and a typical mean flow year (1998). In general, during dry years, the system can experience higher water temperatures combined with low flows. During wet years, higher flows and consequently increased pollutant loadings are expected. A wet year followed by a dry year combines both higher pollutant loadings to the system and higher temperatures, leading to lower DO levels due to increased primary production and bacterial decomposition. Incorporation of this critical period and the corresponding conservative assumptions in the modeling used to develop the TMDL supports the assertion of an implicit MOS. Therefore, a MOS that accounts for uncertainties in the analysis of water quality conditions in the non-tidal Upper Pocomoke River is considered as implicitly included in the model simulation and, consequently, in the TMDL.

7) The TMDL has been subject to public participation.

MDE provided an opportunity for public review and comment on the Phosphorus TMDL for the non-tidal Upper Pocomoke River watershed. The public review and comment period was open from August 23, 2012 through September 21, 2012. MDE received no written comments.

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.

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 non-tidal Upper Pocomoke 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 Upper Pocomoke River 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 Upper Pocomoke River watershed have been met, MDE will revisit the status of nutrient impacts on aquatic life in the non-tidal waters of Upper Pocomoke 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 non-tidal Upper Pocomoke 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.