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

February 13, 2001

Mr. Robert Hoyt
Assistant Secretary
Maryland Department of the Environment
2500 Broening Highway
Baltimore, Maryland 21224

Dear Mr. Hoyt:

The Environmental Protection Agency (EPA) Region III, has reviewed the report "Total Maximum Daily Loads (TMDLs) of Phosphorus for the Marshyhope Creek, Dorchester and Caroline Counties, Maryland" which was submitted by the Maryland Department of Environment (MDE) for final agency review on December 27, 2000. Pursuant to 40 CFR Section 130.7(d), EPA is approving the Marshyhope Creek TMDL.

The definition of Load Allocation (LA) at 40 CFR Section 130.2(g) states, in part, that "Load allocations 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." Further, a wasteload allocation (WLA), according to 40 CFR Section 130.2(h), is "The portion of a receiving water's loading capacity that is allocated to one of its existing or future points sources of pollution." In addition, a TMDL is defined at 40 CFR Section 130.2(i) as "The sum of the individual WLAs for point sources and LAs for nonpoint sources and natural background."

The supporting documentation provided with the TMDL report, specifically, the Technical Memorandum provides one allocation scenario with individual point and nonpoint source allocation. EPA relied upon this information in reviewing and approving the TMDL submittal and in preparing EPA's Decision Rationale. EPA expects for future TMDLs that the Technical Memorandum will be included in any public notice of the TMDLs.

EPA has determined that the TMDL and technical report are consistent with the regulation and requirements of 40 CFR Section 130 (see enclosed Decision Rationale). Pursuant to 40 CFR Sections 130.6 and 130.7(d)(2), the TMDLs and the supporting documentation, including the Technical Memorandum, should be incorporated into Maryland's current water quality management plan.

EPA has authority to object to issuance of a National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with WLAs established for that point source. If an NPDES permit is issued with an effluent limitation that does not reflect the WLA contained in the approved TMDLS and Technical Memorandum, it is expected that Maryland will document this change in the permit Fact Sheet, as discussed in EPA's Decision Rationale.

If you have any questions or concerns, please contact me at (215) 814-1111 or contact Thomas Henry at (215) 814-5752.

Sincerely,

/s/

Rebecca W. Hanmer, Director
Water Protection Division

Enclosure

Decision Rationale

Total Maximum Daily Load of
Phosphorus for
Marshyhope Creek

I. Introduction

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the Total Maximum Daily Loads (TMDLs) of Phosphorus to the Marshyhope Creek submitted for final Agency review on December 27, 2000. The EPA's rationale is based on the TMDL, Technical Memorandum, and other information provided in the submittal document to determine if the TMDL meets the following 8 regulatory conditions pursuant to 40 CFR §130.

1) The TMDLs are designed to implement applicable water quality standards.
2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3) The TMDLs consider the impacts of background pollutant contributions.
4) The TMDLs consider critical environmental conditions.
5) The TMDLs consider seasonal environmental variations.
6) The TMDLs include a margin of safety.
7) The TMDLs have been subject to public participation.
8) There is reasonable assurance that the TMDLs can be met.

The Technical Memorandum, *Significant Phosphourus Point Sources in the Marshyhope Creek Watershed*, submitted by the Maryland Department of the Environment (MDE), specifically allocates phosphorus to three point sources. MDE allocates phosphorus to the Hurlock Waste Water Treatment Plant (WWTP) (NPDES permit # MD0020834), Federalsburg WWTP (NPDES permit # MD0020249), and Col. Richardson High School (NPDES permit # MD0055522). The current load of phosphorus was determined using effluent concentrations and flows reported in Discharge Monitoring Reports (DMR) from 1998. Since only a low-flow scenario was included in the TMDL, specifice nonpoint source allocations to different land uses could not be provided by MDE.

II. Summary

The Marshyhope Creek[1] is approximately 38 miles in length. Its headwaters are located in Sussex and Kent Counties, Delware. Marshyhope Creek drains into the Nanticoke River approximately 2.2 miles southwest of Sharptown. Marshyhope Creek is tidal from the mouth of the creek for approximately 10 miles upstream to a point approximately 1.4 miles norht of the Town of Federalsburge. The navigable reach extends from the mouth up to the crossing with route 313 (for all boats) and up to about 1/4 mile south of the Town of Federalsburg (small boats that need virtually no depth to navigate). The Marshyhope Creek watershed has an area of

[1] The Marshyhope Creek watershed, part of the Lower Eastern Shore Tributary Strategy Basin, is located in Dorchester County and Caroline County. It is contained within sub-basin 02-13-03 (Nanticoke River Area).

approximately 138,485 acres or 216.4 square miles. The dominant land uses in the watershed are mixed agriculture (67,813 acres or 49%), forest (62,055 acres or 45%), and urban (7,677 acres or 5%). [2]

In response to the requirements of Section 303(d) of the Clean Water Act (CWA), MDE listed the Marshyhope Creek on the 1996 303(d) list of impaired waterbodies under Basin Segment 02130306 (Nanticoke River Watershed) for nutrients due to signs of eutrophication in the form of excessive algal blooms and low dissolved oxygen (DO) concentrations. A eutrophic system typically contains an undesirable abundance of plant growth, particularly phytoplankton (photosynthetic microscopic organisms (algae)), periphyton (attached benthic algae), and macrophytes (large vascular rooted aquatic plants)[3]. These impairments interfere with the designated uses[4] of Marshyhope Creek by disrupting the aesthetics of the river and causing harm to inhabited aquatic communities. MDE listed nutrients, both phosphorus, from nonpoint and natural sources as the causes and sources of the impairments, respectively. Marshyhope Creek was given low priority on the 1996 303(d) list. Section 303(d) of the CWA and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the State where technology-based and other controls did not provide for attainment of water quality standards. Although Marshyhope Creek was listed for nutrients, MDE has determined that phosphorus is the limiting nutrient. Therefore, the TMDL submitted by Maryland is designed to address acceptable levels of phosphorus in order to ensure that water quality standards are maintained. These levels of phosphorus will provide for the control of eutrophication and algae blooms (measured through a surrogate indicator known as chlorophyll-a) and ensure that the water quality criterion for DO is attained.

MDE developed this TMDL to address the excessive nutrient enrichment that Marshyhope Creek is currently experiencing. This TMDL is designed to satisfy the water quality standards and designated uses of Marshyhope Creek only for nutrients. Impairments in the remainder of the Nanticoke River watershed are not addressed by this TMDL. In addition, impairments due to suspended sediments are not addressed by this TMDL.

In order to address the impairments of Marshyhope Creek from the 303(d) list, MDE believes it is necessary to control excessive nutrient input to the system. Phosphorus and nitrogen are factors which exert influence on not only the concentrations of DO in a waterbody but also biomass (typically characterized as algae or phytoplankton and measured as chlorophyll-a for modeling purposes). Figure 1 (taken from EPA 823-B-97-002, page 2-14) illustrates the interrelationship of major kinetic processes for BOD, DO, and nutrient analysis.

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[2] This information is based on the 1997 Maryland Office of Planning land cover data, 1997 Delware Office of State Planning land cover data, and 1997 Farm Service Agency (FSA) information..

[3] Protocol for Developing Nutrient TMDLs. First Edition. November 1999. EPA 841-B-99-007.

[4] The designated uses of Marshyhope Creek is Use I (Water Contact Recreation and Protection of Aquatic Life) for all free-flowing tributaries. See Code of Maryland Regulations 26.08.02.

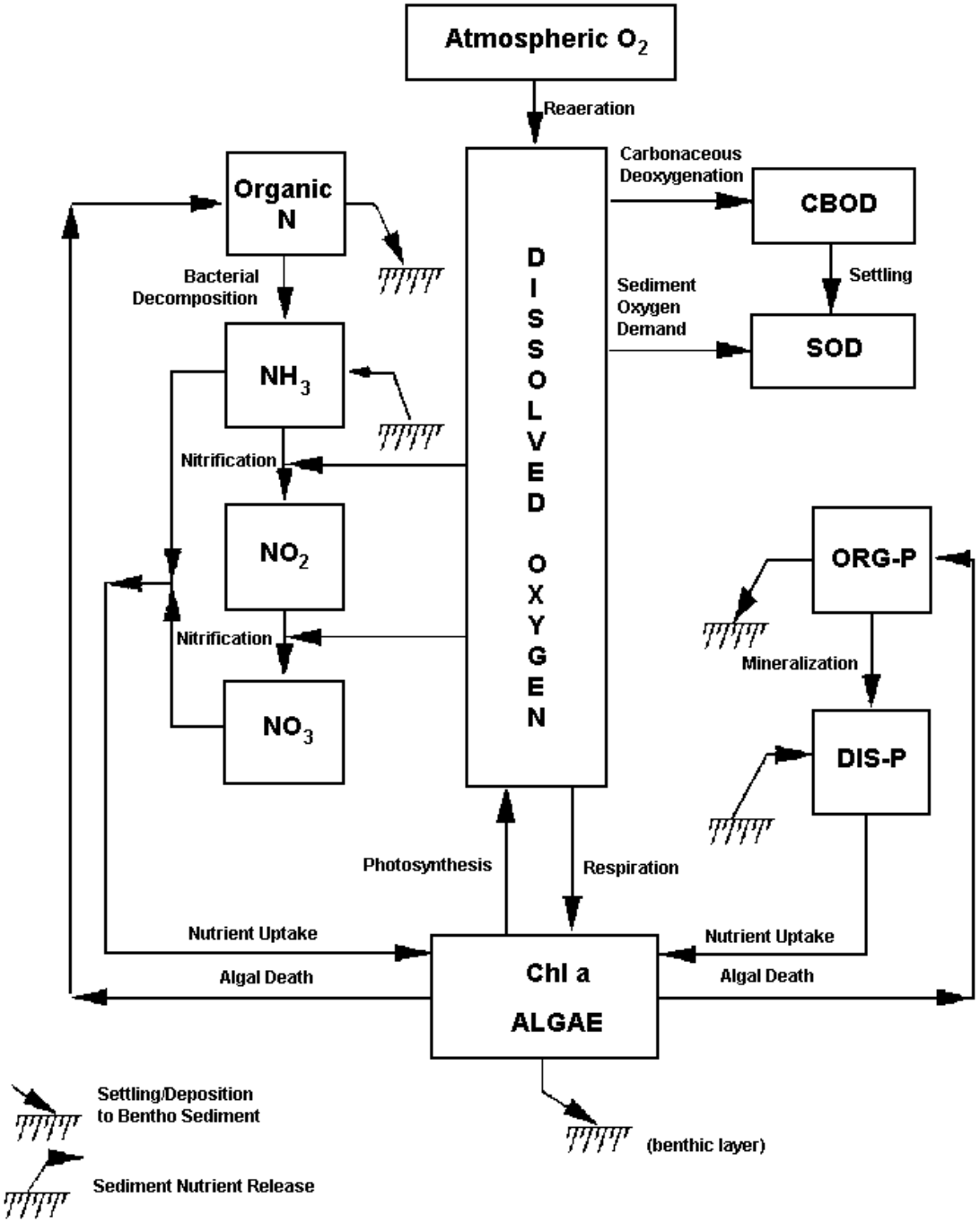

Figure 1

Nutrient enrichment and subsequent algal growth are a concern in rivers and streams because of their effect on DO concentrations. Growing plants provide a net addition of DO to the stream on an average daily basis, yet respiration can cause low DO levels at night that can affect the survival of less tolerant fish species. Also, if environmental conditions cause a die-off of either microscopic or macroscopic plants, the decay of biomass can cause severe oxygen depressions. Therefore, excessive plant growth can affect a streams ability to meet both average daily and

instantaneous DO standards[5]. In addition, excessive nutrients lead to an overabundance of aquatic plant growth.

MDE uses WASP5[6] to evaluate the link between nutrient loadings, algal growth, and DO. This evaluation is based on representing current conditions within the Marshyhope Creek system and determining the necessary reductions in nutrient loadings from various sources to achieve and maintain water quality standards. WASP5 is a general-purpose modeling system for assessing the fate and transport of conventional and toxic pollutants in surface waterbodies (Ambrose, 1987)[7]. The model can be applied in one, two, or three dimensions and includes 2 sub-models (EUTRO5 and TOXI5) to investigate water quality/eutrophication and toxics impairments. EUTRO5 can simulate the transport and transformation of eight state variables including DO, carbonaceous biochemical oxygen demand, phytoplankton carbon and chlorophyll-a, ammonia, nitrate, organic nitrogen, organic phosphorus, and orthophosphate. WASP5 has been previously applied in a number of regulatory and water quality management applications and is an appropriate linkage evaluation tool for the Marshyhope Creek. Based on this analysis, MDE has determined that the levels of nutrient input to the Marshyhope Creek specified by the TMDL will ensure that water quality standards are achieved by controlling algae blooms and maintaining the DO water quality criterion. Table 1 shows a summary of the TMDL as determined by MDE for critical low-flow conditions only.

Table 1, Summary of Phosphorus TMDLs[1]

Flow Regime (Period)	Parameter	TMDL	WLA[2]	LA[3]	FA[4]	MOS[5]
Low-flow (May 1 - Oct. 31)	Phosphorus (lbs/month)	767	415	249	90	13

1 The load allocations for low-flow represent flows developed using a United States Geological Survey regression analysis and 1998 base-flow field data taken in the Marshyhope Creek
2 WLA = Waste Load Allocation
3 LA = Load Allocation
4 FA = Future Allocation
5 MOS = Margin of Safety

III. Discussion of Regulatory Conditions

EPA finds that Maryland has provided sufficient information to meet all of the 8 basic requirements for establishing a phosphorus TMDL for the Marshyhope Creek. EPA therefore approves the TMDL, Technical Memorandum, and supporting documentation for phosphorus in the Marshyhope Creek. EPA's approval is outlined according to the following regulatory requirements:

1) The TMDL is designed to implement the applicable water quality standards.

[5] Technical guidance Manual for Developing Total Maximum Daily Loads, Book 2: Streams and Rivers, Part 1: Biochemical Oxygen Demand/Dissolved Oxygen and Nutrients/Eutrophication. Section 4.2.1.2. March 1997. EPA 823-B-097-002.

[6] Ambrose, R.B., T.A. Wool, and J.L. Martin. 1993. The water quality simulation program, WASP5 version 5.10. Part A: Model documentation. U.S. EPA, ORD, ERL, Athens, GA.

[7] Compendium of Tools for Watershed Assessment and TMDL Development. May 1997. EPA 841-B-97-006.

MDE has indicated that algal blooms and low DO concentrations due to excessive nutrient input have caused violations of the water quality standards and designated uses applicable to the Marshyhope Creek. As previously mentioned, the designated use of Marshyhope Creek is Use I. The DO water quality criterion to support this use indicates that DO concentrations may not be less than 5 mg/L at any time. While Maryland does not have numeric water quality criteria for phosphorus, Maryland interprets it's General Water Quality Criteria to provide numerical objectives for phosphorus which will support the DO water quality criterion as well as a surrogate indicator (chlorophyll-a)[8] to determine acceptable algae levels in the Marshyhope Creek. Chlorophyll-a is desirable as an indicator because algae are either the direct (e.g. nuisance algal blooms) or indirect (e.g. high/low DO and pH and high turbidity) cause of most problems related to excessive nutrient enrichment[9]. The WASP5 model used by Maryland will help to determine those nutrient levels and compliance with the DO criterion and chlorophyll-a levels.

The presence of aquatic plants in a waterbody can have a profound effect on the DO resources and the variability of the DO throughout a day or from day to day[10]. This is due to the photosynthetic and respiration processes of aquatic plants which can cause large diurnal variations in DO that are harmful to fish. Photosynthesis is the process by which plants utilize solar energy to convert simple inorganic nutrients into more complex organic molecules[11]. Due to the need for solar energy, photosynthesis only occurs during daylight hours and is represented by the following simplified equation (proceeds from left to right):

$$\underset{(Carbon\ Dioxide)}{6CO_2} + \underset{(Water)}{6H_2O} \leftrightarrow \underset{(Sugar)}{C_6H_{12}O_6} + \underset{(Oxygen)}{6O_2}$$

In this reaction, photosynthesis is the conversion of carbon dioxide and water into sugar and oxygen such that there is a net gain of DO in the waterbody. Conversely, respiration and decomposition operate the process in reverse and convert sugar and oxygen into carbon dioxide and water resulting in a net loss of DO in the waterbody. Respiration and decomposition occur at all times and are not dependent on solar energy. Waterbodies exhibiting typical diurnal variations of DO experience the daily maximum in mid-afternoon during which photosynthesis is the dominant mechanism and the daily minimum in the predawn hours during which respiration and decomposition have the greatest effect on DO and photosynthesis is not occurring. In order to ensure that the DO concentration of 5mg/L is met at all times, MDE calculates both the daily average DO concentrations and the minimum diurnal DO concentrations as a result of photosynthesis and respiration of phytoplankton using the WASP5 model.

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[8] Chlorophyll-a is typically used as a measure of algal biomass in natural waters because most algae have chlorophyll as the primary pigment for carbon fixation (EPA 823-B-97-002).

[9] Supra, footnote 3

[10] Principles of Surface Water Quality Modeling and Control. Robert V. Thomann., and J.A. Mueller. 1987. Page 283.

[11] Surface Water-Quality Modeling. Steven C. Chapra. 1997. Page 347.

In addition to the negative effects on DO, an overabundance of aquatic plant growth adversely impacts the aesthetic and recreational uses of a waterbody by decreasing water clarity and forming unsightly floating algae blooms which also hinder navigation. MDE utilizes chlorophyll-a, a surrogate indicator for algal biomass[12], to evaluate the link between nutrient loadings and aquatic plant levels necessary to support the designated uses of Marshyhope Creek. Again, using their General Water Quality Criteria, MDE establishes a numeric chlorophyll-a goal of 50 μg/L. This level is based on the goals/strategies recommended by the Algal Bloom Expert Panel to prevent the occurrence of algal blooms similar to those experienced in the Potomac Estuary in 1983[13]. Specifically, the panel believed that nuisance conditions from algal blooms occurred when chlorophyll-a concentrations exceeded 100 μg/l. Similar to the nutrient-DO evaluation, MDE uses the WASP5 model to determine acceptable levels of loadings of nutrients to achieve a chlorophyll-a concentration of 50 μg/l.

EPA believes that the TMDL for phosphorus will ensure that the designated use and water quality criteria for the Marshyhope Creek are met and maintained.

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

Total Allowable Loads

The critical season for excessive algal growth in the Marshyhope Creek has been identified by Maryland as the summer months. During these months, flow in the channel is reduced resulting in slower moving, warmer water which has less dilution potential and is susceptible to algal blooms and low DO concentrations. In order to control the algal activity and its impacts on water quality, particularly with respect to DO levels, Maryland has established an individual TMDL for phosphorus that is applicable from May 1 through October 31. Maryland presented this as monthly loads to be consistent with the monthly concentration limits that are required by NPDES permits. Expressing the TMDLs as monthly loads is consistent with federal regulations at 40 CFR 130.2(i), which state that TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure.

Maryland also recognized that nutrients may reach the river in significant amounts during higher flow periods. The available data and predictive modeling indicated no problems with chlorophyll-a levels or low DO concentrations during these times. Therefore, Maryland did not perform an average annual flow analysis.

EPA's regulations at 40 CFR 130.2(i), define "total maximum daily load (TMDL)" as the

[12] Biomass is defined as the amount, or weight, of a species, or group of biological organisms, within a specific volume or area of an ecosystem (EPA 823-B-97-002).

[13] Thomann, R.V., N.J. Jaworski, S.W. Nixon, H.W. Paerl, and J. Taft. March 14, 1985. Algal Bloom Expert Panel. The 1983 Algal Bloom in the Potomac Estuary. Prepared for the Potomac Strategy State/EPA Management Committee.

"sum of individual WLAs for point sources and LAs for nonpoint sources and natural background." As the total loads provided by Maryland equal the sum of the individual WLAs for point sources and the land-based LAs for nonpoint sources set forth below and in the Technical Memorandum provided with the TMDLs, the TMDLs for phosphorus for Marshyhope Creek are consistent with Section 130.2(i). Pursuant to 40 CFR 130.6 and 130.7(d)(2), the TMDL, Technical Memorandum, and supporting documentation, should be incorporated into Maryland's current water quality management plan.

Waste Load Allocations

EPA regulations require that an approveable TMDL include individual WLAs for each point source. Maryland's TMDL report for the Marshyhope Creek did not include an individual WLA for each of the three point sources (Hurlock WWTP -NPDES permit # MD0020834, Federalsburg WWTP -NPDES permit # MD0020249, and Col. Richardson High School - NPDES permit # MD0055522) of phosphorus. However, the Technical Memorandum did provide a WLA scenario for low-flow TMDLs. The WLAs are presented in Table 2.

Table 2 - Summary of low-flow WLAs for Phosphorus

Facility	NPDES permit #	Current permit Loading[1] (lbs/month)	WLA (lbs/month)	Reduction needed
Hurlock[2,3]	MD0022730	0	113	-----
Federalsburg[4]	MD0020249	375	375	-----
Col. Richardson High School[5]	MD0055522	10	17	-----
		Total:	505	-----

[1] These are estimated values. Estimated based on type of treatment or from a Total Phosphorus permit limit and actual monitoring data. *Note: Hurlock land applies during the critical low flow months. Therefore the assumption is no loads to the receiving water during the summer months.*
[2] This WLA includes the future allocation of 113 lbs/month (0 + 113).
[3] The flow and concentration associated with this future load has not been determined by MDE. Depending on future needs, it will be determined then and will meet the maximum loads as established by this TMDL.
[4] WLA based on a design flow of 0.75 mgd and a phosphorus concentration fo 0.72 mg/L.
[5] WLA based on a design flow of 0.011 mgd and a phosphorus concentration fo 3.72 mg/L.

MDE proposed an alternative WLA in which Hurlock WWTP was permitted to discharge in the summer months directly into the receiving water rather than land applying as is the practice in the current permit. Therefore, the current permit loading for Hurlock was based on loadings when Hurlock is not land applying (winter months). MDE used this alternative WLA to compute the TMDL. The TMDL has addressed the possibility of a separate plant by assuming that the volume of discharge at the location of Hurlock would account for both the needs of Hurlock and Allen Foods. This alternative WLA meets the TMDL. Table 3 presents these WLAs.

Table 3 - Summary of low-flow WLAs for Phosphorus (Option 2)

Facility	NPDES permit #	Current permit loading[1] (lbs/month)	WLA (lbs/month)	Reduction needed
Hurlock[2,3]	MD0022730	2630	360	86%
Federalsburg[4]	MD0020249	375	135	64%
Col. Richardson High School[5]	MD0055522	10	10	-----
		Total:	505	-----

[1] These are estimated values. Estimated based on type of treatment or from a Total Phosphorus permit limit and actual monitoring data. *Note: This is the estimated current permit level for discharging into the receiving water during average flow.*

[2] This WLA includes the future allocation (FA) of 90 lbs/month [270 (WLA) + 90 (FA)].

[3] WLA based on a design flow of 2.0 mgd [1.5 mgd + 0.5 mgd (FA)] and a phosphorus concentration of 1.44 mg/L [0.72 mg/L + 0.72 mg/L (FA)].

[4] WLA based on a design flow of 0.75 mgd and a phosphorus concentration fo 0.72 mg/L.

[5] WLA based on a design flow of 0.011 mgd and a phosphorus concentration fo 3.72 mg/L.

The point source loads used to represent the expected current conditions during low flow were calculated using effluent data gathered from DMRs from July, August, and September 1998. The WLAs of the TMDL represent point source loads which will provide compliance with the water quality standards mentioned in Section 1 above. The low-flow monthly WLA values are most applicable from May 1 to October 31. The low-flow TMDL analysis was accomplished using nonpoint source loads which are based on 1998 field survey data from the Marshyhope Creek.

It is necessary to distinguish between current permitted loading, the wasteload allocation determined through the TMDL process, and actual loading. Current permitted loading refers to the allowable loading as designated by NPDES permit for each facility prior to the TMDL process. The WLA represents the allowable point source pollutant load necessary to achieve water quality standards as determined by the TMDL process. The actual loading represents the amount of pollutant loading that a facility is discharging. This load must not exceed the permitted load specified in the NPDES permit. However, it is very likely that actual loading is less than both the current permitted load and WLA such that pollutant loadings from particular facilities may not be impacted by the TMDL process. Conversely, permit limits may need to be adjusted to reflect the WLA determined in the TMDL process. Thus, while a facility may not be required to take action to reduce pollutant loadings, the NPDES permit may need to be revised in order to reflect findings from the TMDL process.

Other Considerations

Currently Allen Family Foods, Inc. discharges to the Hurlock WWTP; however, Allen Family Foods, Inc. has submitted a draft Wastewater Treatment Plant permit (NPDES MD0068209) for aproval. One of the proposals in the draft permit is Allen Family Foods not discharging to the Hurlock WWTP. Instead, Allen Family Foods would regulate treated poultry processing wastewater and stormwater through the construction of a new treatment facility with Biological Nutrient Removal (BNR). This would result in a major permit being issued as Allen Family Foods, Inc. provides at least three quarters of the flow to the Hurlock WWTP. The discharge point of this new facility would be on Wrights Branch.

Allen Family Foods, though, may or may not actually use this permit for its wastewater discharge. Should Allen Family Foods continue to discharge to the Hurlock WWTP, the LA for Hurlock would take this into account in that they are currently applying for a reissuance of their permit and have proposed an expansion to 2.0 mgd. This draft permit also includes six different Effluent Limitations, which describe conditions prior to and after plant upgrades. Following plant upgrades, Hurlock proposes year round discharge regardless of whether Allen Family Foods is discharging to Hurlock. In two of the proposed Effluent Limitations scenarios in the Hurlock draft permit, there are 2 proposed flows if Allen Family Foods discontinues discharging to Hurlock. One is a year round discharge with a flow of 2.0 mgd and the other is a year round discharge with a flow of 0.2 mgd in summer and 0.7 mgd in winter.

The outcome of the above situation (whether Allen Family Food discontinues discharging to Hurlock and build own plant) will affect this TMDL in that MDE may have to reassess the TMDL based on the impact of the WLA on the receiving water. For instance, if Allen Family Foods discontinues discharging to Hurlock and builds its own plant, the WLAs will need to reflect the addition of a major point source. Furthermore, if Hurlock is permitted a year round flow of 2.0 mgd (one of the effluent scenarios without Allen Family Foods) and Allen Family Foods is also discharging into Wrights Branch then MDE needs to determine if these load would still meet this TMDL.

Load Allocations

Maryland provided adequate land use and loading data in the TMDL report, but did not distribute the total load allocation to specific land use categories in the TMDL report. Maryland included a gross LA for the low-flow TMDL.

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 loads should be distinguished. MDE uses the Chesapeake Bay Program model Phase IV loading coefficients (Year 2000 scenario) which are land use specific and include natural background contributions, atmospheric deposition (to land and/or water), and baseflow contributions.

A breakdown by land use cannot be determined for nonpoint source loads during low flow.

These nonpoint source loads which were based on observed conentrations account for "natural" and human-induced components. Table 4 presents the gross LA for low flow.

Table 4 - Summary of low-flow LAs for Phosphorus

"Existing"[1] Nonpoint Source Load (lbs/month)	LA (lbs/month)	Reduction needed
392	249	37%

[1] Based on1998 observed field data. Reflects what is considered as current conditions.

Allocations Scenarios

EPA realizes that the above breakouts of the total loads for phosphorus to the point sources and nonpoint sources is one allocation scenario. As implementation of the established TMDLs proceed, Maryland may find that other combinations of point and nonpoint source allocations are more feasible and/or cost effective. However, any subsequent changes in the TMDL must conform to gross waste load and load allocations and must ensure that the biological, chemical, and physical integrity of the waterbody is preserved.

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. EPA has authority to object to the issuance of an NPDES permit that is inconsistent with WLAs established for that point source. To ensure consistency with these TMDLs, as NPDES permits are issued for the point sources that discharge the pollutants of concern to Marshyhope Creek, any deviation from the WLAs set forth in the Technical Memorandum and described herein for the particular point source must be documented in the permit Fact Sheet and made available for public review along with the proposed draft permit and the Notice of Tentative Decision. The documentation should; 1) demonstrate that the loading change is consistent with the goals of the TMDL and will implement the applicable water quality standards, 2) demonstrate that the changes embrace the assumptions and methodology of these TMDLs and Technical Memorandum, and, 3) describe that portion of the total allowable loading determined in the State's approved TMDL report that remains for other point sources (and future growth where included in the original TMDL) not yet issued a permit under the TMDL. It is also expected that Maryland will provide this Fact Sheet, for review and comment, to each point source included in the TMDL analysis as well as any local and State agency with jurisdiction over land uses for which load allocation changes may be impacted.

In addition, EPA regulations and program guidance provides for effluent trading. Federal regulations at 40 CFR 130.2 (i) state: "If Best Management Practices (BMPs) or other nonpoint source pollution controls make more stringent load allocations practicable, then wasteload allocations may be made less stringent. Thus, the TMDL process provides for nonpoint source control tradeoffs." The State may trade between point sources and nonpoint sources identified in this TMDL as long as three general conditions are met; 1) the total allowable load to the waterbody is not exceeded, 2) the trading of loads from one

source to another continues to properly implement the applicable water quality standards and embraces the assumptions and methodology of these TMDLs and Technical Memorandum, and 3) the trading results in enforceable controls for each source. Final control plans and loads should be identified in publicly available planning document, such as the State's water quality management plan (see 40 CFR 130.6 and 130.7(d)(2). These final plans must be consistent with the goals of the approved TMDLs.

Based on the foregoing, EPA has determined that the TMDL and the Technical Memorandum for Phosphorus for Marshyhope Creek are consistent with the regulations and requirements of 40 CFR Section 130. Pursuant to 40 CFR 130.6 and 130.7(d)(2), this TMDL and the supporting documentation, including the Technical Memorandum, should be incorporated into Maryland's current water quality management plan.

3) The TMDL considers the impacts of background pollutant contributions.

In terms of the low-flow TMDL analysis, Maryland used 1998 field data which would adequately consider pollutant contributions from baseflow, which is considered to be most influential during low-flow periods, as well as other nonpoint source contributions such as atmospheric deposition and loads from septic tanks.

In terms of the high-flow TMDL analysis, Chesapeake Bay Model Phase IV loading coefficients (Year 2000 scenario) were used which effectively consider natural background, loads from septic tanks, as well as baseflow contributions.

4) The TMDLs consider critical environmental conditions.

EPA regulations at 40 CFR 130.7(c)(1) require TMDLs to take into account critical conditions for streamflow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Marshyhope Creek is protected during times when it is 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.[14] Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has 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. For example, stream analysis often uses a low-flow (7Q10) design condition as critical because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

Based on the 1998 field data and current knowledge regarding eutrophication, Maryland

[14] 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 Water Management Division Directors, August 9, 1999.

identified the months of July, August, and September as the critical period. The specific conditions that describe this critical period are reduced flows in the stream (low-flow), higher concentrations of nutrients, and warmer water temperatures. These conditions combine to create favorable conditions for algal growth and wide fluctuations in DO concentrations which lead to violations of the designated uses and water quality criteria of the Marshyhope Creek. Furthermore, the data showed that chlorophyll-a levels were of concern and DO concentrations are violating the water quality criteria. The low-flow TMDL analysis using the WASP5 model adequately considers those critical conditions.

MDE also recognizes that increased nonpoint source loads of nutrients during precipitation events could adversely affect water quality, thus a critical condition itself, despite the fact that the 1998 field data shows that chlorophyll-a levels and DO concentrations were not of concern for the months of February and March.

MDE believes that agricultural ditching, direct loading from animals, and deposition of nutrient-laden sediment from high-flow events, traditionally seen as nonpoint sources, are contributing significant amounts of nutrients to the Marshyhope Creek which negatively impact water quality during critical low-flow periods. In order to control these sources of nutirents, MDE believes that nonpoint source control mechanisms are necessary to improve water quality during low-flow periods. MDE states that controlling these nonpoint sources of nutrients to the Marshyhope Creek will ensure that water quality standards during low-flow periods will be achieved.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in streamflow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flow normally occurs during the colder period of winter and in early spring from snowmelt and spring rain, while seasonally low flow typically occurs during the warmer summer and early fall drought periods[15]. Consistent with EPA's discussion regarding critical conditions, the WASP5 model and TMDL analysis will effectively consider seasonal environmental variations.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. Margins of safety may be implicit, built into the modeling process, or explicit, taken as a percentage of the WLA, LA, or TMDL.

In terms of the low-flow TMDL analysis for phosphorus, MDE states that it explicitly allocates 5% of the LA value and reserves this for the MOS. However, analysis indicates that the margins of safety represent much larger percentages of the LAs.

[15] Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2, Part 1, Section 2.3.3, (EPA 823-B-97-002, 1997).

In addition, MDE uses certain conservative assumptions which are implicitly included in the modeling process. The low-flow analysis sets a goal of 50 µg/l for chlorophyll-a, which MDE believes is conservative given the generally acceptable range of chlorophyll-a values for waters meeting their water quality standards of 50 - 100 µg/l.

7) The TMDLs have been subject to public participation.

The TMDLs of phosphorus to the Marshyhope Creek were open for public comment from October 26, 2000 through November 27, 2000. Only one set of written comments were received by MDE. This was provided along with MDE's response document with the TMDL report.

The United States Fish and Wildlife Service had no comments on the proposed TMDL.

8) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL 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 authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs, including EPA's Clean Water Action Plan and Maryland's Water Quality Improvement Act of 1998, and the State's Chesapeake Bay Agreement's Tributaries Strategies for Nutrient Reduction.

Nonpoint source controls during low-flow conditions can also be achieved through control of identified sources. Dissolved forms of the impairing substances from groundwater, agricultural ditching, animals in the stream, and deposition of nutrients and organic matter to the stream bed from higher flow events have been identified as contributing sources during low-flow. It is unclear to EPA how groundwater and deposition from higher flow events can be controlled. MDE believes that through controlling these sources in combination, the nonpoint source reductions proposed in this TMDL can be achieved.

In addition, there will be follow-up monitoring within five years as part of Maryland's Watershed Cycling Strategy. This follow-up monitoring will allow Maryland and EPA to determine whether these TMDLs have been implemented successfully.