Decision Rationale

Total Maximum Daily Loads for Phosphorus and Sediments to Adkins Pond, Wicomico County, Maryland

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies 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, that may be discharged to a water quality-limited water body.

This document sets forth the United States Environmental Protection Agency's (USEPA) rationale for approving the TMDLs for phosphorus and sediment in the Adkins Pond watershed. The TMDLs were established to address impairments of water quality, caused by nutrients and sediments, as identified in Maryland's 1996 and 1998 Section 303(d) lists. The Maryland Department of the Environment (MDE), submitted the *Total Maximum Daily Loads of Phosphorus and Sediment to Adkins Pond in the Pocomoke River Watershed, Wicomico County, MD*, dated December 2001, to USEPA for final review on December 11, 2001. A revised TMDL was received on January 25, 2002. These TMDLs address one segment, Adkins Pond, on Maryland's 1998 Section 303(d) list.

USEPA's rationale is based on the TMDL Report, information contained in the Appendix to the report, and the Technical Memorandum. USEPA's review determined that the TMDLs meets the following eight regulatory requirements pursuant to 40 CFR Part 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) There is reasonable assurance that the TMDLs can be met.
8) The TMDLs have been subject to public participation.

The Technical Memorandum, *Significant Phosphorus and Sediment Non-point Sources in the Adkins Pond Watershed* submitted by the MDE, specifically allocates phosphorus and sediment to each of two separate land use/source categories (direct atmospheric deposition of phosphorus to the water surface is obviously not considered a "land use" source). Each land use or source is allocated some percentage of the total load originating from nonpoint sources. Current nonpoint source load estimates were based on the Chesapeake Bay Model Phase IV loading coefficients from segment 430 which considers natural background, loads from septic tanks, as well as baseflow contributions. Likewise, the load allocations to each land use also consider natural background, septic tanks and baseflow. Each land use load allocation represents yearly allowable loads of phosphorus. There are no point sources in this watershed. Table 1

summarizes the TMDLs for Adkins Pond as determined by MDE.

Table 1 - Phosphorus and Sediment TMDLs Summary

Parameter	Rate	TMDL	WLA[2]	LA[3]	MOS[4]
Phosphorus	lbs/yr	2,505	0	2,254	251
	lbs/day[1]	6.9	0.0	6.2	0.7
Sediment	m^3/year	587	0	587	Implicit
	m^3/day[1]	1.6	0.0	1.6	Implicit

[1] The TMDL rate of pounds per day or tons per day is derived by dividing the pounds and tons per year values by 365, respectively.
[2] WLA = Waste Load Allocation
[3] LA = Load Allocation
[4] MOS = Margin of Safety

The TMDLs are written plans and analysis established to ensure that a waterbody will attain and maintain water quality standards. The TMDLs are scientifically-based strategies which consider current and foreseeable conditions, the best available data, and account for uncertainty with the inclusion of a "margin of safety" value. Conditions, available data, and the understanding of the natural processes can change more than what was anticipated by the margin of safety. The option is always available to refine TMDLs for re-submittal to USEPA for approval.

II. Summary

Adkins Pond is an impoundment located in the upper Pocomoke Watershed (02-13-02-03) in Wicomico County, Maryland (Figure 1). The Pocomoke River flows into Pocomoke Sound and Chesapeake Bay at the Virginia/Maryland state line. Adkins Pond was created for agricultural water supply purposes in 1940. Currently, Adkins Pond supports a warm water fishery and is used for recreational purposes, including boating and fishing.

The Adkins Pond watershed lies in the Atlantic Coastal Plain physiographic province. The soils in the drainage area generally consist of Evesboro loamy sand, Fallsington sandy loam and Pocomoke sandy loam (Soil Conservation Service 1970). These soils are typically level to gently sloping (U.S. Department of Agriculture, Soil Survey of Wicomico County, 1970).

Inflow to the pond is primarily via two tributaries (Figure 1). Truitt Branch, Savanna Branch and Campbell Ditch merge to form the northernmost tributary, while Givens Branch forms the westernmost tributary. Under base flow conditions, the tributaries are generally shallow (about 1 foot) at their point of discharge to the pond. The pond discharges to the Pocomoke River, which flows southwesterly to Chesapeake Bay.

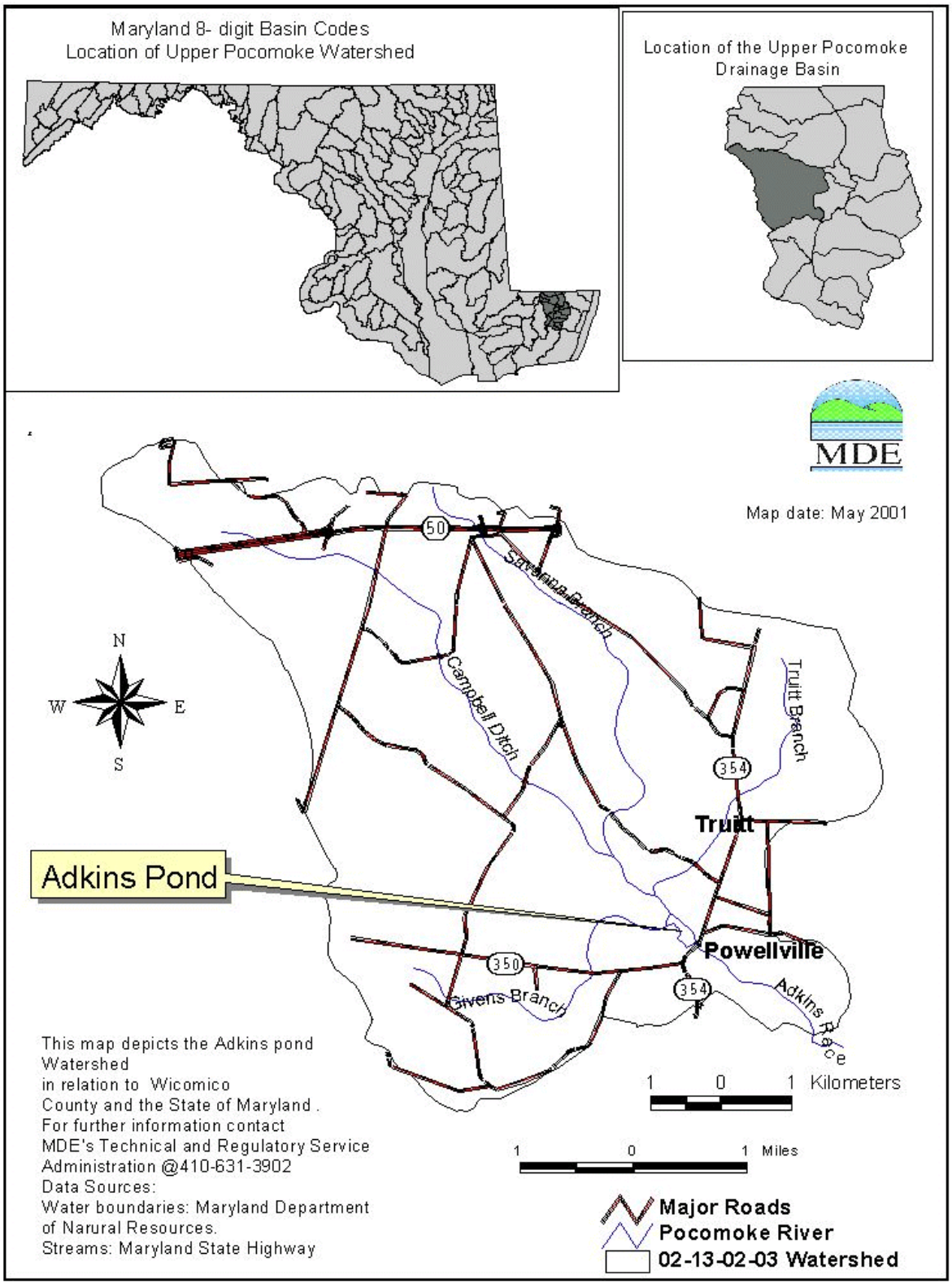

Figure 1 - Location Map of Adkins Pond in Wicomico County, Maryland

Table 2 presents the 1940 and present physical characteristics of Adkins Pond.

Table 2 - Physical Characteristics of Adkins Pond

Characteristic	1940	Present (2001)
Surface Area	17.2 acres	11.9 acres
Average Pond Depth	4.5 feet	2.51 feet
Drainage Area to Pond	21.6 square miles	21.6 square miles
Volume of Pond	77 acre-feet	29.8 acre-feet

The land use distribution in the watershed is approximately 46% forested and 54% agriculture (Maryland Department of Planning, 1997 Land use). There are no point sources located in the Adkins Pond drainage area.

Adkins Pond was identified as having low dissolved oxygen levels and nuisance levels of algae in the *Maryland Lake Water Quality Assessment Report* (1995) and therefore added to Maryland's 1998 Section 303(d) list of water quality limited segments (WQLS). Adkins Pond was monitored by MDE in June and August of 1993. Water quality samples were collected from one station below the overflow structure and one station at each of the tributaries. The samples were analyzed for total phosphorus, soluble orthophosphorus, nitrate and nitrite N, total Kjeldahl nitrogen, total organic solvents, and chlorophyll "a". Physical measurements of depth, water temperature, pH, conductivity, and dissolved oxygen (DO) were recorded in the field.

The water quality impairments of Adkins Pond consist of a violation of the numerical water quality for DO and violations of general narrative criteria applicable to the designated use of the water in the state's regulations. The Surface Water Use Designation for Adkins Pond in the Maryland water quality standards is Use I, *Water Contact Recreation and Protection of Aquatic Life*. Under the Code of Maryland Regulations (COMAR), this designation states that "all waters of this State shall be protected for the basic uses of water contact recreation, fish, other aquatic life, wildlife and water supply." The constituents causing the water quality criteria violations in Adkins Pond are nutrients and sediment. The pond suffers from excessive sedimentation and eutrophication that interfere with the designated use of the pond.

The Clean Water Act (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 TMDLs submitted by MDE are designed to attain acceptable loadings of phosphorus into the pond and allowable sediment concentrations. Furthermore, these TMDLs are designed to restore the designated uses of Adkins Pond and attain narrative water quality criteria that are currently not being met. See Table 1 for a summary of the allowable loads.

III. Discussion of Regulatory Conditions

USEPA finds that MDE has provided sufficient information to meet all of the eight basic requirements for establishing phosphorus and sediment TMDLs for Adkins Pond. USEPA therefore approves the TMDLs for phosphorus and sediment in Adkins Pond. This approval is outlined below according to the eight 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. Maryland does not currently have numeric water quality criteria for nutrients (nitrogen or phosphorus) or sediments. Maryland has a numerical criterion for dissolved oxygen (DO). According to the criterion, DO concentrations may not be less than 5.0 milligrams per liter (mg/L) unless resulting from naturally occurring conditions. In lake environments, low concentrations of DO are expected in bottom waters even under optimal natural conditions. However, achievement of the 5.0 mg/L criterion is expected in well-mixed surface waters. Also, a narrative criterion states that excessive sedimentation shall not interfere with the Use I designation. The violation of both criteria in Adkins Pond indicates nutrient enrichment in the pond. The overall objective of the TMDLs is to reduce phosphorus and sediment loads in order to meet all water quality criteria that support the Use I designation.

The TMDLs propose that the violation of the water quality criterion for DO is caused by excessive growth of plants and algae. This excessive growth is linked to the trophic status of the pond, which is controlled by phosphorus loading. Because phosphorus binds to sediment, sedimentation rates are also associated with phosphorus loading. Reduction of phosphorus loading will result in a decrease in sedimentation rates as well as adherence to the water quality criterion.

Chlorophyll-"a" (chl-"a"), a measure of algal biomass, is used as the endpoint. The chl-'a" endpoint selected for Adkins Pond – 20 µg/l, or approximately 60 on the Carlson's Trophic State Index (TSI) – is in the lower range of eutrophy, which is an appropriate trophic state at which to manage this impoundment. Other states have adjusted their trophic-state expectation for lakes or impoundments with differing uses. Minnesota, for example, uses an ecoregion-based approach. Heiskary (2000) reports that individuals utilizing lakes for recreational purposes (water contact, fishing) demanded relatively clear, less enriched lakes in the Northern Lakes and Forest (NLF) and North Central Hardwood Forest (NCHF) ecoregions. In the Western Corn Belt Plains (WCBP) and Northern Glaciated Plains (NGP) ecoregions, however, users accepted relatively greater enrichment and less clarity. Under Minnesota's classification system, lakes in the NLF and NCHF ecoregions are considered to fully meet use support with TSIs of about 53 and 57, respectively. Lakes in the other two ecoregions, both of which are largely agricultural, are considered to fully support use with TSIs of about 60 (Heiskary, 2000). Adkins Pond lies in the Mid-Atlantic Coastal Plain (MACP) ecoregion, which extends from central New Jersey to northern Georgia. Topography is low and flat. Soils are sandy, the dominant land use is agricultural, and there are few natural lakes (none in Maryland). Impoundments tend to be shallow with large ratios of watershed area to lake surface area, resulting in a relatively high degree of nutrient loading. Thus, this type of morphometry favors

eutrophy. The MACP ecoregion is topographically and functionally similar to the two agricultural ecoregions Heiskary describes in Minnesota.

Adkins Pond is used as a recreational warm-water fishery. Moderate degrees of eutrophication are compatible with sustenance and enhancement of such warm-water fisheries. An appropriate management goal, therefore, is to enhance or maintain support of the Adkins Pond fishery. An endpoint for maintaining the productive fishery while avoiding nuisance algal blooms is a maximum permissible Chl-*a* level of 20 µg/L. This endpoint is in the lower range of eutrophy and is therefore an appropriate trophic state at which to manage the pond.

The constituents discussed above are related by means of two accepted empirical methods known as the Vollenweider Relationship and Carlson's Trophic State Index (TSI). R.A. Vollenweider developed the relationship by assessing a large number of lakes[1]. He established a linear relationship between the log of phosphorus loading and the log of the ratio of the lake's mean depth to hydraulic residence time. Carlson's TSI is a frequently used, biomass-related index. The TSI considers Secchi depth, chlorophyll-*a*, and total phosphorus, with each providing an independent measure of trophic state. Index values range from 0 (ultraoligotrophic) to 100 (hypereutrophic). The following classification can be used to interpret the TSI:

1) TSI <35 Most oligotrophic lakes
2) 35<TSI<55 Mesotrophic lakes
3) TSI > 55 Eutrophic lakes
4) TSI > 70 Hypereutrophic lakes

The Chl-'a" endpoint of 20 µg/L corresponds to a TSI of 60.

Since phosphorus binds to sediments, reducing the phosphorus loads will result in lower sediment loads as well. MDE believes that these reductions will be sufficient to prevent violations of the State's narrative criteria.

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

Total Allowable Load

As mentioned above, the endpoint used is a maximum Chl-'a" of 20 µg/L, since a relationship exists between the level of Chl-"a" concentration, phosphorus loading, and excessive sedimentation.

MDE determined that the limiting nutrient is phosphorus. Therefore, a TMDL for nitrogen was not necessary. Separate TMDLs have been calculated for both phosphorus and sediment. The allocations are presented as yearly loads. Expressing TMDLs as yearly loads is consistent with Federal regulations at 40 CFR 130.2(i), which state that TMDLs can be expressed in terms

[1] Vollenweider, R.A. "Scientific Fundamentals of the Eutrophication of Lakes and Flowing Waters, with Particular Reference to Nitrogen and Phosphorus as Factors in Eutrophication." Technical Report to OECD, Paris, France. 1968.

of either mass per time, toxicity, or other appropriate measure.

USEPA regulations at 40 CFR 130.2.(i) state that the total allowable load shall be the sum of individual waste load allocations for point sources, and load allocations for nonpoint sources, and natural background concentrations. The TMDLs for phosphorus and sediment for Adkins Pond are consistent with 40 CFR 130.2 (i) because the total loads provided by MDE equal the sum of the individual wasteload allocations for point sources and the land-based load allocations for nonpoint sources set forth in the Technical Memorandum provided with the TMDL document. Pursuant to 40 CFR 130.6 and 130.7(d)(2), these TMDLs and the Technical Memorandum and supporting documentation, should be incorporated into Maryland's current water quality management plan. See Table 1 for a summary of the allowable loads.

Waste Load Allocations

The watershed that drains to Adkins Pond contains no permitted surface water discharges. Therefore, the wasteload allocation was set to zero.

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 load allocation for the low-flow and average-flow TMDLs. These gross load allocations were presented in Table 1. Nonpoint source loading rates represent a cumulative impact from all sources, including naturally occurring and human-induced sources.

According to Federal regulations at 40 CFR 130.2(g), 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. 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.

As noted above, Maryland did not provide a breakdown of the load allocation in the TMDL report; however, such a breakdown for average annual flow was provided in the Technical Memorandum. The TMDLs are based on phosphorus loading from the two land uses/sources within the watershed. According to the Technical Memorandum, the specific load allocations for the TMDLs during average flow are presented in Tables 3 and 4.

Table 3 - Summary of Load Allocations for Phosphorus (average flow)

Land Use Category	% Land Use	Watershed Area (acres)	% Nonpoint source current load	Nonpoint source current load (lbs/yr)	% nonpoint source TMDL load	Nonpoint source TMDL load (lbs/yr)	% reduction needed
Mixed Agriculture	54	7,465	98.7	9,704	98.7	2,225	77
Forest/other Herbaceous	46	6,359	1.3	127	1.3	29	77
Total	100	13,824	100	9,831	100	2,254	-----

Table 4 - Summary of Load Allocations for Sediments (average flow)

Land Use Category	% Land Use	Watershed Area (acres)	% Nonpoint source current load	Nonpoint source current load (m^3/yr)	% nonpoint source TMDL load	Nonpoint source TMDL load (m^3/yr)	% reduction needed
Mixed Agriculture	54	7,465	98.7	943	98.7	579	38.5
Forest/other Herbaceous	46	6,359	1.3	12	1.3	8	38.5
Total	100	13,824	100	955	100	587	-----

Allocations Scenarios

USEPA realizes that the above breakouts of the total loads for phosphorus and sediments to the and nonpoint sources is one allocation scenario. As implementation of the established TMDLs proceed, Maryland may find that other combinations of allocations are more feasible and/or cost effective. However, any subsequent changes in the TMDLs 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 wasteload allocation for the discharge prepared by the state and approved by USEPA. USEPA has authority to object to the issuance of an NPDES permit that is inconsistent with wasteload allocations established for that point source. To ensure consistency with these TMDLs, if an NPDES permit is issued for a point source that would discharge the pollutants of concern in the Adkins Pond watershed, any deviation from the wasteload allocations set forth in the Technical Memorandum, TMDL report, and described herein for a 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 any 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, USEPA 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, USEPA has determined that the TMDLs and the Technical Memorandum are consistent with the regulations and requirements of 40 CFR Section 130. Pursuant to 40 CFR 130.6 and 130.7(d)(2), these TMDLs and the supporting documentation, including the Technical Memorandum, should be incorporated into Maryland's current water quality management plan.

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

Adkins Pond's background environment is known to have been impaired by deposition of sediment over time. The contributions of background pollutants have been incorporated in the TMDLs through the baseline developed MDE's 1993 sampling data.

In terms of the 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.

USEPA 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 defined as those that violate applicable water quality criteria— in this case, criteria for Chl-"a" and DO concentrations. The TMDLs address the critical values for

these Chl-"a" and DO, which are 20 µg/L and 5.0 mg/L, respectively. The TSI ranking of 60 can also be used as a critical value.

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[2].

The TMDLs appropriately consider seasonal variations by estimating loading rates over the entire year. This approach captures the dryweather loading rates, which generally occur during the warmer months when algae production is most prevalent. This approach also captures the wet-weather loading rates, which contribute significant sediment-bound sources of phosphorus. The method used (the Vollenweider Relationship) specifically employs long-term loading estimates to avoid adopting a single transient loading pulse, which would yield erroneous results.

6) The TMDL includes a margin of safety.

The requirement for a margin of safety (MOS) is intended to add a level of conservatism to the modeling process in order to account for uncertainty. Based on USEPA 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 explicit MOS for phosphorus in accordance with the first approach. The load allocated to the MOS is computed as 10 percent of the total allowable load.

MDE has also incorporated conservative assumptions that effectively constitute an additional, implicit MOS. In calculating minimum DO concentrations, MDE assumed a water temperature of 30°C; the highest temperature observed during monitoring was 25.8°C.

In establishing an MOS for sediments, MDE has adopted an implicit approach by incorporating conservative assumptions. Because phosphorus binds to sediment, sediment will be controlled as a result of controlling phosphorus. The estimate of sediment reduction is based on the load allocation for phosphorus rather than the entire phosphorus TMDL, including the MOS. Thus, the explicit 10 percent MOS for phosphorus will result in an implicit MOS for sediment. Also, MDE conservatively assumed a sediment to phosphorus ratio of 0.5:1 rather than the standard 1:1 ratio (Chesapeake Bay Program).

7) There is reasonable assurance that the TMDLs can be met.

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[2] U.S. USEPA. 1997. Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2, Part 1, Sction 2.3.3. USEPA 823-B-97-002.

USEPA requires that there be a reasonable assurance that the TMDLs can be implemented. Wasteload allocations 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 wasteload allocation for the discharge prepared by the state and approved by USEPA. Furthermore, USEPA has authority to object to issuance of an NPDES permit that is inconsistent with wasteload allocations established for that point source.

Nonpoint source controls to achieve load allocations 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 nutrient reductions will depend heavily on implementation of agricultural best management practices (BMP). The TMDL document lists the following as BMPs: a Soil Conservation and Water Quality Plan, treatment of highly erodible land, conservation tillage, and Nutrient Management Plans. The sediment TMDL will also rely on a number of BMPs, both structural and nonstructural, can be implemented to significantly reduce sediment loads.

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 USEPA to determine whether these TMDLs have been implemented successfully.

8) The TMDL has been subject to public participation.

MDE provided an opportunity for public review of and comment on the phosphorus and sediment TMDLs for Adkins Pond. The public review and comment period extended from September 28, 2001 to October 29, 2001. Two sets of written comments were received by MDE. These comments and responses were provided with the TMDL document.

On October 4, 2001, EPA initiated informal consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service (NMFS) pursuant to Section 7(c) of the Endangered Species Act, regarding certain federal agency actions by EPA Region III regarding Maryland TMDLs. The Region forwarded a Biological Evaluation to the Services on February 8, 2002 regarding our proposed action on Maryland TMDLs. On February 27, 2002, EPA received concurrence from the U.S. Fish and Wildlife Services and on March 1, 2002 EPA received concurrence from the National Marine Fisheries Service that our action is not likely to adversely affect endangered species and their critical habitat.