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

Ms. Denise Ferguson Southard
Assistant Secretary
Maryland Department of the Environment
2500 Broening Highway Baltimore,
Maryland 21224

APR 24, 2002

Re: Centennial Lake
Total Maximum Daily Load (TMDL)

Dear Ms. Southard:

The U.S. Environmental Protection Agency (USEPA), Region III, is pleased to approve the Centennial Lake Total Maximum Daily Loads (TMDLs), submitted to the USEPA by the Maryland Department of Environment (MDE) by letter dated December 27, 2001 and received January 8, 2002. A revised report was received on February 2, 2002. The TMDLs were established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act. The TMDLs were established to address impairment of water quality as identified in Maryland's 1998 Section 303(d) list. Maryland identifies the impairment for this water quality-limited waterbody based on low dissolved oxygen levels and nuisance levels of algae. Centennial Lake is located in Howard County, Maryland.

In accordance with Federal regulations found at 40 CFR § 130.7, a TMDL must: 1) be designed to meet water quality standards; 2) include, as appropriate, both wasteload allocations (WLAs) from point sources and load allocations from non-point 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 any uncertainties in the relationship between pollutant loads and in-stream water quality; 7) include reasonable assurance that the TMDL can be met; and 8) be subject to public participation. The enclosure to this letter describes how the Centennial Lake TMDLs and supporting documentation satisfy each of these requirements. The supporting documentation provided with the TMDL report, specifically, the Technical Memorandum provides one allocation scenario with a zero wasteload for point sources and a load allocation for nonpoint sources. USEPA relied upon this information in reviewing and approving the TMDL submittals and in preparing USEPA's Decision Rationale. USEPA expects for future TMDLs that the Technical Memorandum will be included in any public notice of the TMDLs.

Following the approval of these TMDLs, MDE shall incorporate them into the state's Water Quality Management Plan pursuant to 40 CFR § 130.7(d)(2). Also, any new or revised National Pollution Discharge Elimination System (NPDES) permits with applicable effluent limits must be consistent with the TMDLs' WLA pursuant to 40 CFR § 122.44(d)(1)(vii)(B)(2). If a NPDES permit is issued with an effluent limitation that does not reflect the wasteload allocation 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 USEPA's Decision Rationale.

If you have any questions or concerns, please call me or have your staff contact Mr. Thomas Henry, the TMDL Program Manager, at (215) 814-5752.

Sincerely,

Jon M. Ca c a, Acting Director
Water Protection Division

Enclosure

cc: Mr. Jim George, MDE
Mr. Robin Grove, MDE

Decision Rationale

Total Maximum Daily Load of
Phosphorus and Sediments to Centennial Lake,
Little Patuxent River Watershed
Howard County, MD

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 Centennial Lake. The TMDLs were established to address impairments of water quality, caused by nutrients and sediments, as identified in Maryland's 1998 Section 303(d) lists. The Maryland Department of the Environment (MDE), submitted the *Total Maximum Daily Loads of Phosphorus and Sediment to Centennial Lake in Howard County, Maryland*, dated December 2001, to USEPA for final review on January 8, 2002. A revised TMDL was received on February 2, 2002. These TMDLs address one segment, Centennial Lake, 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 meet 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 Nonpoint Sources in the Centennial Lake Watershed* submitted by MDE, specifically allocates phosphorus and sediments to each of three 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 340 that 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 and sediments. There are no point sources in the watershed. Table 1 summarizes the TMDLs for Centennial Lake as determined by MDE.

Table 1 - Phosphorus and Sediment TMDLs Summary

Parameter	Rate	TMDL	WLA[2]	LA[3]	MOS[4]
Phosphorus	lbs/yr	664	0	598	66
	lbs/day[1]	1.8	0.0	1.6	0.2
Sediment	m^3/year	587	0	897	Implicit
	m^3/day[1]	2.5	0.0	2.5	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

II. Summary

In 1985, an impoundment named Centennial Lake[1] was created through the construction of an earthen dam on Little Patuxent River in Howard County, Maryland. Figure 1 shows the location of Centennial Lake in Maryland. The lake, which was created for flood control and recreational purposes, lies on Little Patuxent River, which is a tributary to the Patuxent River, and is part of the Little Patuxent River watershed (02-13-11-05). Inflow to the lake is through two tributaries. No information was provided regarding the phosphorus load originating from these two tributaries. MDE assumes direct deposition of watershed-derived phosphorus and sediments to the lake based on the land use/loading coefficient approach.

[1] Centennial Lake is owned by the Howard County Department of Public Works.

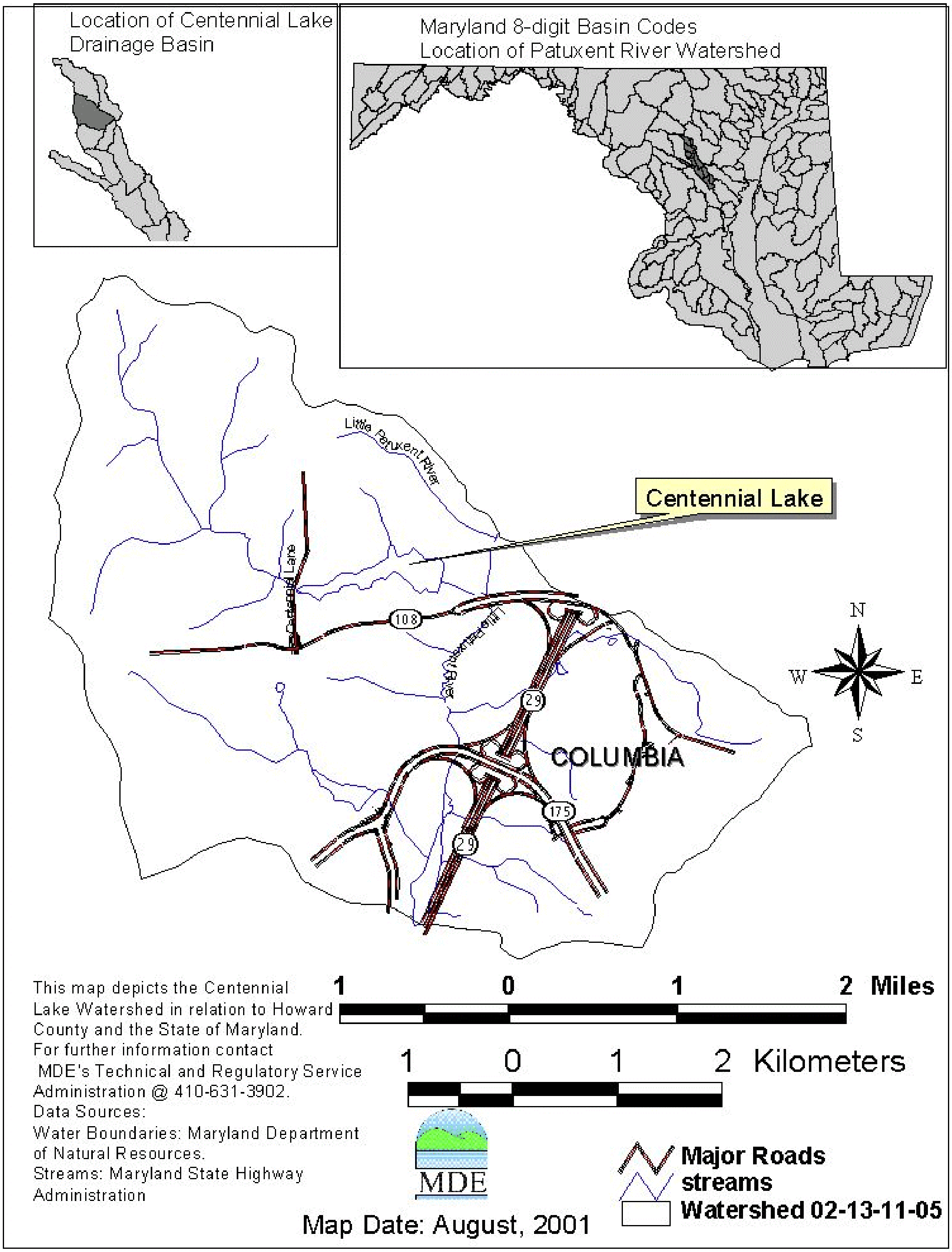

Figure 1 - Location of Centennial Lake

The dominant land use in the watershed is agricultural (39%), with developed (35%), forested/herbaceous (24%), and water (2%) comprising the remaining land use distribution.

As a result of the Maryland Lake Water Assessment Report (MLWAP) (MDDNR, 1998), Centennial Lake was included on the 1998 Clean Water Act (CWA) Section 303(d) list of water quality impaired waterbodies. The lake was classified as eutrophic due to trophic status indicators (high chlorophyll "a" and total phosphorus, and stratified water temperatures) and the observation of low dissolved oxygen concentrations in summer months in the hypolimnion (below the thermal stratification layer). Maryland believes that the death and decay of algae in the hypolimnion is the cause of the low dissolved oxygen levels experienced in Centennial Lake. Additionally, the thermal stratification of the lake prevents mixing of the hypolimnion with the epilimnion, which is currently attaining the dissolved oxygen water quality criterion that applies to surface waters (refer to footnote 5). The primary reason for listing this watershed was the water quality impairments as demonstrated by excessive sedimentation, seasonal algal blooms, excessive plant growth, foul odors and low dissolved oxygen concentrations (only in the hypolimnion) that caused violations of designated uses[2] of Centennial lake by disrupting the ecosystem balance. Nutrients and sediments resulting from nonpoint sources were listed as the causes and source of the water quality impairment, respectively. Centennial Lake was given low priority on the 1998 Section 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.

MDE developed TMDLs to address the excessive nutrient enrichment and sedimentation that Centennial Lake is currently experiencing. These TMDLs are designed to satisfy the water quality standards and designated uses of Centennial Lake only. Impairments in the remainder of the Little Patuxent River watershed and the Patuxent River watershed are not addressed by these TMDLs.

Maryland has interpreted its narrative water quality standards in order to determine appropriate endpoints for the TMDLs. The sediment TMDL is designed to restore the designated uses of Centennial Lake through the control of sediment delivery to the lake and will preserve 20-69% of the lake's original design volume over 100 years. In order to control nutrient enrichment in Centennial Lake to restore designated uses, a phosphorus TMDL was developed by MDE predicated on the identification of phosphorus as the limiting nutrient. The phosphorus TMDL is designed to control nuisance seasonal algae blooms, excessive plant growth, and foul odors. When phosphorus enters surface waters in substantial amounts it becomes a pollutant, contributing to the excessive growth of algae and other aquatic vegetation and, thus, to the accelerated eutrophication of lakes and reservoirs[3]. MDE determined that phosphorus is the limiting nutrient by dividing the total nitrogen by the total phosphorus concentrations in the

[2] The Code of Maryland Regulations (COMAR) at Section 26.08.02.07 list the designated uses of Centennial Lake as Use I- Water Contact Recreation and Protection of Aquatic Life.

[3] Soil and Water Quality, 1993, Committee on Long-Range Soil and Water Conservation, National Academy Press.

lake[4]. The phosphorus TMDL is also designed to control the growth and death/decay of algae in the lake that in turn will prevent decreased levels of dissolved oxygen in the hypolimnion. In addition, MDE links the control of phosphorus loading to the attainment of the dissolved oxygen water quality standard in the hypolimnion of Centennial Lake. Based on MDE's previous interpretation of the dissolved oxygen water quality criterion as it applies to surface waters[5] of lakes, MDE states that "*Although the numeric criterion is not applied to the bottom waters of lakes, the information provided by such data is assessed by water quality managers, in conjunction with other information, to ensure that the designated uses are being attained*". Centennial Lake is currently attaining the dissolved oxygen water quality criterion as it applies to surface-waters. Using this interpretation, MDE links the attainment of the hypolimnion dissolved oxygen water quality criterion to the phosphorus loading according to the TMDL through the use of a nomogram relating water temperature, hypolimnion dissolved oxygen saturation percentage, and dissolved oxygen concentration[6]. EPA believes that this endpoint is acceptable for assuring that the designated uses and water quality criteria of Centennial Lake will be restored. Table 1 below summarizes the phosphorus and sediment TMDLs.

III. Discussion of Regulatory Conditions

EPA finds that Maryland has provided sufficient information to meet all of the 8 basic requirements for establishing phosphorus and sediment TMDLs for Centennial Lake. EPA therefore approves the TMDLs, Technical Memorandum, and supporting documentation for phosphorus and sediments in Centennial Lake. Our approval is outlined according to the regulatory requirements listed below.

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

Maryland does not currently have numeric water quality standards for nutrients (phosphorus or nitrogen) or sediments. Therefore, Maryland utilized its General Water Quality Criteria[7], the Vollenweider Approach[8], and Carlson's Trophic State Index (TSI) to establish an endpoint for phosphorus and sediments such that the designated uses of Centennial Lake are restored. Utilizing land use specific phosphorus loading coefficients from the Chesapeake Bay Program model Phase 4.3 Segment 340, the current areal annual phosphorus load to Centennial

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[4] MDE estimated a total nitrogen to total phosphorus ratio of 19:1 based on the 1998 MLWAP data. In addition, MDE calculated a total dissolved nitrogen to total dissolved phosphorus ratio of 62:1.

[5] Maryland has provided an interpretation regarding how the dissolved oxygen water quality standard applies to lakes in a June 17, 1999 letter to Tom Henry, EPA from Robert Summers, MDE. The dissolved oxygen water quality criterion only applies to the well-mixed surface layers of the lake.

[6] Reid, George K., R.D. Wood, Ecology of Inland Waters and Estuaries, Second Edition, 1976, D. Van Nostrand Company.

[7] The Code of Maryland Regulations at Section 26.08.02.03B(5)(a).

[8] The Vollenweider Approach (1968, 1975) is a simple empirical model that uses a linear relationship between phosphorus loading and the ratio of the lake's mean depth to hydraulic residence time to establish the lake's eutrophication status.

Lake was calculated as 2.8-g/m^2 yr (1,230.2 lbs/yr total). This current phosphorus load and the ratio of the mean depth to hydraulic residence time of Centennial Lake were used to classify the lake as significantly eutrophic according to the Vollenweider Plots. The endpoint of the phosphorus TMDL was identified as the areal phosphorus loading which is consistent with achieving a TSI value of 60. This is consistent with a low to moderate level of eutrophy according to the Vollenweider plots. MDE believes that achieving this TSI will support the designated uses and general water quality criteria of Centennial Lake. Based on previous studies by Heiskary[9], a TSI of about 60 is considered fully supporting of recreationally based designated uses. Furthermore, MDE states that moderate degrees of eutrophication are compatible with sustenance and enhancement of warm water fisheries like Centennial Lake. The areal phosphorus loading must be reduced from the current loading of 2.8 g/m^2 yr to the TMDL value of 1.5 g/m^2 yr which represents a moderate level of eutrophy based on the lake's current characteristics and Maryland's interpretation of the eutrophic zone according to the Vollenweider plots. The following calculations demonstrate the relationship between the TSI value and the areal phosphorus loading:

$$TSI\ (TP) = 4.15 + 14.42 \ln [TP]$$

$$60 = 4.15 + 14.42 \ln [TP]$$

$$[TP] = 48\ \mu g/l$$

$$48\ \mu g/L = \frac{[X]\ x\ (retention\ time)\ x\ 10^6\ \mu g/g}{1\ m^2\ x\ 1\ m^2\ (depth)\ x\ 10^3\ l/m^3}$$

where [X] = the areal loading rate, the equation may be rearranged to yield X = 1.5 g/m2/yr

This areal load was then converted to 664 lbs/yr for consistency with the TMDL process. Implementation of the TMDL will result in a 46% reduction to current phosphorus loading into Centennial Lake.

Although nutrients, both nitrogen and phosphorus, are listed as the cause of impairment in Centennial Lake, a TMDL for phosphorus was developed to control algae blooms, excessive plant growth, and possible dissolved oxygen criteria violations in the hypolimnion because phosphorus is often the major nutrient in shortest supply and is frequently a prime determinant of the total biomass[10]. Phosphorus is also the most effectively controlled using existing engineering technology and land use management[11]. Schindler (1977) maintains that all freshwater lakes will

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[9] Heiskary, S. Proposal for listing lakes in the 303(d) List of Impaired Waters: Based on Nutrient Overenrichment. Minnesota Pollution Control Agency, Lakes and Streams Unit, Environmental Monitoring and Analysis Section, Environmental Outcomes Division. Draft Report, January 2000.

[10] Modeling Phosphorus Loading and Lake Response under Uncertainty: A manual and compilation of Export Coefficients, 1980, EPA 440/5-80-011.

[11] Id.

eventually be phosphorus limited because other nutrients have an atmospheric pathway in their biogeochemical cycles and are thus more subject to internal regulation, whereas phosphorus cycling is strictly geologic and this more sensitive to external factors[12].

Lake eutrophication is both a natural and culturally based phenomenon. Natural eutrophication is a slow, largely irreversible process associated with the gradual accumulation of organic matter and sediments in lake basins. Cultural eutrophication is an often rapid, possibly reversible process of nutrient enrichment and high biomass production stimulated by cultural activities causing nutrient transport to lakes[13]. Lakes are considered to undergo a process of "aging" which can be characterized by the trophic status as oligotrophic, mesotrophic, or eutrophic. Oligotrophic lakes are normally associated with deep lakes which have relatively high levels of dissolved oxygen throughout the year, bottom sediments typically contain small amounts of organic matter, chemical water quality is good, and aquatic populations are both productive and diverse. Mesotrophic lakes are characterized by intermediate levels of biological productivity and diversity, slightly reduced dissolved oxygen levels, and generally has adequate water quality to support designated uses. However, there is recognition that these lakes are naturally or culturally moving towards a eutrophic state. Lakes that are classified as eutrophic typically exhibit high levels of organic matter, both suspended in the water column and in the upper portions of sediments. Biological productivity is high , often indicated by seasonal algae blooms and excessive plant growth. Dissolved oxygen concentrations are low, and may reach extreme levels during critical periods. In addition, water quality is often poor resulting in violations of the designated uses[14]. Table 2 illustrates typical water quality variables of these three trophic designations.

Table 2 - Trophic-state classifications and typical variables

	Trophic State		
Variable	**Oligotrophic**	**Mesotrophic**	**Eutrophic**
Total Phosphorus (µg/L P)	< 10	10-20	> 20
Chlorophyll-a (µg/L Chl-a)	< 4	4-10	> 10
Secchi-disk depth (m)	> 4	2-4	< 2
Hypolimnion Oxygen Saturation (% saturation)	> 80	10-80	< 10

In a conceptual sense, the Vollenweider Approach attempts to provide a standard means of expressing nutrient input so that the supply to different lakes could be compared on a common basis in the hopes that this would lead to relationships between this standard measure of nutrient

[12] Schindler, D.W. 1977. Evolution of phosphorus limitation in lakes. Science 195:260-262.

[13] Supra, footnote 10.

[14] Technical Guidance Manual for Performing Water Load Allocations, Book IV, Lakes and Impoundments, Chapter 2, Nutrient/Eutrophication Impacts, EPA 440/14-84-019.

supply and the degree of eutrophication of the lakes[15]. In that regard, Vollenweider first attempted to plot the areal total phosphorus loading against mean depth on a log-log scale, in essence the volumetric loading. This simple empirical model worked well for lakes with phosphorus loading data available at that time. However, it was soon recognized that this model was an approximation at best and required further development. Vollenweider refined his model to incorporate the flushing rate of lakes by plotting the phosphorus loading against the mean depth divided by the mean residence time of water, which is equivalent to the height of water load that is supplied to the lake in one year. This refinement added significant accuracy for the prediction of trophic states of lakes. Dillion[16] comments that a plot of phosphorus loading against mean depth divided by mean residence time would have the same corrective result as a plot which included both the flushing rate and the phosphorus retention rate. The difference being that the latter plot would account for one more source of variation.

As previously mentioned, MDE links the attainment of a hypolimnion dissolved oxygen water quality criterion to the phosphorus loading according to the TMDL through the use of a nomogram relating water temperature, hypolimnion dissolved oxygen saturation percentage, and dissolved oxygen concentration.

MDE uses this nomogram to determine the expected hypolimnion dissolved oxygen concentrations based on the expected phosphorus load resulting from the TMDL. The nomogram is employed by using a straightedge to connect the observed water temperature and the expected dissolved oxygen saturation that corresponds to a meso-eutrophic status to determine the expected dissolved oxygen concentrations. According to the MLWAP data (MDDNR, 1998), the highest observed water temperature was 25°C. In order to determine the dissolved oxygen saturation expected with a meso-eutrophic status, MDE extrapolated the mesotrophic data on hypolimnion oxygen (% saturation) seen in Table 2 above. It appears that MDE simply divided the available range of saturation percentages (10-80%) by 3 in order to provide an appropriate scale that would now include the trophic states of meso-eutrophic and oligo-mesotrophic. The results of this extrapolation are seen in Table 3.

[15] The Application of the Phosphorus Loading Concept to Eutrophication Research, Vollenweider, R.A. and P.J Dillion, Canada Centre for Inland Waters, NRCC 13690, Environmental Secretariat, 1975.

[16] Id.

Table 3 - Extended Trophic State Classifications

Trophic Status	Hypolimnion Oxygen (% saturation)
Eutrophic	0 %
Meso-eutrophic	10%
Mesotrophic	33%
Oligo-mesotrophic	56%
Oligotrophic	80%

Continuing this exercise, Maryland connects the line originating from the observed water temperature of 25ºC and the expected oxygen saturation percentage of 10% to determine that this TMDL should result in an expected hypolimnion dissolved oxygen concentrations of 0.5 mg/l. This is considered the "worst-case" based on sample water temperature observations and expected TMDL phosphorus loads. Maryland also includes the lowest observed water temperature to provide a range of expected hypolimnion dissolved oxygen concentrations. Using a water temperature of 18°C and an expected 10% oxygen saturation value, the expected DO concentration in the hypolimnion is 0.7 mg/l.

The sediment TMDL endpoint was determined based on identifying an acceptable reservoir volume loss rate such that the designated uses of Centennial Lake are achieved and maintained. MDE determined that preserving 20-69% of the reservoir design volume over a period of 100 years supported this water quality objective. Sediment loading to Centennial Lake will be reduced 18.9% from a current rate of 1106.6 tons per year to 897.1 tons per year.

The rationale for an 18.9% decrease in sediment loading is based on sediment/phosphorus control relationships from the Chesapeake Bay Program watershed modeling assumptions. When considering agricultural Best Management Practices (BMPs), a 1 to 1 control ratio can be expected. However, due to variation in the type of BMPs to be used in Centennial Lake watershed, Maryland uses a 0.5 to 1 ratio, which means that for each unit of phosphorus controlled, only ½ of the sediment unit will be controlled. Additionally, this ratio is only applied to nonpoint source sediment loads from agricultural lands. Thus, BMPs that result in a 46% reduction in phosphorus loading will result in a 23% reduction in sediment loading from agricultural lands. Overall, the total sediment load is reduced by 18.9% based on a 23% reduction from agricultural lands.

MDE uses estimated volume-weight measurements to determine the loss of impoundment volume resulting from a sediment load of 897.1 tons per year. Using an environmentally conservative range of sediment volume-weights, MDE estimated an annual volume loss of 1.6 acre-feet to 4.1 acre-feet. Over 100 years, this translates into a range of volumetric preservation of 20%-69%. EPA believes that this endpoint is acceptable and meets water quality standards.

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

Wasteload Allocations

EPA regulations require that an approvable TMDL include individual WLAs for each point source. However, Maryland states that there are no point sources in the Centennial Lake watershed. Therefore, the WLA is set at 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. Those gross load allocations are contained in Table 1.

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, not to 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 was provided in the Technical Memorandum. The TMDL is based on sediment and phosphorus loading from the 3 land uses/sources within the watershed. According to the Technical Memorandum, the specific load allocations for the TMDL are as presented in Tables 4 and 5.

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

Land Use Category	% Land Use	% Nonpoint source current load	Nonpoint source current load (lbs/yr)	% nonpoint source TMDL load	Nonpoint source TMDL load (lbs/yr)	% reduction needed
Mixed Agriculture	39	66	814	66	394	52
Forest/other Herbaceous	24	1	12	1	6	50
Developed	35	33	404	33	197	51
Total	98	100	1,230	100	598	-----

Table 5 - Summary of Load Allocations for Sediment (average flow)

Land Use Category	% Land Use	% Nonpoint source current load	Nonpoint source current load (tons/yr)	% nonpoint source TMDL load	Nonpoint source TMDL load (tons/yr)	% reduction needed
Mixed Agriculture	39	82	911	66	738	19.0
Forest/other Herbaceous	24	3	35	1	29	18.2
Developed	35	14	160	33	130	18.9
Total	98	100	1,107	100	897	-----

Allocation Scenarios

EPA realizes that the above breakout of the total loads for sediment and 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 source 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 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, if NPDES permits are issued for any point source that discharges the pollutants of concern to Centennial Lake, any deviation from the WLAs set forth in the Technical Memoranda and described herein 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 Memoranda, and 3) describe that portion of the total allowable loading determined in the state's approved TMDL report that remains for any other point source (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 any future 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 Memoranda, 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 TMDLs and the Technical Memoranda for Sediment and Phosphorus for Centennial Lake 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 Memoranda, should be incorporated into Maryland's current water quality management plan.

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

As previously stated, MDE relies on the EPA Chesapeake Bay Program model Phase IV (segment 340) to determine the amount of phosphorus and sediment originating from land used in the Centennial Lake watershed. Natural background contributions as well as contributions from base flow are included within those loading coefficients.

4) The TMDLs consider critical environmental conditions.

EPA regulations at 40 CFR 130.7(c)(1) requires 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 Centennial Lake 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.[17] 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.

In terms of phosphorus, one critical condition occurs during precipitation events that increase the loading of phosphorus to the lake from overland flow. In general, phosphorus loss by leaching to groundwater is not a problem.[18] Furthermore, the majority of phosphorus lost

[17] 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.

[18] Check on this

from agricultural lands is through surface flow, both in solution (soluble phosphorus) and bound to eroded sediment particles (particulate)[19]. Another critical period specific to phosphorus occurs during times when the lake experiences warmer temperatures that encourage algae growth.

The Vollenweider Approach implicitly considers critical environmental conditions such as those described above. Sediment and phosphorus loads are given on a yearly basis and would effectively include precipitation events. The TMDLs also consider the critical water temperatures which may be experienced by this lake during the summer months through the use of temperature values in the dissolved oxygen calculations in the hypolimnion that cover the range of those experienced by the lake.

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[20]. Consistent with our discussion regarding critical conditions, the Vollenweider Approach 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 wasteload allocation, load allocation, or TMDL.

MDE utilizes an explicit process for determining the margin of safety for the phosphorus TMDL by allocating 10% of the total allowable load to the margin of safety. In addition, certain implicit margins of safety, such as assuming a higher temperature than observed for use in the minimum dissolved oxygen calculations, are included in the phosphorus TMDL margin of safety. Since the sediment reductions are based on the level of phosphorus reductions necessary to achieve the TMDL goals, the explicit 10% margin of safety for the phosphorus TMDL provides an implicit margin of safety for the sediment TMDL.

EPA believes that this combined explicit/implicit approach to account for margins of safety are acceptable in this situation.

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

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

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs, including Maryland's Lower Potomac Tributary Strategy, which was developed as part of Maryland's commitment under the Chesapeake bay Agreement. Other existing programs include EPA's Clean Water Action Plan and Maryland's Water Quality Improvement Act of 1998.

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.

8) The TMDLs have been subject to public participation.

The TMDLs of nitrogen and phosphorus to the Centennial Lake were open for public comment from November 13, 2001 through December 14, 2001. Only one set of written comments was received by MDE. This was provided along with MDE's response document with the TMDL report.

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.