



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029
4/9/2001**

Mr. James M. Seif, Secretary
Pennsylvania Department of Environmental Protection
Rachel Carson State Office Building
400 Market Street
Harrisburg, PA 17101

Re: The Lake Carey Total Maximum Daily Load (TMDL)

Dear Mr. Seif:

The U. S. Environmental Protection Agency (EPA) Region III, is pleased to approve the Lake Carey Total Maximum Daily Load (TMDL), submitted to EPA by the Pennsylvania Department of Environmental Protection (PADEP) by letter dated March 2, 2001. The TMDL was established and submitted in accordance with Section 303(d)(1)© and (2) of the Clean Water Act. The TMDL was established to address impairment of water quality as identified in Pennsylvania's 1996 Section 303(d) list. Pennsylvania identifies the impairment for this water quality limited waterbody based on excessive nutrients. Lake Carey is located in Wyoming County, Pennsylvania.

In accordance with Federal regulations found in 40 CFR '130.7, a TMDL must: be designed to meet water quality standards; include, as appropriate, both wasteload allocations (from point sources) and load allocations (from nonpoint sources); consider the impacts of background pollutant contributions; take critical stream conditions into account (the conditions when water quality is most likely to be violated); consider seasonal variations; include a margin of safety (which accounts for any uncertainties in the relationship between pollutant loads and instream water quality); and be subject to public participation. The enclosure to this letter describes how the Lake Carey TMDL satisfies each of these requirements.

Following the approval of this TMDL, PADEP shall incorporate it into the state's Water Quality Management Plan pursuant to 40 CFR '130.7(d)(2). As you know, any new or revised National Pollution Discharge Elimination System permits with applicable effluent limits must be consistent with the TMDL's Waste Load Allocation (WLA) pursuant to 40 CFR '122.44(d)(1)(VII)(B).

Any such permit should be submitted to EPA for review consistent with our letter dated October 1, 1998. Please note that PADEP determined there are currently no permitted point source dischargers in the Lake Carey TMDL watershed. If you have further questions, please call me or have your staff contact Mr. Thomas Henry, the TMDL Program Manager, at (215) 814-5752.

Sincerely,

/S/

Rebecca W. Hanmer, Director
Water Protection Division

Enclosure

cc: **Mr. Lawrence Tropea, Jr., PADEP**
Mr. Terry Fabian, PADEP
Mr. Fred Marrocco, PADEP
Mr. Edward Brezina, PADEP

**Decision Rationale
Total Maximum Daily Load
Phosphorus
Lake Carey
Wyoming County, Pennsylvania**

I. Introduction

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the Total Maximum Daily Load (TMDL) for nutrients for Lake Carey submitted by the Pennsylvania Department of Environmental Protection (PADEP) by letter dated March 2, 2001, and received by EPA on March 5, 2001. Our rationale is based on information provided¹ in the document which is used to determine if the TMDLs meets the following eight regulatory conditions as set forth in 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 includes a margin of safety.
- 7) The TMDLs has been subject to public participation.
- 8) There is reasonable assurance that the TMDLs can be met.

II. Background

Lake Carey is a natural lake located in Lemon and Tunkhannock Townships, Wyoming County, Pennsylvania. It is a valuable asset to the community providing a wide range of recreational activities including fishing, swimming and boating for area residents. Lake Carey has a surface area of approximately 230 acres; PADEP indicates its protected use is designated as a Trout Stocking Fishery (TSF) during the spring months and a Warm Water Fishery (WWF) for the remainder of the year, with secondary uses of recreation. The lake exhibits water quality problems in the form of excessive algae growth and blooms, limiting the recreational use of Lake Carey. The cause of this problem has been attributed to elevated levels of nutrients entering the lake.

Pursuant to Section 303(d) of the Clean Water Act (CWA), PADEP listed Lake Carey in 1996 as

¹ EPA considers supporting information which may be included in the submittal but not the TMDL document in determining our approval.

impaired due to excessive nutrients from agricultural sources. During the development of this TMDL, PADEP determined several additional sources of nutrient impairment. Section 303(d) and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the state where technology-based and other required controls did not provide for attainment of water quality standards. The TMDL submitted by PADEP is designed to determine the acceptable level of nutrient loading to the lake allowable to ensure that water quality standards and designated uses are maintained. EPA notes that this TMDL was developed specifically to restore the applicable designated use of recreation (swimming) to Lake Carey. PADEP determined that the lake is meeting its aquatic life uses.

PADEP has developed a TMDL for phosphorus². Table 1 below summarizes the elements of the TMDL for phosphorus that was developed for Lake Carey. 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. Tables 1 and 2 below summarize the elements of the TMDLs for phosphorus developed by PADEP.

Table 1. Summary of Phosphorus TMDL (lbs/year)

Parameter	TMDL	WLA ¹	LA	MOS
Phosphorus	860	0	774 ²	86 ³

¹ Pennsylvania DEP indicates that there are no point sources contributing to the pollutant loads in Lake Carey.

² The Load Allocation for Phosphorus is broken down into the Uncontrollable Load (UL), which is the load resulting from the forested land use minus in-lake biological processes, and the Controllable Load (CL), which is the result of anthropogenic impacts. The UL is 169.4 lbs/yr and the CL is 604.6 lbs/yr.

³ The explicit MOS is calculated as 10% of the target TMDL load.

Despite the fact that EPA believes that annual loads are appropriate for these TMDLs, for the sake of consistency we are breaking the annual loads down into daily loads. Table 2 below shows the loads in pounds per day.

Table 2. Breakdown of Annual TMDLs into Daily Loads (lbs/day)

Parameter	TMDL	WLA ¹	LA	MOS
Phosphorus	2.36	0	2.12 ²	.24 ³

¹ Pennsylvania DEP indicates that there are no point sources in the Lake Carey watershed.

² The Load Allocation for Phosphorus is broken down into the Uncontrollable Load (UL), which is the load resulting from the forested land use minus in-lake biological processes, and the Controllable Load (CL), which is the result of anthropogenic impacts. The UL is .46 lbs/day and the CL is 1.66 lbs/day³ the explicit MOS is calculated as 10% of the controllable load.

² Refer to Section III, Part I for discussion of phosphorus as the limiting nutrient.

The TMDL is a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically based strategy, which considers current and foreseeable conditions, the best available data, and accounts 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 anticipated by the margin of safety. The option is always available to refine the TMDL for re-submittal to EPA for approval. The Unassessed Waters Protocol, a method of conducting biological assessments of Pennsylvania’s waters, was developed in 1996 and began implementation in 1997. PADEPs goal is to achieve a comprehensive, statewide assessment of surface waters in Pennsylvania. Additionally, as part of an on-going lake monitoring program to support the Unassessed Waters Protocol, EPA has monitored over 75 lakes. After completion of the initial assessments, the long-range goal is to reassess all waters on a five-year cycle. Therefore, while the TMDL should not be modified at the expense of achieving water quality standards expeditiously, the TMDL may be modified when warranted.

III. Discussion of Regulatory Conditions

EPA finds that the TMDL for phosphorus for Lake Carey meets the regulatory requirements of the CWA. Our approval is outlined according to the regulatory requirements listed below.

1) The TMDLs are designed to implement the applicable water quality standards.

Pennsylvania and EPA do not currently have numeric water quality criteria for nutrients (nitrogen or phosphorus). Therefore, Pennsylvania utilized its general water quality criteria, which states “water may not contain substances attributable to point or non-point source waste discharges in concentrations or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant, or aquatic life”³. To determine the amount of nutrient reduction needed to restore full recreational use to Lake Carey, Pennsylvania utilizes Carlson’s Trophic Status Index (TSI) as an indicator of water quality to assess the current conditions and nutrient loadings. Although nutrients, both nitrogen and phosphorus, are listed as the cause of impairment in Lake Carey, a TMDL for phosphorus was developed to control excessive algal blooms and restore water quality. PADEP is identified phosphorus as the limiting nutrient in Lake Carey⁴. Phosphorus is often the major nutrient in shortest supply and is frequently a prime

³ Pennsylvania Code, Title 25., Environmental Protection, Chapter 93. Water Quality Standards, Section 93.6(a).

⁴ Lake Water Quality Assessment: Inventory of Lakes in the Susquehanna River Basin in Pennsylvania and Water Quality Characteristics of Eleven Publicly-Owned Lakes (Ballaron et al., 1996)

determinate of the total biomass⁵. Phosphorus is also the most effectively controlled using existing engineering technology and land use management⁶.

The applicable water quality standard level to protect the recreational use of Lake Carey is set by determining the allowable phosphorus load as indicated by TSI. PADEP chose a TSI of 50. This represents the boundary condition between mesotrophic and eutrophic, and is empirically linked to an average concentration for chlorophyll-a of 6.4 micrograms/liter. Concentrations at this level are shown not to have algae linked water quality implications. Chlorophyll-a is a conventional chemical method for estimating phytoplankton (including blue-green algae) biomass, and provides an indication of trophic state level. To determine the reductions needed to reach the desired in-lake phosphorus concentration and correlating TSI of 50, the LAKE for windows program was used. EPA believes that this application is reasonable given: 1) the goal of the TMDL to attain and maintain the recreational uses of the lake; 2) the current land uses within the watershed; and 3) the proposed levels of reduction to phosphorus loading. The overriding consideration of this TMDL should be the overall reduction of phosphorus by 67%.

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

A) Wasteload Allocations

Pennsylvania indicates there are no point sources in the Lake Carey watershed. Therefore the WLA is set at zero.

B) Load Allocations

In order to determine the existing phosphorus loading to Lake Carey, PADEP utilized a simple land use area/loading coefficient method. Loadings were computed based on land use type and accepted land use runoff coefficients based on Reckow (1983) and used for Phase One Clean Lakes Studies conducted by Coastal Environmental Services for PADEP on similar Lakes in Pennsylvania. The coefficients, when multiplied by the number of acres, produce loads for the selected land use.

The sum of these loads represents the existing total phosphorus loading to the lake. The total phosphorus loading was entered into the LAKE for Windows program, along with other

⁵ Modeling Phosphorus Loading and Lake Response under Uncertainty: A Manual and Compilation of Export Coefficients, 1980, EPA 440/5-80-011

⁶ I.d.

required lake data, to determine the existing TSI value and index. Based on current phosphorus loading, the TSI value of Lake Carey is 65.9, which indicates that the lake is currently hyper-eutrophic. In the case of Lake Carey, the phosphorus load allocation process was based on attaining the TMDL of 860 lbs/yr of phosphorus. The loads from forest lands (229.3) and in-lake (biological) processes (-59.9) are the 'uncontrollable' loads, and are subtracted from the TMDL load of 860 lbs/yr. In addition, 86 lbs/yr is also subtracted. This 10% of the total TMDL load is set-aside as a Margin of Safety (MOS) to account for any uncertainty in the analysis.

The determination of load allocation distribution is at the discretion of PADEP. This process is established on a site-specific basis and considers several factors regarding ability to affect the pollutant loading processes. Practical feasibility, in addition to technical aspects are taken into account. The large proportion of private residential properties in the vicinity of Lake Carey is an additional factor. Unlike private agricultural properties, which may qualify for loans or grant funding to implement structural management practices to control pollution, the control of runoff from private residential properties relies heavily on environmental education. Community awareness on the type of day-to-day activities that have long-term negative impacts on the lake is difficult to quantify, and therefore difficult to allocated to with a reasonable assurance that the allocation will be met. PADEP determined through field surveys done during the development of this TMDL and during conversations with Wyoming County Conservation District staff, that agricultural runoff is currently being reduced through the implementation of best management practices. In addition, the tributaries flowing through the agricultural lands and into the lake have recently been assessed by the Department and are attaining their water-quality standards/designated uses. This indicates that the contribution from agriculture is diminishing. The Department therefore determined the major sources of concern to Lake Carey are septic systems and internal loading. As discussed in the TMDL, septic systems are documented to contribute significant amounts of nutrients when located within 300 feet of a lake shore (U.S. EPA, 1980), and Lake Carey has a significant number of residences using septic systems located well within 300 feet of the shore. This determination is also consistent with a previous study conducted by the Department in 1991, which found a main source of phosphorus in the lake was coming from internal recycling. Internal loading was weighted the heaviest for reductions in the TMDL because it would be most easily dealt with through selective dredging.

A modified Equal Marginal Percent Reduction (EMPR)⁷ method was employed to distribute the remaining controllable load of 604.6 lbs/yr of phosphorus. This method equitably assigns the largest contributing source, the greater reduction requirements. As discussed above, PADEP made adjustments to the EMPR based on the practical feasibility of meeting the allocations. Table 3 below shows the load allocations of phosphorus in the Lake Carey watershed. The table shows the overall average reductions in phosphorus for each land use.

⁷ Pennsylvania Department of Environmental Protection. June 1986. Implementation Guidance for the Water Quality Analysis Model 6.3. Document 391-2000-007.

Table 3. Summary of Load Allocations for the Phosphorus TMDLs

Land Use	Sediment (lbs/yr)							
	Acres		Baseline Reduction	Baseline Load ^b	EMPR reduction ^c	Amended reduction	TMDL Load allocation ^d	% Reduction
Agriculture	1065	569.9	0	569.9	389.0	339.0	230.3	60%
Forested	1296	229.3	--	--	--	--	229.3	0
Residential	288	128.4	0	128.4	87	66.2	62.2	52%
Internal	--	697.3	92.7	604.6	412.7	521.5	83.1	88%
Septic systems	--	1020	415.4	604.6	412.7	375.6	229	77%
Lake surface ^e	230	-59.9	--	--	--	--	-59.9	0
Total	2879	2585	508.1	1907.5	1301.4	1302.9	774^d	67%

^aThe current load is based on information collected during the 1996 survey by Ballaron et.al

^bThe baseline value is utilized during the EMPR method to allow for equitable distribution of the controllable load. See the discussion concerning the EMPR method below.

^cEqual Marginal Percent Reduction (EMPR) is the method used to allocate the controllable load. See the discussion concerning the EMPR method below. The values in this column represents the portion of the controllable load allocated to that land use based on the EMPR method.

^dThe TMDL allocation is the TMDL load minus the margin of Safety.

^e This reduction accounts for ambient levels of in-lake biological processes

The EMPR method for phosphorus works in the following manner. Certain land use loadings are assumed to remain the same; these land uses often include forested, wetland, open water and waterfowl. These land uses remain constant due to a very limited ability to affect the phosphorus loading processes, or the fact that the land use acts as a sink for phosphorus. In the case of Lake Carey only the forested land use and the lake surface (open water) type is held constant. Each of the remaining “active land use” current loads (agriculture, residential -- overland runoff, and septic tank contributions) is compared with the remaining controllable load of 604.6 lbs/yr to determine if any contributor would exceed the load by itself. If the controllable load is exceeded, that contributor would be reduced to the controllable load of 604.6 lbs/yr. This is represented from Table 3 as the baseline load column. If the controllable load is not exceeded, the current load is carried over to the baseline portion. The baseline loads from the “active land uses” are summed to allow for calculation of the equal percent reduction. In Lake Carey, the controllable load of 604.6 lbs/yr is divided by the baseline load sum of 1907.5 lbs/yr, which results in an approximate reduction of 31% to the baseline load. This reduction is then multiplied by the baseline loading for each “active land use” to determine the portion of the controllable load distributed to that land use. In Table 3, this corresponds to the column labeled EMPR. EPA believes that the method of allocating the controllable load is acceptable.

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

An important component of determining a TMDL is considering the background pollutant contributions which may be present in a waterbody. The state has included natural background as a component of the load allocations, as required by 40 CFR §130.2(g). The existing non-point source load for phosphorus was established based on information determined during previous studies on Lake Carey through extensive monitoring of ambient water quality. The concentrations of the pollutants recorded, and the loadings determined based on land use represent both naturally-occurring and anthropogenic sources.

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 Lake Carey 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. 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. There are multiple critical conditions for lakes. In terms of loading, wet periods are critical because storm events transport significant quantities of non-point source load to lakes. However, because there is generally a significant lag time between the introduction of sediment and nutrients to a lake during wet weather events, and the resulting impact on the protected uses of the lake in the form of algae blooms in the drier summer months, establishing the TMDL using annual loads which take into account both storm loads and wet weather loads is protective. In order to effectively consider these critical times, PADEP used the loading coefficients derived on a yearly basis, which are indicative of loadings experienced over an entire year including any high-flow events.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as 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 snow melt and spring rains, while

seasonally low flow typically occurs during the warmer summer and early fall drought periods⁸ Consistent with the discussion regarding critical conditions, expressing the load allocations of an annual basis using field-derived or accepted loading coefficients will account for seasonal 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. The Margins of Safety may be implicit, built into the modeling process, or explicit, taken as a percentage of the waste load allocation, load allocation, or the TMDL. PADEP reserves 10% of the TMDL load as the margin of safety. This accounts for uncertainty in the data and computational methodology used in the analysis. PADEP calculates the MOS for phosphorus as 10% of the controllable load, or 86 lbs/yr. EPA finds this explicit MOS acceptable.

7) The TMDLs has been subject to public participation.

Pennsylvania published a notice of availability of the Lake Carey TMDL for public review and comment in the Pennsylvania Bulletin on December 16, 2000 (Volume 30, number 51). A notice was also published in the local paper, the Lancaster Intelligencer. The public comment period extended from December 16, 2000 to January 11, 2001. The TMDL was posted on PADEPs website, and public meetings were held on January 18, 2001 at 2:00 pm and 7:00 pm at the Pennsylvania Department of Agriculture Building in Tunkhannock. The TMDL was public noticed for 60 days, with written comments received by the Department from (1) the Lake Carey Cottagers' Association and (2) Ms. Joanne M. Fiorito. Responses from PADEP to those comments were provided in the TMDL submittal. EPA finds that PADEP conducted adequate public participation.

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

PADEP believes that the implementation of best management practices (BMPs) throughout the Lake Carey watershed will allow the TMDL to be achieved. PADEP has estimated that these BMPs range in efficiency from 20% to 70% for sediment reduction. Implementation of BMPs aimed at sediment reduction will also assist in the reduction of phosphorus due to the affinity of phosphorus to bind to sediment. The TMDL states that agricultural runoff in the watershed is already being reduced through management practices

⁸ Section 2.3.3 of the Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2, Part 1 (EPA 823-B-97-002, 1997).

promoted by the Wyoming County Conservation District. Substantial reductions in the amount of nutrients reaching the lake from residential areas can be made through the establishment of “No Mow” zones, the planting of riparian buffer zones, and community education on nutrient load contributions from septic tanks, and the application of lawn and garden fertilizers and pesticides.

The internal loading, caused by the regeneration of phosphorus from the bottom sediments into the water column, is expected to decrease with time as the external phosphorus loads are controlled. Watershed controls combined with selective internal controls are expected to reduce the internal loading contributions to Lake Carey over time

Field surveys should be performed to assess both the extent of existing BMPs, and to determine the most cost-effective and environmentally protective combination of BMPs required to meet the nutrient reductions.

Funding for the types of projects described above include Pennsylvania’s Growing Greener funding which has provided more than \$65 million dollars to environmental initiatives through out the Commonwealth. Additionally, annual funding from the section 319 grant, supported by the Unified Watershed Assessment and the Watershed Restoration Action Strategies, is designed to focus resources towards the implementation of Best Management Practices for non-point source pollutants. Pennsylvania has staffed watershed coordinators in each Regional office who are available to provide grant application assistance to stakeholders as well as technical assistance on the installation of management practices.