UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029
10/16/2003

Dr. Richard Eskin, Director
Technical and Regulatory Services Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 540
Baltimore, Maryland 21230-1718

Dear Mr. Eskin:

The Environmental Protection Agency (EPA) Region III is pleased to approve the Total Maximum Daily Load (TMDL) report for Biochemical Oxygen Demand (BOD), Nitrogen and Phosphorus for the Town Creek watershed located in Talbot County, Maryland. The TMDL report was submitted to EPA for final review on December 30, 2002. The TMDL was established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address impairments of water quality as identified in Maryland's Section 303(d) list. Town Creek is a part of the Lower Choptank River watershed and was first identified on Maryland's 1996 Section 303(d) list for nutrients, fecal coliform, and suspended sediments. The TMDLs described in this document were developed to address localized water quality impairments identified within the watershed, specifically BOD and nutrient stressors in Town Creek. The suspended sediment, nutrient and fecal coliform impairments within the other portions of the Lower Choptank River watershed will be addressed by Maryland in a separate document.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards, (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) for point sources and load allocations for nonpoint sources, (3) consider the impacts of background pollutant contributions, (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated), (5) consider seasonal variations, (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality), (7) consider reasonable assurance that the TMDL can be met, and (8) be subject to public participation. The enclosure to this letter describes how the BOD, nitrogen and phosphorus TMDLs for the Town Creek watershed satisfy each of these requirements.

Following the approval of this TMDL, Maryland shall incorporate the TMDL into the Water Quality Management Plan pursuant to 40 CFR § 130.7(d)(2). As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the

TMDL WLA pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please don't hesitate to contact Ms. Susan Sciarratta at (215) 814-5733.

Sincerely,

Signed

Jon M. Capacasa, Director
Water Protection Division

Enclosure

Decision Rationale

Total Maximum Daily Loads of Biochemical Oxygen Demand (BOD), Nitrogen and Phosphorus to Town Creek, Talbot 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 (EPA) rationale for approving the TMDLs for biochemical oxygen demand (BOD), nitrogen and phosphorus in Town Creek watershed. The TMDL was established to address impairments of water quality, caused by nutrients as identified in Maryland's 1996 Section 303(d) list. The Maryland Department of the Environment (MDE), submitted the *Total Maximum Daily Loads of Biochemical Oxygen Demand (BOD), Nitrogen and Phosphorus to Town Creek into which the Town of Oxford Wastewater Treatment Plant Discharges, Talbot County, Maryland*, dated December 2002, to EPA for final review on December 30, 2002. Town Creek is a part of the Lower Choptank River watershed (02-13-04-03) and was first identified on Maryland's 1996 Section 303(d) list for nutrients, fecal coliform, and suspended sediments. The TMDLs described in this document were developed to address localized water quality impairments identified within the watershed, specifically BOD and nutrient stressors in Town Creek. The suspended sediment, nutrient, and fecal coliform impairments within the other portions of the Lower Choptank River watershed will be addressed separately by MDE in a separate TMDL document.

EPA's rationale is based on the TMDL Report and information contained in the Appendix to the report. EPA'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 Town of Oxford Wastewater Treatment Plant (WWTP) is the only point source in the Town Creek watershed. 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. In the past, Maryland has included a Technical Memorandum breaking down the load allocation

to specific land uses. However, Maryland used site specific data for the load allocation which could not be broken down into specific land uses. Therefore, Maryland included a gross load allocation for the low flow and average annual flow TMDLs. These gross load allocations are presented in Tables 1 and 2 of this decision rationale. Nonpoint source loading rates represent a cumulative impact from all sources, including naturally occurring and human-induced sources.

Table 1- BOD, Nitrogen and Phosphorus TMDLs Summary for Low Flow, May 1 through October 31

Parameter	Rate	TMDL	WLA[1]	LA[2]	MOS[3]
BOD	lbs/month	921.1	780.6	9.9	130.6
Nitrogen	lbs/month	531.1	468.4	4.2	58.5
Phosphorus	lbs/month	59.3	52.0	0.5	6.8

[1] WLA = Waste Load Allocation
[2] LA = Load Allocation
[3] MOS = Margin of Safety

Table 2 - BOD, Nitrogen, and Phosphorous TMDLs Summary for Average Annual Flow, November 1 through April 30

Parameter	Rate	TMDL	WLA[1]	LA[2]	MOS[3]
BOD	lbs/year	11,279.8	9,367.2	334.6	1,578.0
Nitrogen	lbs/year	6,471.7	5,620.8	144.1	706.8
Phosphorus	lbs/year	722.7	624.0	16.3	82.4

[1] WLA = Waste Load Allocation
[2] LA = Load Allocation
[3] MOS = Margin of Safety

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.

Summary

From this point forward, some references in this approval rationale are found in the TMDL Report, *Total Maximum Daily Loads of Biochemical Oxygen Demand (BOD), Nitrogen and Phosphorus to Town Creek into which the Town of Oxford Wastewater Treatment Plant Discharges, Talbot County, Maryland*.

Town Creek's[1] headwaters originate in Oxford near the intersection of Maryland Route 333 with Morris Avenue. Town Creek is a tributary of the Tred Avon River that ultimately drains to

[1] Town Creek is located within Talbot County, Maryland and is part of the Lower Choptank River watershed. It is contained within sub-basin 02-13-04-03.

the Choptank River. The creek is approximately 1.2 miles (1.9 km) in length. Town Creek watershed has an area of approximately 597 acres (0.93 sq. miles). Figure 1 of the TMDL Report shows the location of Town Creek. Figures 2 and 3 of the TMDL Report show the land uses in the Town Creek watershed. The land uses in the watershed consist of open water (143 acres or 24%), urban (131 acres or 22 %), and mixed agriculture (322 acres or 54 %).[2] In the Town Creek watershed, the baseline average annual total nitrogen load is 11,465 lbs/year, and the estimated average annual phosphorus load is 1,274 lbs/year.

The pollutants of concern for the Town Creek TMDLs are the amount of BOD and nutrients entering the system that results in the low dissolved oxygen and high chlorophyll-*a* concentrations immediately below the Town of Oxford WWTP discharge point. The facility is permitted through the National Pollution Discharge Elimination System (NPDES) to discharge a maximum flow of 0.208 million gallons per day (mgd) treated domestic wastewater into Town Creek, with effluent quality limits of 30 milligrams per liter (mg/L) BOD_5, 2.0 mg/L total phosphorus, assumed 18 mg/L total nitrogen and 5.0 mg/L dissolved oxygen (DO).

In response to the requirements of Section 303(d) of the CWA, MDE listed Town Creek, as part of the Lower Choptank River Watershed on the 1996 Section 303(d) list of impaired waterbodies. It was listed as being impaired by nutrients due to signs of eutrophication, expressed as high chlorophyll-*a* concentrations. Eutrophication is the over-enrichment of aquatic systems by excessive inputs of nutrients (nitrogen and phosphorus). The nutrients act like fertilizer leading to excessive growth of aquatic plants, which eventually die and decompose, leading to bacterial consumption of DO and DO concentrations below what is necessary to support the designated use.

MDE developed these TMDLs to address the excessive nutrient enrichment that Town Creek is currently experiencing. These TMDLs are designed to satisfy the water quality standards and designated uses of Town Creek for nutrients. Impairments due to fecal coliform and suspended sediments are not addressed by these TMDLs.

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

[2] This information is based on the 1997 Maryland Office of Planning land cover data.

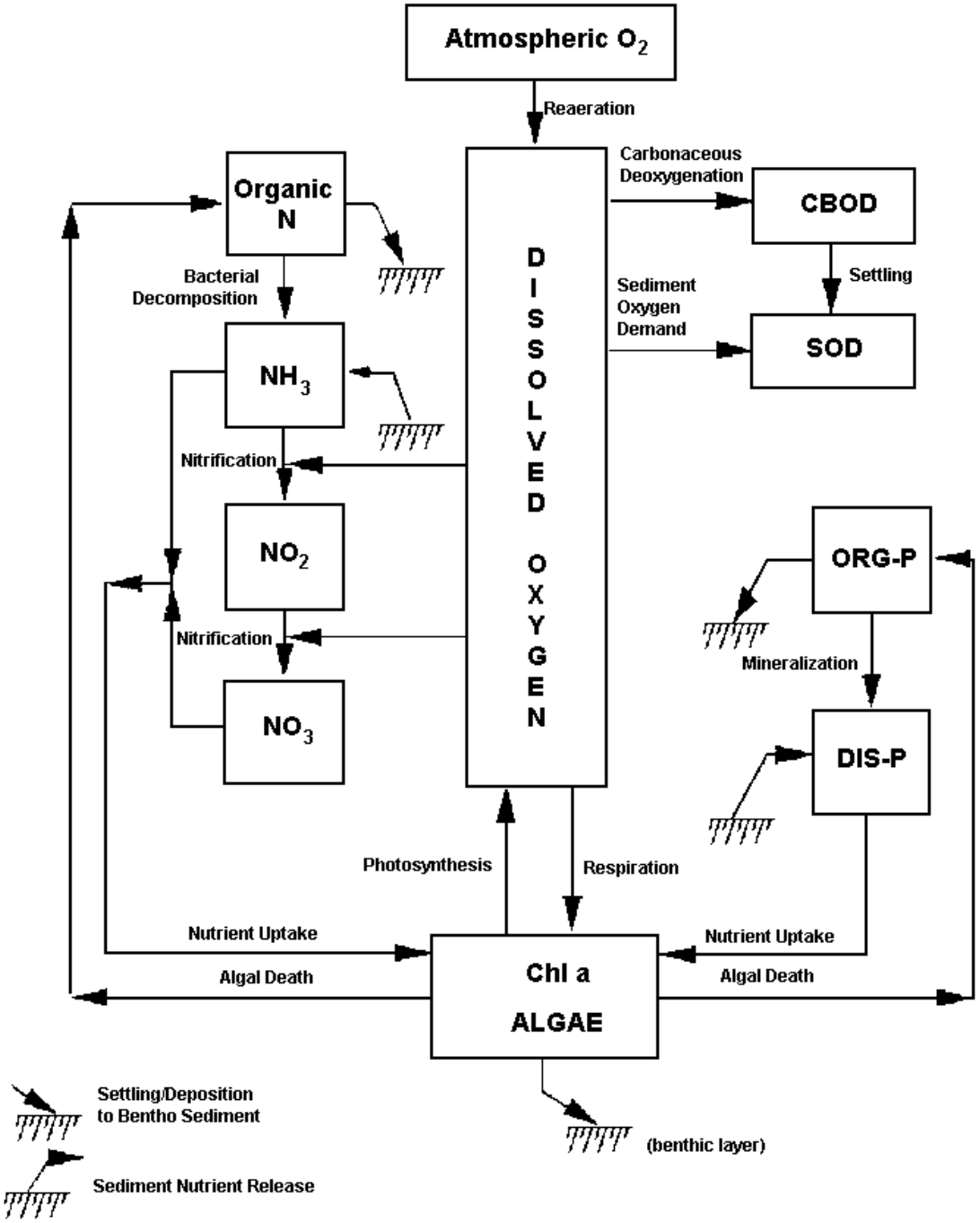

Figure 1 - Illustration of the interrelationship of major kinetic processes for BOD, DO, and nutrient analysis

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

an average daily and instantaneous basis[3]. In addition, excessive nutrients lead to an overabundance of aquatic plant growth.

MDE uses the Water Quality Analysis Simulation Program version 5.1 (WASP5.1)[4] model to evaluate the link between nutrient loadings, algal growth, and DO. This water quality simulation program provides a generalized framework for modeling contaminant fate and transport in surface waters and is based on the finite-segment approach (Di Toro *et al.,* 1983). WASP5.1 is supported and distributed by U.S. EPA's Center for Exposure Assessment Modeling (CEAM) in Athens, Georgia (Ambrose *et al.,* 1993).

The model analysis is based on representing current conditions within Town Creek and determining the necessary reductions in nutrient loadings from various sources to achieve and maintain water quality standards. WASP5.1 is a general-purpose modeling system for assessing the fate and transport of conventional and toxic pollutants in surface waterbodies (Ambrose, 1987)[5]. The model can be applied in one, two, or three dimensions and includes two sub-models (EUTRO5 and TOXI5) to investigate water quality/eutrophication and toxic impairments. EUTRO5 can simulate the transport and transformation of eight state variables including DO, carbonaceous BOD, phytoplankton carbon and chlorophyll-*a*, ammonia, nitrate, organic nitrogen, organic phosphorus, and orthophosphate.

The WASP5.1 model was implemented in a steady-state mode. This mode of using WASP5.1 simulates constant flow, and average water body volume over the tidal cycle. The tidal mixing is accounted for using dispersion coefficients, which quantify the exchange of conservative substances between WASP5.1 model segments. The model simulates an equilibrium state of the water body, which in this case, considered low flow and average annual flow conditions, described in more detail below.

WASP5.1 has been previously applied in a number of regulatory and water quality management applications and is an appropriate linkage evaluation tool for Town Creek. Based on this analysis, MDE has determined that the levels of nutrient input to Town Creek specified by the TMDLs will ensure that water quality standards are achieved by controlling algae blooms and maintaining the DO water quality criterion. See Tables 1 and 2 of this decision rationale for a summary of the allowable loads.

The spatial domain of Town Creek model extends from the Town of Oxford WWTP discharge point for about 1.2 miles to the confluence of Town Creek with Tred Avon River. Fourteen WASP5.1 model segments represent this modeling domain. Concentrations of relevant water quality parameters, observed in 1998, serve as the model's upstream and downstream boundaries.

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

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

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

A diagram of the WASP5.1 model segmentation is presented in Figure 9 of the TMDL report.

III. Discussion of Regulatory Conditions

EPA finds that Maryland has provided sufficient information to meet all of the eight basic requirements for establishing nitrogen, phosphorus, TMDL for Town Creek. EPA therefore approves the TMDLs, and supporting documentation for BOD, nitrogen and phosphorus in Town Creek. EPA's approval is outlined according to the regulatory requirements listed below.

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

MDE has indicated that algal blooms due to excessive nutrient input have caused violations of the water quality standards and designated uses applicable to Town Creek. The designated use of Town Creek is Use II - Shellfish harvesting waters. The DO water quality criterion to support this use indicates that DO concentrations may not be less than 5.0 mg/L at any time. While Maryland does not have numeric water quality criteria for nitrogen and phosphorus, Maryland interprets its General Water Quality Criteria to provide numerical objectives for nitrogen and phosphorus which will support the DO water quality criterion as well as a surrogate indicator (chlorophyll-*a*)[6] to determine acceptable algae levels in Town Creek. Chlorophyll-*a* is desirable as an indicator because algae are either the direct (e.g., nuisance algal blooms) or indirect (e.g., high/low DO and pH and high turbidity) cause of most problems related to excessive nutrient enrichment[7]. The WASP5.1 model used by Maryland will help to determine those nutrient levels and compliance with the DO criterion and chlorophyll-*a* levels.

The presence of aquatic plants in a waterbody can have a profound effect on the DO resources and the variability of the DO throughout a day or from day to day[8]. This is due to the photosynthetic and respiration processes of aquatic plants which can cause large diurnal variations in DO that are harmful to fish. Photosynthesis is the process by which plants utilize solar energy to convert simple inorganic nutrients into more complex organic molecules[9].

Due to the need for solar energy, photosynthesis only occurs during daylight hours and is represented by the following simplified equation (proceeds from left to right):

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

In this reaction, photosynthesis is the conversion of carbon dioxide and water into sugar and

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

[7] Supra, footnote 3

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

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

oxygen such that there is a net gain of DO in the waterbody. Conversely, respiration and decomposition operate the process in reverse and convert sugar and oxygen into carbon dioxide and water resulting in a net loss of DO in the waterbody. Respiration and decomposition occur at all times and are not dependent on solar energy. Waterbodies exhibiting typical diurnal variations of DO experience the daily maximum in mid-afternoon during which photosynthesis is the dominant mechanism and the daily minimum in the predawn hours during which respiration and decomposition have the greatest effect on DO and photosynthesis is not occurring. In order to ensure that the minimum DO concentration of 5 mg/L is met at all times, MDE calculates both the daily average DO concentrations and the minimum diurnal DO concentrations as a result of photosynthesis and respiration of phytoplankton using the WASP5.1 model.

In addition to the negative effects on DO, an overabundance of aquatic plant growth adversely impacts the aesthetic and recreational uses of a waterbody by decreasing water clarity and forming unsightly floating algae blooms which also hinder navigation. MDE utilizes chlorophyll-*a*, a surrogate indicator for algal biomass[10], to evaluate the link between nutrient loadings and aquatic plant levels necessary to support the designated uses of Town Creek. Again, using their General Water Quality Criteria, MDE establishes a numeric chlorophyll-*a* goal of 50 µg/L. This level is based on the goals/strategies recommended by the Algal Bloom Expert Panel to prevent the occurrence of algal blooms similar to those experienced in the Potomac Estuary in 1983[11]. Specifically, the panel believed that nuisance conditions from algal blooms occurred when chlorophyll-*a* concentrations exceeded 100 µg/l. Similar to the nutrient-DO evaluation, MDE uses the WASP5.1 model to determine acceptable levels of loadings of nutrients to achieve a maximum chlorophyll-*a* concentration of 50 µg/l.

EPA finds that the TMDLs for BOD, nitrogen and phosphorus will ensure that the designated use and water quality criteria for Town Creek are met and maintained.

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

Total Allowable Loads

The critical season for excessive algal growth in Town Creek has been identified by Maryland as the summer months. During these months, flow in the channel is reduced resulting in slower moving, warmer water which has less dilution potential and is susceptible to algal blooms and low DO concentrations. In order to control the algal activity and its impacts on water quality, particularly with respect to DO levels, Maryland has established individual TMDLs for BOD, nitrogen and phosphorus that are applicable from May 1 through October 31. Maryland presented these as monthly loads to be

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

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

consistent with the monthly concentration limits that are required by NPDES permits. Expressing the TMDLs as monthly loads is consistent with federal regulations at 40 CFR 130.2(i), which state that TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure.

The average annual TMDLs are being established to protect water quality in Town Creek since loading limits on average annual loads contribute to water quality problems observed in the low flow critical season. The average annual TMDLs were presented by Maryland as yearly loads.

The EPA's regulations at 40 CFR 130.2(i), also define "total maximum daily load (TMDL)" as the "sum of individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background." As the total loads provided by Maryland equal the sum of the individual wasteload allocations for point sources and the land-based load allocations for nonpoint sources set forth below, the TMDLs for BOD, nitrogen and phosphorus for Town Creek are consistent with Section 130.2(i). Pursuant to 40 CFR 130.6 and 130.7(d)(2), these TMDLs and supporting documentation, should be incorporated into Maryland's current water quality management plan. See Tables 1 and 2 of this decision rationale for a summary of the allowable loads.

Waste Load Allocation

EPA regulations require that an approved TMDL include individual waste load allocations for each point source. The Town of Oxford WWTP is the only point source in the Town Creek watershed. The facility is permitted through NPDES to discharge a maximum flow of 0.208 mgd treated domestic wastewater into Town Creek, with effluent quality limits of 30 mg/L BOD_5, 2.0 mg/L total phosphorus, assumed 18 mg/L total nitrogen and 5.0 mg/L DO. Point source baseline loads were based on the current WWTP maximum permitted loads.

Low flow and average annual flow wasteload allocations are summarized in Tables 1 and 2 of this decision rationale. These point source load allocations of BOD, nitrogen and phosphorus represent 50% point source reductions from the baseline scenario. In order to meet the required waste load allocations, the Town of Oxford WWTP will be required to raise the WWTP effluent minimum DO from 5.0 to 6.0 mg/L in its NPDES permit.

Load Allocation

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 annual flow TMDLs. These gross load allocations were presented in Tables 1 and 2 of this decision rationale. 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. In previous nutrient TMDLs, Maryland used loading coefficients from the Chesapeake Bay Program watershed model. However, in these TMDLs, MDE used

observed site data.

MDE's estimate of annual loads is the best estimate available that is based on observed data from the summer of 1998. MDE's estimate is further supported by the results of water quality modeling, which indicated that loads higher than what was estimated on the basis of observed data would result in unrealistically elevated nutrients and algal levels in the creek. Therefore, MDE's estimate of nonpoint source loads is considered reasonable. The analysis used to estimate the maximum allowable load to the water body (TMDL) does not depend on the baseline estimate of NPS loads. Thus, any uncertainty in the baseline NPS estimation does not affect the certainty of the estimated TMDL.

As noted above, a breakdown by land use was not determined for nonpoint source loads during low and average annual flows. These nonpoint source loads, which were based on nonpoint source background concentrations observed in the summer of 1998, account for "natural" and human-induced components. Low flow and average annual flow load allocations are summarized in Tables 1 and 2 of this decision rationale. Load allocations for average annual flow were based on observed summer 1998 data and computed average annual flow. These nonpoint source load allocations of BOD, nitrogen and phosphorus represent 35% nonpoint source reductions from the baseline scenario based on observed summer 1998 nonpoint source background concentrations.

The TMDL report states 50% point source and 35% nonpoint source reductions from the baseline scenario for low flow and average annual flow loads.

Allocations Scenarios

Six scenarios were utilized by MDE to determine the best allocation scenario for Town Creek. Sections 4.3 and 4.4 of the TMDL report describe these scenarios in detail. Scenario 4 was chosen for low flow allocations while Scenario 5 was used for average annual flow allocations. EPA realizes that the total loads for BOD, nitrogen and phosphorus, shown in Tables 1 and 2 of this decision rationale, is one allocation scenario for low flow and average annual flow conditions. As implementation of the established TMDLs proceed or more detailed information becomes available, Maryland may be able to break out the loads into land uses and find other combinations of land use allocations that are feasible and/or cost effective. Any subsequent changes, however, 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.

The current TMDLs present that there is only one point source in Town Creek. 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 EPA. EPA 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, as NPDES permits are issued for the point sources that discharge the pollutants of concern to Town Creek, any deviation from the wasteload allocations set forth in the TMDL report, and described herein for the particular point

source must be documented in the permit Fact Sheet and made available for public review along with the proposed draft permit and the Notice of Tentative Decision. The documentation should; 1) demonstrate that the loading change is consistent with the goals of the TMDL and will implement the applicable water quality standards, 2) demonstrate that the changes embrace the assumptions and methodology of these TMDLs and Technical Memorandum, and 3) describe that portion of the total allowable loading determined in the State's approved TMDL report that remains for other point sources (and future growth where included in the original TMDL) not yet issued a permit under the TMDL. It is also expected that Maryland will provide this Fact Sheet, for review and comment, to each point source included in the TMDL analysis as well as any local and State agency with jurisdiction over land uses for which load allocation changes may be impacted.

In addition, EPA regulations and program guidance provides for effluent trading. Federal regulations at 40 CFR 130.2 (I) state: "If Best Management Practices (BMPs) or other nonpoint source pollution controls make more stringent load allocations practicable, then wasteload allocations may be made less stringent. Thus, the TMDL process provides for nonpoint source control tradeoffs." The State may trade between point sources and nonpoint sources identified in this TMDL as long as three general conditions are met; 1) the total allowable load to the waterbody is not exceeded, 2) the trading of loads from one source to another continues to properly implement the applicable water quality standards and embraces the assumptions and methodology of these TMDLs and Technical Memorandum, and 3) the trading results in enforceable controls for each source. Final control plans and loads should be identified in publicly available planning document, such as the State's water quality management plan (see 40 CFR 130.6 and 130.7(d)(2). These final plans must be consistent with the goals of the approved TMDLs.

Based on the foregoing, EPA has determined that the Town Creek TMDLs for BOD, nitrogen and phosphorus 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, should be incorporated into Maryland's current water quality management plan.

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

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

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 stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Town Creek is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be

undertaken to meet water quality standards. 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.

The nutrient TMDL analysis consists of two broad elements, an assessment of low flow loading conditions, and an assessment of annual average loading. The low flow TMDL analysis investigates the critical conditions under which symptoms of eutrophication are typically most acute, that is, in late summer when flows are low, leading to poor flushing of the system, and when sunlight and temperatures are most conducive to excessive algal production.

The water quality model was calibrated to reproduce observed water quality characteristics for observed low flow conditions. Calibration of the model for the low flow regime establishes an analysis tool that may be used to assess a range of scenarios with differing flow, BOD, and nutrient loading conditions. Observed water quality data collected during 1998 was used to support the calibration process, as explained further in Appendix A of the TMDL report.

5) The TMDLs consider seasonal environmental variations.

Seasonal variation 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 low flow typically occurs during warmer summer and early fall drought periods[12]. Consistent with EPA's discussion regarding critical conditions , the WASP5.1 model and TMDL analysis effectively considers seasonal environmental variations.

6) The TMDLs include a margin of safety.

A margin of safety (MOS) is required as part of a TMDL in recognition of many uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural water bodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection.

Based on EPA guidance, the MOS can be achieved through two approaches (EPA, April 1991). One approach is to reserve a portion of the loading capacity as a separate term in the TMDL. The second approach is to incorporate the MOS as conservative assumptions used in the TMDL analysis.

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[12]Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2, Part 1, Section 2.33, (EPA 823-B-97-002, 1997)

Maryland has adopted margins of safety that combine these two approaches. Following the first approach, the MOS at the Oxford WWTP was calculated at 25% of the difference between the weekly and monthly effluent permit limits for BOD, nitrogen and phosphorus for the low flow TMDLs. Similarly, a 25% MOS was included in computing the average annual TMDLs. The nonpoint source MOS was computed as 5% of the nonpoint source loads for BOD, nitrogen and phosphorus for the low flow and average annual flow TMDLs. These explicit BOD, nitrogen, and phosphorus margins of safety are summarized in Tables 3 and 4, below.

Table 3 - Low Flow Margins of Safety (MOS)

Parameter	Rate	Point Source MOS	Nonpoint Source MOS	Total MOS
BOD	lbs/month	130.1	0.5	130.6
Nitrogen	lbs/month	58.3	0.2	58.5
Phosphorus	lbs/month	6.8	0.02	6.8

Table 4 - Average Annual Flow Margins of Safety (MOS)

Parameter	Rate	Point Source MOS	Nonpoint Source MOS	MOS
BOD	lbs/year	1,561.2	16.8	1,578.0
Nitrogen	lbs/year	699.6	7.2	706.8
Phosphorus	lbs/year	81.6	0.8	82.4

In addition to these explicit set-aside MOS, additional safety factors are built into the TMDL development process. The low flow analysis sets a goal of 50 µg/l for chlorophyll-*a*, which MDE believes is conservative given the generally acceptable range of chlorophyll-*a* values for waters meeting their water quality standards of 50 - 100 µg/l.

In the average annual flow analysis, conservative assumptions are used and result in an implicit MOS. The average annual flow analysis was run under the assumption of summer temperature and summer solar radiation. When the water is warmer and more sunlight is present, there will be more algal growth and a higher potential for low dissolved oxygen concentrations. The model was also run under steady-state conditions, for 120 days, assuming continuous average annual flows and loads. It is unlikely that these flows and loads will actually be seen for such an extended period of time during the summer. The higher temperatures and solar radiation are conservative assumptions that represent a significant implicit margin of safety.

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

EPA 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 EPA. The watershed that drains to Town Creek has only one permitted point source that discharges nutrients.

For these TMDLs, Maryland has several well-established programs that will be drawn upon: the NPDES permit limits will be based on the TMDL loadings, the Water Quality Improvement Act of 1998 (WQIA), and the EPA-sponsored Clean Water Action Plan of 1998 (CWAP), and the State's Chesapeake Bay Agreement's Tributary Strategies for Nutrient Reduction. Also, Maryland has adopted procedures to assure that future evaluations are conducted for all TMDLs that are established.

Enforceable NPDES permit limits will include raising the WWTP effluent minimum DO from 5.0 to 6.0 mg/L any time, in addition to the mass loadings which will also provide confidence in assuring the implementation of these TMDLs. The implementation of point source BOD, nitrogen, and phosphorus controls will be executed through the NPDES permit for the Town of Oxford WWTP.

Maryland's WQIA requires that comprehensive and enforceable nutrient management plans be developed, approved, and implemented for all agricultural lands throughout Maryland. This act specifically requires that these nutrient management plans be developed and implemented by 2004. Maryland's CWAP has been developed in a coordinated manner with the States 303(d) process. All Category I waters identified in Maryland's Unified Watershed Assessment process are totally coincident with the impaired waters list for 1996 and 1998 approved by EPA. The State has given a higher priority for funding assessment and restoration activities to these watersheds.

In 1983, the states of Maryland, Pennsylvania, and Virginia, the District of Columbia, the Chesapeake Bay Commission, and the EPA joined in a partnership to restore the Chesapeake Bay. In 1987, through the Chesapeake Bay Agreement, Maryland made a commitment to reduce the nutrient loads to the Chesapeake Bay. In 1992, the Bay Agreement was amended to include the development and implementation of plans to achieve these nutrient reduction goals. Maryland's resultant Tributary Strategies for Nutrient Reduction provide a framework that will support the implementation of nonpoint source controls in the Eastern Shore Tributary Strategy Basin, including the Town Creek watershed. Maryland is in the forefront of implementing quantifiable nonpoint source controls through the Tributary Strategy efforts. This will help to assure that nutrient control activities are targeted to areas in which nutrient TMDLs have been established.

It is reasonable to expect that nonpoint source loads can be reduced during low flow conditions. While the low flow loads cannot be partitioned specifically into contributing sources, the sources themselves can be identified. These sources include dissolved forms of the impairing substances from ground water, the effects of agricultural ditching and animals in the stream, and deposition of nutrients and organic matter to the streambed from higher flow events. When these sources are controlled in combination, it is reasonable to achieve nonpoint source reductions of the magnitude identified by this TMDL allocation.

Finally, Maryland has recently adopted a five-year watershed cycling strategy to manage its

waters. Pursuant to this strategy, the State is divided into five regions and management activities will cycle through those regions over a five-year period. The cycle begins with intensive monitoring, followed by computer modeling, TMDL development, implementation activities, and follow-up evaluation. 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.

MDE has conducted a public review of the TMDL for BOD, nitrogen and phosphorus loadings in Town Creek. The public comment period was open from November 22, 2002 to December 21, 2002. Three sets of written comments were received by MDE. These were provided along with MDE's response document with the TMDL report. EPA commented on the Town Creek TMDL in a letter dated October 8, 2002. MDE provided responses to EPA on October 17, 2002.

EPA initiated consultation with the United States Fish and Wildlife Service (USFWS) and the United States National Marine Fisheries Service (USNMFS) on March 26, 2002, pursuant to the Endangered Species Act, about the availability of the TMDL. Following the Services' review of the TMDL, EPA received concurrence from the USFWS on December 21, 2002 and from the USNMFS on July 29, 2003 on the proposed TMDLs for Town Creek.

IV. Additional Information

The following table presents the TMDLs in pounds per day.

Flow Regime (Period)	Parameter	TMDL	WLA[1]	LA[2]	MOS[3]
Low flow (May 1 - Oct. 31)	BOD (lbs/day)[4]	30.2	25.6	0.3	4.3
	Nitrogen (lbs/day)[4]	17.4	15.4	0.1	1.9
	Phosphorus (lbs/day)[4]	1.9	1.7	0.02	0.2
Average annual flow (Nov. 1 - April 30)	BOD (lbs/day)[4]	30.9	25.7	0.9	4.3
	Nitrogen (lbs/day)[4]	17.7	15.4	0.4	1.9
	Phosphorus (lbs/day)[4]	2.0	1.7	0.04	0.2

[1] WLA = Waste Load Allocation

[2] LA = Load Allocation

[3] MOS = Margin of Safety

[4] 30.5 days per month was used to convert lbs/month to lbs/day. 365 days/year was used to convert lbs/year to lbs/day. Although monthly and annual loads are appropriate for these TMDLs, for the sake of consistency, EPA is deriving daily loads from the stated monthly and annual loads.