00-0806

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

The Honorable Jane T. Nishida
Secretary
Maryland Department of the Environment
2500 Broening Highway
Baltimore, Maryland 21224

Dear Secretary Nishida:

The Environmental Protection Agency (EPA), Region III has reviewed the report "Total Maximum Daily Load (TMDL) of Biochemical Oxygen Demand (BOD) for the Western Branch of the Patuxent River" which was submitted by the Maryland Department of Environment (MDE) for final agency review on December 6, 1999. Pursuant to 40 CFR Section 130.7(d), EPA is approving the TMDL for the Western Branch of the Patuxent River.

The definition of Load Allocation (LA) at 40 CFR Section 130.2(g) states, in part, that "Load allocations are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading." Further, a wasteload allocation (WLA), according to 40 CFR Section 130.2(h), is "The portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation." In addition, a TMDL is defined at 40 CFR Section 130.2(I) as "The sum of the individual WLAs for point sources and LAs for nonpoint sources and natural background."

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

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

EPA has authority to object to issuance of a National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with WLAs established for that point source. If an NPDES permit is issued with an effluent limitation that does not reflect the WLA contained in the approved TMDL and Technical Memoranda, it is expected that Maryland will document this change in the permit Fact Sheet, as discussed in our Decision Rationale. If you have any further questions or concerns, please contact me at 215-814-5715 or contact Thomas Henry at 215-814-5752.

Sincerely,

for Joseph T. Piotrowski, Acting Director
Water Protection Division

Enclosure

Decision Rationale

Total Maximum Daily Load of
Biochemical Oxygen Demand for
the Western Branch of the Patuxent River
Prince George's County, Maryland

I. Introduction

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the Total Maximum Daily Loads (TMDLs) of Biochemical Oxygen Demand to the Western Branch River submitted for final Agency review on December 6, 1999. Our rationale is based on the TMDL, Technical Memorandum, and other information provided in the submittal document to determine if the TMDL meets the following 8 regulatory conditions pursuant to 40 CFR §130.

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

The Technical Memoranda, *Significant Biochemical Oxygen Demand Point and Nonpoint Sources in the Western Branch River Watershed* submitted by the Maryland Department of the Environment (MDE), specifically allocates biochemical oxygen demand (BOD) to 2 point sources as well as to a general nonpoint source category. While nonpoint source allocations are typically made to distinct land uses, MDE utilized in-stream dry weather sampling data to more accurately represent nonpoint source contributions of BOD which precluded the ability to allocate to individual land uses in the watershed. Nonpoint source load estimates were based on the observed dry weather samples taken by MDE and Prince George's County which would include impacts from natural background, loads from septic tanks, atmospheric deposition, and contributions from urban, agriculture, and forest areas. Likewise, the gross load allocations consider natural background, septic tanks and baseflow. MDE also allocates BOD to the Western Branch Waste Water Treatment Plant (WWTP) (NPDES permit # MD0021741) and Croom Manor Housing WWTP (NPDES permit #0063967), which are the only significant point sources in the watershed. The current load of BOD was determined using effluent concentrations and flows reported in applicable National Pollutant Discharge Elimination System (NPDES) permits.

II. Summary

The Western Branch River, which is approximately 20 miles long, can be separated into an upper portion which is free-flowing and a lower, tidal portion, the majority of which is classified as Piedmont shallow fresh marsh. It flows into the Patuxent River near Mt. Calvert in the oligohaline salinity zone. The surrounding watershed encompasses approximately 71,420 acres and the dominant land uses are forest (31,100 acres), urban (21,970 acres), and various agriculture (18,180).

In response to the requirements of Section 303(d) of the Clean Water Act (CWA), MDE listed the Western Branch River on the 1996 303(d) list of impaired waterbodies based on available information. The specific causes of impairment included minor seasonal violations of the dissolved oxygen water quality criterion. Initially, it was thought that the impairment was due to nutrients. However, upon further analysis, it was determined that BOD was the primary substance causing low dissolved oxygen concentrations. Therefore, addressing and controlling BOD is the most effective solution to resolve dissolved oxygen impairments. The impact of low DO concentrations or of anaerobic conditions is reflected in an unbalanced ecosystem, fish mortality, odors, and other aesthetic nuisances.[1] These types of impairments interfere directly with the designated uses[2] of the Western Branch River by disrupting the aesthetics of the river and causing harm to inhabited aquatic communities through wide fluctuations of the dissolved oxygen levels. MDE listed nutrients, from nonpoint and natural sources as the causes and sources of the impairments, respectively. However, as previously mentioned, BOD substances from point sources were determined to be the cause and source. Western Branch River was given low priority on the 1996 303(d) list. Section 303(d) of the CWA and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the State where technology-based and other controls did not provide for attainment of water quality standards. The TMDLs submitted by Maryland are designed to address acceptable levels of BOD, as demonstrated by the WASP5 model, in order to ensure that water quality standards are maintained. These levels of BOD will provide for the control of oxygen demand and ensure that the water quality criterion for dissolved oxygen is attained.

EPA believes it is important to document MDE's commitment to improving water quality by recognizing that, while these impairments may currently be minor and infrequent, increased flows from significant point sources in this system will surely bring about more frequent and severe violations of the dissolved oxygen criterion.

MDE developed this TMDL to address the excessive BOD that Western Branch River is

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[1] Thomann, R.V., J.A. Mueller. 1987. Principles of Surface Water Quality Modeling. HarperCollins Publishers, Inc.

[2] The designated uses of Western Branch River are Use I (Water Contact Recreation and Protection of Aquatic Life). See Code of Maryland Regulations 26.08.02.

currently experiencing. This TMDL is designed to satisfy the water quality standards and designated uses of Western Branch River only for dissolved oxygen. Impairments in the remainder of the Patuxent River watershed are not addressed by this TMDL. In addition, impairments due to suspended sediments are not addressed by these TMDLs.

In order to address the impairments of Western Branch River from the 303(d) list, MDE believes it is necessary to control excessive BOD input to the system. BOD substances exert influence on the concentrations of dissolved oxygen in a waterbody. The figure below illustrates the interrelationship of major kinetic processes for BOD, DO, and nutrient analysis.

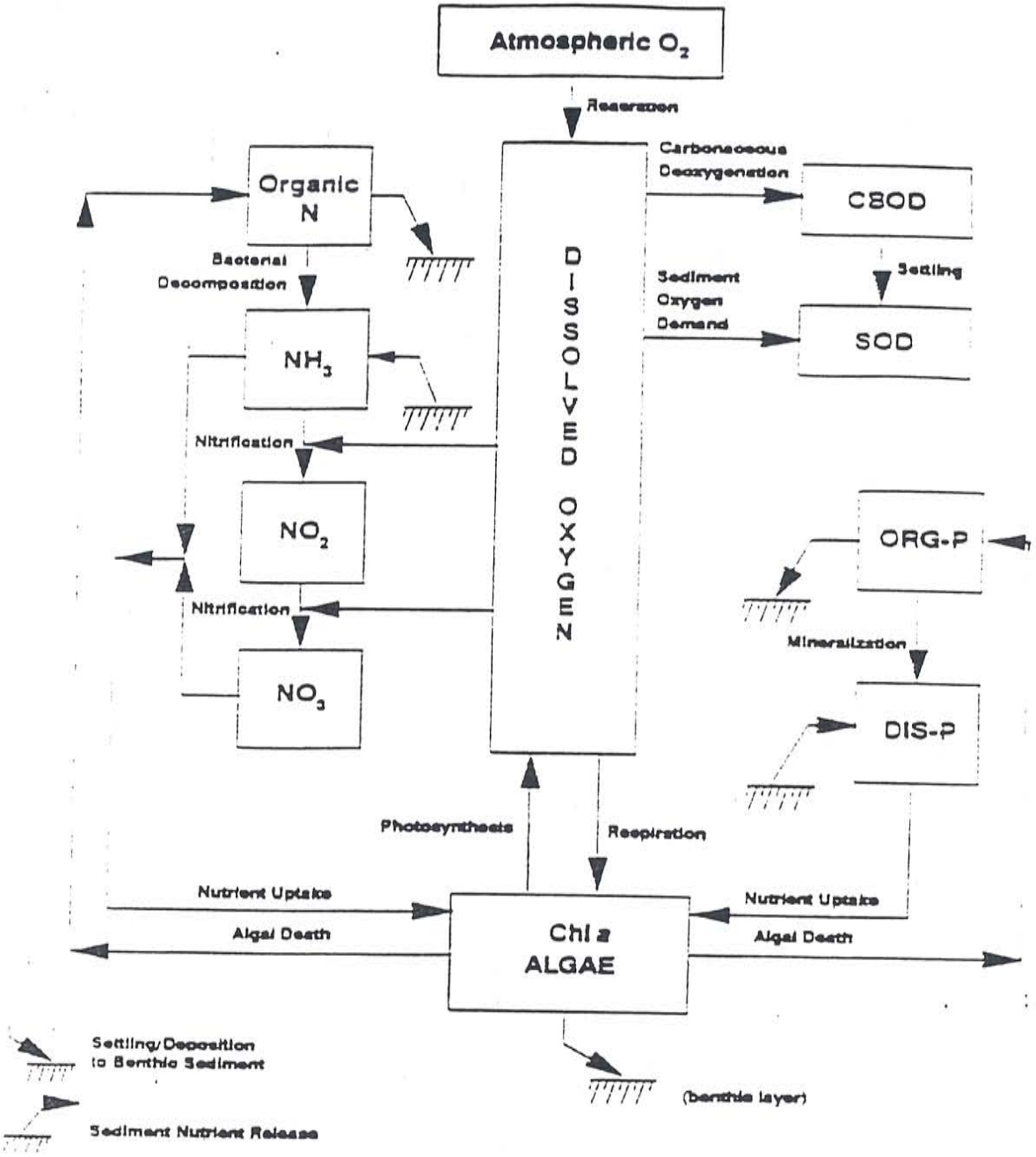

FIGURE 2-5. INTERRELATIONSHIP OF MAJOR KINETIC PROCESSES FOR BOD, DO, AND NUTRIENT ANALYSES AS REPRESENTED BY WATER QUALITY MODELS (After McCutcheon, 1989)

Figure 1
(Taken from EPA 823-B-97-002, page 2-14)

BOD is a measure of the amount of oxygen required to stabilize organic matter in wastewater[3]. It is typically determined from a standardized test measuring the amount of oxygen available after incubation of the sample at 20°C for a specific length of time, usually 5 days. Conceptually, BOD requires a distinction between the oxygen demand of the carbonaceous material in waste effluents and the nitrogenous oxygen demanding component of an effluent[4]. Carbonaceous biochemical oxygen demand (CBOD) involves the breakdown of organic carbon compounds while nitrogenous biochemical oxygen demand (NBOD) involves the oxidation of ammonia to nitrate, commonly referred to the nitrification process[5].

MDE uses WASP5[6] to evaluate the link between nutrient loadings, BOD, and dissolved oxygen. This evaluation is based on representing current conditions within the Western Branch River system and determining the necessary reductions in BOD loadings from various sources to achieve and maintain water quality standards. WASP5 is a general-purpose modeling system for assessing the fate and transport of conventional and toxic pollutants in surface waterbodies (Ambrose, 1987)[7]. The model can be applied in one, two, or three dimensions and includes 2 sub-models (EUTRO5 and TOXI5) to investigate water quality/eutrophication and toxics impairments. EUTRO5 can simulate the transport and transformation of eight state variables including dissolved oxygen, carbonaceous biochemical oxygen demand, phytoplankton carbon and chlorophyll-a, ammonia, nitrate, organic nitrogen, organic phosphorus, and orthophosphate. WASP5 has been previously applied in a number of regulatory and water quality management applications and is an appropriate linkage evaluation tool for the Western Branch River. Based on this analysis, MDE has determined that the levels of BOD input to the Western Branch River specified by the TMDL will ensure that water quality standards are achieved by maintaining the dissolved oxygen water quality criterion. The model was calibrated to MDE data gathered in December 1997 and post-validated based on summer data gathered by the Washington Suburban Sanitary Commission.

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[3] U.S. Environmental Protection Agency. Office of Water. March 1997. Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2: Streams and Rivers, Part 1: Biochemical Oxygen Demand/Dissolved Oxygen and Nutrients/Eutrophication. EPA 823-B-97-002.

[4] Supra, footnote 1.

[5] Chapra, S.C. 1997. Surface Water-Quality Modeling. WCB/McGraw-Hill.

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

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

Table 1 below shoes a summary of the TMDL as determined by MDE

Table 1, TMDL summary (lbs/month)

Parameter	TMDL	LA	WLA	FA	MOS
BOD	84,840	1,040	75,080	4,680	4,040

III. Discussion of Regulatory Conditions

EPA finds that Maryland has provided sufficient information to meet all of the 8 basic requirements for establishing BOD TMDLs for the Western Branch River. EPA therefore approves the TMDLs, Technical Memoranda, and supporting documentation for BOD in the Western Branch River. Our 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 minor, seasonal violations of the dissolved oxygen water quality criterion have been found near the confluence of the Western Branch and the Patuxent River. As previously mentioned, the designated uses of Western Branch River are Use I. The dissolved oxygen water quality criterion to support those uses indicates that DO concentrations may not be less than 5 mg/l at any time. The WASP5 model used by Maryland will help to determine those BOD levels to support the DO criterion. While the TMDL applies only to BOD because of MDE's determination that this was the controlling substance for DO concentrations, the modeling effort does consider potential effects from those processes of figure 1 including nutrients, algae, and sediment oxygen demand (SOD).

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):

$$\underset{\text{(Carbon Dioxide)}}{6CO_2} + \underset{\text{(Water)}}{6H_20} \text{ <----------> } \underset{\text{(Sugar)}}{C_6H_{12}O_6} + \underset{\text{(Oxygen)}}{6O_2}$$

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

[8] Supra, footnote 1.

[9] Supra, footnote 5.

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

In addition, the analysis performed by MDE indicated that the Western Branch WWTP contributes the majority of the nutrient and BOD loading to the system and is the primary source of the low dissolved oxygen concentrations. In order to support the DO criterion, MDE has indicated that the Western Branch WWTP must continue to meet its current NPDES permit limits for nitrogen, ammonia, and phosphorus as well as meeting an effluent DO requirement of 6.8 mg/l.

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 low dissolved oxygen concentrations in the Western Branch River has been identified by Maryland as the summer months. In order to control impacts to water quality, particularly with respect to DO levels, Maryland has established a TMDL for BOD that is applicable from April 1through October 15. Maryland presented this as monthly loads to be consistent with the monthly concentration limits that are required by NPDES permits. Expressing the TMDLs as monthly loads is consistent with federal regulations at 40 CFR 130.2(I), which state that TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure.

EPA's regulations at 40 CFR 130.2(I), define "total maximum daily load (TMDL)" as the "sum of individual WLAs for point sources and LAs for nonpoint sources and natural background." As the total loads provided by Maryland equal the sum of the individual WLAs for point sources and the land-based LAs for nonpoint sources set forth below and in the Technical Memoranda provided with the TMDLs, the TMDLs for BOD for Western Branch River are consistent with Section 130.2(I). Pursuant to 40 CFR 130.6 and 130.7(d)(2), these TMDLs and the Technical Memoranda and supporting documentation, should be incorporated into Maryland's current water quality management plan.

Waste load Allocations

EPA regulations require that an approvable TMDL include individual WLAs for each point source. Maryland's TMDL report for the Western Branch River did not include individual waste load allocations for the 2 point sources (Western Branch WWTP (NPDES permit # MD0021741) and Croom Manor Housing WWTP (NPDES permit #0063967)) of BOD. However, the Technical Memorandum did provide waste load allocation scenarios for the low-flow TMDL. The WLAs are listed below.

Table 2, summary of WLAs

Western Branch WWTP			
NPDES permit # MD0021741			
parameter	current loading	WLA	reduction needed
BOD (lbs/month)[a]	75,060	75,060	-
Croom Manor Housing WWTP			
NPDES permit # MD0063967			
parameter	current loading	WLA	reduction needed
BOD (lbs/month)[b]	15	15	-

[a] WLA based on a design flow of 30 mgd and a BOD concentration of 10 mg/l.

[b] WLA based on a design flow of 0.004 mgd and a BOD concentration of 15 mg/l.

The point source loads used to represent the current conditions were calculated using current NPDES permit limits. The TMDL is based on the Western Branch WWTP continuing to meet it's current permit limits for total nitrogen, total phosphorus, ammonia-nitrogen, and BOD. However, the TMDL does require that the effluent DO concentration must be at least 6.8 mg/l in order to ensure that water quality criterion of 5 mg/l is met. Croom Manor housing WWTP is also expected to continue to meet it's current permit limits for total kjeldahl nitrogen (organic and ammonia nitrogen) and BOD.

Load Allocations

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.

The Western Branch WASP model considers nonpoint source loads from 2 sources which represent the upper Western Branch watershed and the Charles Branch watershed. The upper

Western Branch flows used to represent low-flow conditions are based on data gathered from a United States Geological Survey gage in Upper Marlboro (01594526). The nonpoint source loads were based on water quality data collected by MDE staff at water quality station WXT0045. The flows used to represent Charles Branch were calculated as a portion of the flow of Western Branch based on relative drainage area of the basins. The nonpoint source loads represent average concentrations from various water quality stations in the basin. Additionally, the load from the Prince George's County Composting Facility, which has an individual stormwater permit, was included in the Charles Branch load. These loads are representative of nonpoint source load experienced during low-flow and include contributions from atmospheric deposition, septic tanks, as well as baseflow loads.

MDE provided a gross load allocation for nonpoint source. Further separation into distinct load allocations for specific land uses was not possible because the data used to represent nonpoint source contributions was based on in-stream sampling. Furthermore, low-flow analysis typically considers nonpoint source loads due to only background and baseflow loads. The table below shows not only the gross load allocations to the upper Western Branch and Charles Branch, but also the future allocations of BOD.

Table 3, summary of load allocations and future allocations

Watershed	Load Allocation	Future Allocation
Western Branch	970[a]	4,360[c]
Charles Branch	70[b]	320[d]

[a] LA based on flow of 3 cfs and BOD concentration of 2 mg/l.

[b] LA based on flow of 0.22 cfs and BOD concentration of 2 mg/l.

[c] LA based on flow of 3 cfs and additional BOD concentration of 9 mg/l.

[d] LA based on flow of 0.22 cfs and additional BOD concentration of 9 mg/l.

Allocations Scenarios

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

Federal regulations at 40 CFR 122.44(d)(1)(vii)(B), require that, for an NPDES permit for an individual point source, the effluent limitations must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA. EPA has authority to object to the issuance of an NPDES permit that is inconsistent with WLAs established for that point source. To ensure consistency with these TMDLs, as NPDES

permits are issued for the point sources that discharge the pollutants of concern to Western Branch River, any deviation from the WLAs set forth in the Technical Memoranda 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 Memoranda, 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 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 TMDL and the Technical Memoranda for BOD for Western Branch River 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.

In terms of the low-flow TMDL analysis, Maryland used August 1995 field data as well field data from the Charles Branch and the composting facility 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 streamflow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Western Branch River 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.[10] 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.

As previously mentioned, MDE has identified the summer, low-flow period as the critical condition based on data which indicated seasonal (summer) violations of the DO criterion. Modeling analysis performed by MDE confirmed that violations of DO will occur during these conditions. In addition, MDE performed an analysis using data which would represent high-flow conditions and found no violations of the DO criterion. MDE's analysis using the WASP5 model adequately considers critical conditions. Furthermore, sensitivity analyses were conducted to confirm that BOD is the controlling substance for DO concentrations.

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[11]. Consistent with our discussion regarding critical conditions, the WASP5 model and TMDL analysis will effectively consider seasonal environmental variations.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account

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[10] 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.

[11] Supra, footnote 3.

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.

Explicitly, MDE has reserved 4,040 lbs/month, or 4.76%, of BOD for the MOS. Implicitly, the use of the 7Q10 flow during the allocation process as well as design flows and maximum concentrations provides an additional MOS.

7) The TMDLs have been subject to public participation.

The TMDLs of BOD to the Western Branch River were open for public comment from November 9, 1998 through December 10, 1998. Eleven commentors provided written comments to MDE, which was provided along with their response document with the TMDL report.

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

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

In terms of nonpoint sources, concentrations during low-flow conditions are not expected to significantly change in the future.