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

June 29, 2005

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 Nitrogen and Phosphorus for the Back Creek. The TMDL report was submitted to EPA for review and approval on March 9, 2005. The TMDL was developed and submitted in accordance with Sections 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. Maryland identified Back Creek as impaired by nutrients due to signs of eutrophication, expressed as high chlorophyll *a* levels.

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 TMDL for the nutrient impairment for the Back River satisfies 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 Mr. Thomas Henry at (215) 814-5752.

Sincerely,

Jon M. Capacasa

Jon M. Capacasa, Director
Water Protection Division

Enclosure

Note: This letter approves MDE's "Total Maximum Daily Loads for Back River for Nitrogen and Phosphorus in Baltimore City and Baltimore County, Maryland," not for Back Creek.

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REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

October 5, 2005

Nauth Panday, Program Manager
Technical and Regulatory Services Administration
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, MD 21230

Dear Mr. Panday:

This letter is in response to Richard A. Eskin's August 12, 2005, letter to Jon M. Capacasa regarding EPA's approval documents for MDE's nitrogen and phosphorus TMDLs for the Back River. The letter identified errors and omissions in EPA's June 29, 2005, approval letter and decision rationale which approved the Back River TMDL report as submitted by MDE.

Unfortunately, EPA's approval letter referred to the Back Creek instead of Back River, a separate TMDL also submitted by MDE for EPA's approval. However, the decision rationale correctly identifies Back River as the waterbody addressed and clearly identifies the location of Back River which cannot be confused with the location of Back Creek.

The August 12 letter also corrected details of the technical procedure used to develop the Back River TMDLs which do not affect the values of the load and wasteload allocations.

The last item of the August 12 letter requests that EPA re-examine the paragraph explaining the rationale for the Back River WWTP allocations. The decision rationale details WWTP nitrogen reduction already implemented but failed to identify the TMDL nitrogen allocation to be achieved by MDE's Enhanced Nutrient Removal program and NPDES permits to further reduce the nitrogen allocation. The detailed wasteload and load allocations are included in the decision rationale in flow charts taken from the TMDL Report, Appendix D, making it unlikely that the Back River WWTP allocation would be misconstrued.

Because the above corrections and clarification do not alter EPA's decision, the decision rationale is not being revised but an *errata* page is being added. EPA will now post the decision rationale on the Region's web site. If you should have any questions, please contact me at 215-814-5752 or Mary F. Beck at 215-814-3429.

Sincerely,

Signed
Thomas M. Henry,
Program Manager
TMDL Program

encl.

cc Richard A. Eskin, MDE
Robert Summers, MDE
Jennifer Waxenski, MDE
Scott Macomber, MDE
Melissa Chatham, MDE
Sefania Shamet, EPA

An *errata* page is added to the Decision Rationale signed by Jon Capacasa on June 29, 2005, providing the above corrections and clarifications.

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

Decision Rationale

Total Maximum Daily Loads for Back River for Nitrogen and Phosphorus in Baltimore City and Baltimore County, Maryland

Jon M. Capacasa
Jon M. Capacasa, Director
Water Protection Division

Date: *6/29/05*

Errata

Page 1, paragraph 2, lines 7-8: "…..source load estimates were based on the Chesapeake Bay Model Phase IV year 2000 loading coefficients which consider natural background…" should read "…source load estimates, including natural background, were estimated using a hydrological Simulation program Fortran (HSPF) watershed model, developed by MDE for the Patapsico/Black River watershed…"

Page 1, paragraph 3, lines 6-7: "…based on the HSPF model of the watershed from 1996 – 1997" should read "…based on a future projection using the HSPF model of the watershed, which was calibrated for the period 1995 – 1997."

Page 4, paragraph 2, line 5: "The package also included a sediment process model…" should read, "The package also included a watershed model (HSPF), a sediment process model…"

Page 7, paragraph 3: It should be noted that the 22% reduction identified is an interim reduction already implemented. Further reductions will be achieved by MDE's Enhanced Nutrient Removal program and NPDES permits to reduce the nitrogen concentration to 4 mg/l. The TMDL average annual allocation (WLA) for the WWTP is 1,582,055 lb/yr as shown in the flow charts following page 11 of the decision rationale.

9/27/05

Decision Rationale
Maximum Daily Load of
Nitrogen and Phosphorus for
Back River

I. Introduction

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the Total Maximum Daily Loads (TMDLs) of Nitrogen and Phosphorus to the Back River during low flow conditions (May – October) and average annual flow conditions, submitted for final Agency review and approval on March 9, 2005. The EPA's rationale is based on the TMDL, Technical Memorandums, 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 Memorandum, *Significant Nutrient Nonpoint Sources in the Back River Watershed*, submitted by the Maryland Department of the Environment (MDE), specifically allocates nitrogen and phosphorus to each of three separate land use/source categories (atmospheric deposition of nitrogen or phosphorus to the water surface is included in the loads attributed to mixed agriculture, forest and other herbaceous, and urban land uses). Each land use or source is allocated some percentage of the total allowed nutrient load originating from nonpoint sources. Current nonpoint source load estimates were based on the Chesapeake Bay Model Phase IV Year 2000 loading coefficients which consider natural background, loads from septic tanks, as well as baseflow contributions. Likewise, the load allocations to each land use also consider natural background, septic tanks and baseflow. Each land use load allocation represents yearly allowable loads of nitrogen and phosphorus.

The Technical Memorandum, *Significant Nutrient point Sources in the Back River Watershed*, submitted by MDE specifically allocates nitrogen and phosphorus to sources permitted under the National Pollutant Discharge Elimination System (NPDES) in the watershed. This includes waste water treatment plants and municipal separate stormwater discharges. Allocations to the point sources were based on its permitted flow, while the allocations to the stormwater discharges were based on the Hydrological Simulation Program Fortran (HSPF) model of the watershed from 1995 – 1997. The stormwater nutrient loads account for contributions from urban land.

Table 1 presents a summary of the TMDLs as determined by MDE.

Table 1 - Summary of Phosphorus and Nitrogen TMDLs for the Back River					
Flow Regime Period	Parameter	TMDL	WLA[1]	LA[2]	MOS[3]
Low Flow (May 1 -October 31)	Nitrogen (lbs/month)	113,321	111,299	1,345	677
	Phosphorus (lbs/month)	7,995	7,888	34	73
Average Flow (November 1 – April 30)	Nitrogen (lbs/year)	1,773,100	1,737,626	26,323	9,151
	Phosphorus (lbs/year)	99,171	96,896	1,239	1,036

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

II. Summary

The Back River Watershed[1] is located in the western shore region of Maryland and drains into the Chesapeake Bay. It lies within the Piedmont and the Coastal Plain provinces of Central Maryland. The Back River watershed has an area of approximately 39,075 acres or 158.1 square miles. The dominant land uses in the watershed are urban (28,037 acres or 71.7%) and non-urban which is comprised of mixed agriculture and forest and other herbaceous (6,753 acres or 17.7%) and open water (4,295 acres or 11%)[2].

In response to the requirements of Section 303(d) of the Clean Water Act (CWA), MDE listed the Back River on the 1996 303(d) list of impaired waterbodies under Basin Segment 02130901 as impaired by nutrients due to signs of eutrophication in the form excessive algae levels. A eutrophic system typically contains an undesirable abundance of plant growth, particularly phytoplankton (photosynthetic microscopic organisms (algae)), periphyton (attached benthic algae), and macrophytes (large vascular rooted aquatic plants)[3]. These impairments interfere with the designated uses[4] of the Back River by disrupting the aesthetics of the river and causing harm to inhabited aquatic communities. MDE listed nutrients, both nitrogen and phosphorus, from nonpoint and point sources as the causes and sources of the impairments, respectively. Back 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 nitrogen and phosphorus, and a minimum concentration of Dissolved Oxygen of 5.0 mg/L as demonstrated by

[1] The Back River watershed, part of the Patapsco/Back River Tributary Strategy Basin.

[2] This information is based on 1997 Maryland Office of Planning information.

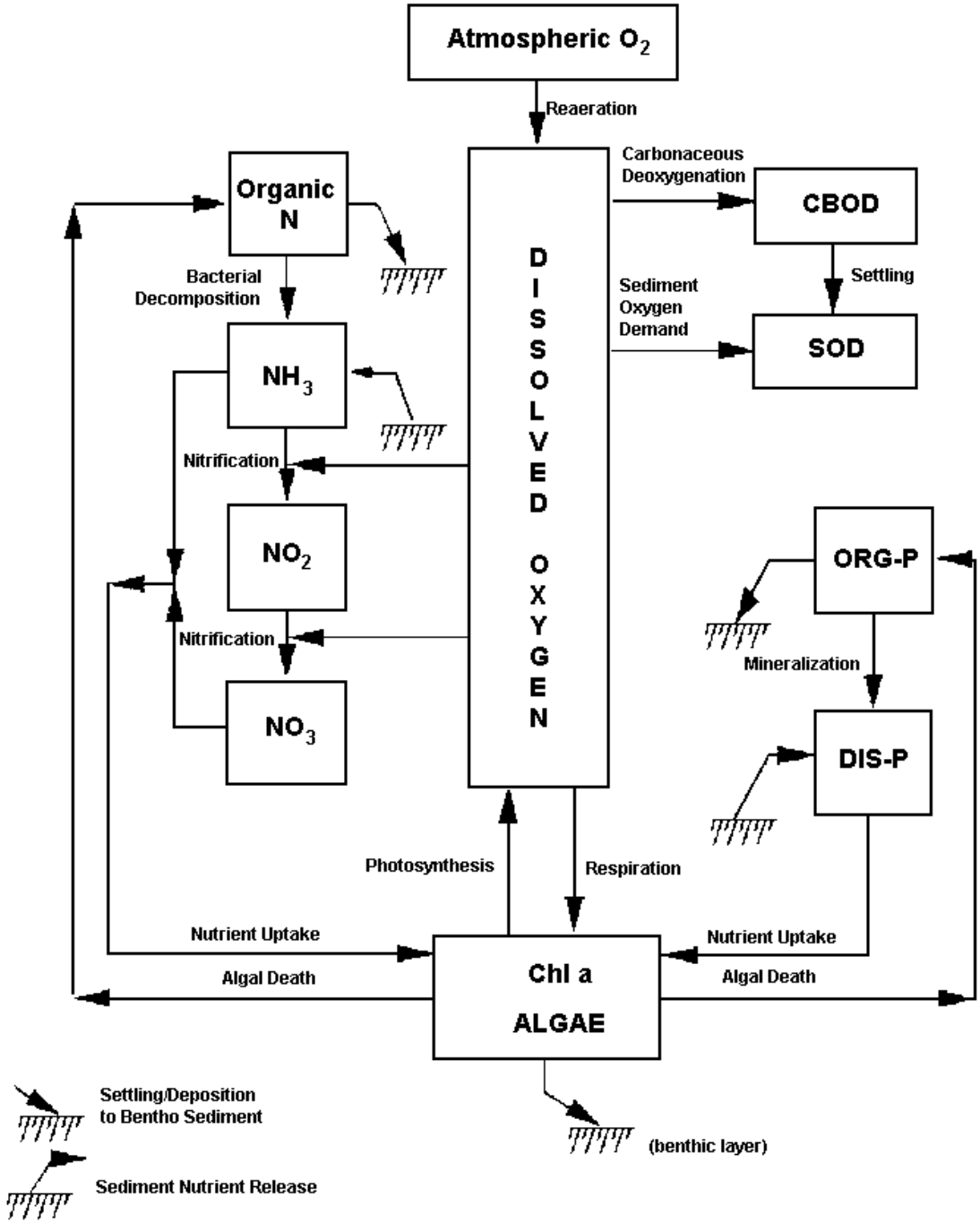
[3] Protocol for Developing Nutrient TMDLs. First Edition. November 1999. EPA 841-B-99-007.

[4] The designated use of the Back River is Use I (Water Contact Recreation and Protection of Aquatic Life) for Tidal Waters. See Code of Maryland Regulations 26.08.02.

using a time-variable, three dimensional water quality model package. These levels of nitrogen and phosphorus will provide for the control of eutrophication and algae blooms (measured through a surrogate indicator known as chlorophyll-*a*) and ensure that the instantaneous water quality criterion of 5.0 mg/L for DO is attained.

MDE developed these TMDLs to address the excessive nutrient enrichment that Back River is currently experiencing. This TMDL is designed to satisfy the water quality standards and designated uses of Back River only for nutrients. The Back River was also identified on the 303(d) list as being impaired by bacteria (fecal coliform), toxics (PCB's), metals (zinc) and suspended sediments. The impairments due to these contaminants have been or will be addressed in a separate analyses by MDE.

In order to address the impairments of Back River from the 303(d) list, MDE believes it is necessary to control excessive nutrient input to the system. Nitrogen and phosphorus 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) illustrates 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 both average daily and instantaneous DO standards[5]. In addition, excessive nutrients lead to an overabundance of aquatic plant growth.

The TMDLs for nitrogen and phosphorus were developed using a modeling package, which included the following: In order to ensure that water quality standards are maintained, MDE uses the time variable Corps of Engineers Water Quality-Integrated Compartment Model (CE-QUAL-ICM) as the analysis tool to link the nutrients source loadings to the DO criteria and the chlorophyll a goal. The package also included a sediment process model, and the hydrodynamic model, Curvilinear Hydrodynamic in Three Dimensions (CH3D). This evaluation is based on representing current conditions within the Back River system and determining the necessary reductions in nutrient loadings from various sources to achieve and maintain water quality standards.

The water quality model was calibrated to reproduce observed water quality characteristics for 1992–1997 conditions. The calibration of the model for these years establishes an analysis tool that may be used to assess a range of scenarios for differing flow and nutrient loading conditions. Observed conditions in the streams in the years of 1995-1997 were used to determine the baseline condition scenario. The urban-stormwater concentrations and the nonpoint source nutrient concentrations for the calibration and baseline scenarios were estimated from the HSPF model of the Back River Watershed, using observed data collected from 1995-1997. This model simulates stormwater and nonpoint loads and integrates all natural and human nutrient sources, including atmospheric deposition, and septic tanks which are associated with river base flow during low flow conditions. Based on this analysis, MDE has determined that the levels of nutrient input to the Back River specified by the TMDL will ensure that water quality standards are achieved by controlling algae blooms and maintaining the DO water quality criterion.

III. Discussion of Regulatory Conditions

EPA finds that Maryland has provided sufficient information to meet all of the 8 basic requirements for establishing nitrogen and phosphorus TMDLs for the Back River. EPA therefore approves the TMDLs, Technical Memorandum, and supporting documentation for nitrogen and phosphorus in the Back River. EPA's approval is outlined according to the regulatory requirements listed below.

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[5] 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.

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 the Back River. As previously mentioned, the designated use of Back River is Use I. The DO water quality criterion to support this use indicates that DO concentrations may not be less than 5 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 the Back River. Chlorophyll-*a* are 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 CE-QUAL-ICM model package used by Maryland was used 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):

$$_{2} + 6H_2O \quad \leftrightarrow \quad C_6H_{12}O_6 + 6O_2$$

6CO

[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.

(Carbon Dioxide) (Water) (Sugar) (Oxygen)

In this reaction, photosynthesis is the conversion of carbon dioxide and water into sugar 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. The targeted DO level of 5 mg/L is specified criteria for Use I waters set forth in COMAR 28.08.02.

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 Back River. Again, using their General Water Quality Criteria, MDE established 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.

EPA believes that the TMDLs for phosphorus and nitrogen will ensure that the designated use and water quality criteria for the Back River 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

[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.

The critical season for excessive algal growth in the Back River 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 nitrogen and phosphorus that are applicable from May 1 through October 31. Maryland presented these 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.

Maryland also recognized that nutrients may reach the river in significant amounts during higher flow periods. The average annual flow TMDL analysis investigates critical conditions in dry years and/or very wet years. The years 1995, 1996 and 1997 were chosen to estimate the TMDLs because it covers a period with a dry year as well as a wet year, accounting for seasonality and critical conditions. The TMDLs for nitrogen and phosphorus are presented in Table 1.

EPA's regulations at 40 CFR § 130.2(i), define "total maximum daily loads (TMDLs)" 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 Memorandums provided with the TMDLs, the TMDLs for nitrogen and phosphorus are consistent with § 130.2(i). Pursuant to 40 CFR § 130.6 and § 130.7(d)(2), these TMDLs and the Technical Memorandums and supporting documentation, should be incorporated into Maryland's current water quality management plan. Flow charts below, taken from Appendix D of the TMDL, outline how the allocations were assigned and distributed.

Waste Load Allocations

During the 1995-1997 period, the watersheds draining to the Back River had two permitted point sources, the Back River Waste Water Treatment Plant (WWTP) and the Eastern Stainless Plant, discharging nutrients directly to the river. The Back River WWTP was given a TMDL allocation. The Eastern Stainless Plan stopped discharging in 1999, and therefore was not assigned an allocation. Municipal and industrial discharge monitoring information was obtained from discharge reports stored in MDE's point source database.

Since 1997, the Back River Treatment Plant has implemented a Biological Nutrient Reduction (BNR) program, thus reducing its phosphorus contributions to the Back River. The TMDL states that the Back River WWTP could reduce its annual average load, with current permit flow (130 MGD) and concentrations (8 mg/L of Total Nitrogen, 0.2 mg/L Total Phosphorus) from 4,080,417

to 3,167,002 lbs/yr, a reduction of 22%. Because the loads from the permitted point sources have been addressed, through the elimination of the Eastern Stainless Plant and the BNR treatment at the Back River WWTP, reductions assigned in the TMDL are focused on addressing the stormwater contributions now permitted under the MS4 program.

Stormwater runoff from urban landuses including Phase I individual permits and Phase II permits, are also assigned a WLA (see C.F.R. § 130.2). The stormwater allocation is represented as a gross allotment due to the limitation of available data and information specific to outfalls. The stormwater allocation is however, defined separately for Baltimore City with 40% of the total urban area, and Baltimore County with 60% of the total urban area (see Table 2). A total reduction of 15% from baseline TN and TP is assigned to urban stormwater loads for both low flow and the remaining months of the year. These WLA's aggregate municipal and industrial stormwater loads, including loads from construction activity. Urban stormwater concentrations for the model calibration and baseline scenario were estimated from the HSPF model using observed data from 1995-1997. The Technical Memorandum, *Significant Nutrient point Sources in the Back River Watershed*, submitted by MDE specifically allocates nitrogen and phosphorus to sources permitted under the NPDES permit program in the watershed. This includes waste water treatment plants and municipal separate stormwater discharges.

Load Allocations

Maryland provided adequate land use and loading data in the TMDL report, assigning the reductions to the urban landuses, but not distributing the total load allocation to specific land use categories in the TMDL report. Maryland included a gross load allocation for the low-flow and average-flow TMDLs.

According to federal regulations at 40 CFR § 130.2(g), LAs 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. As discussed earlier, the nonpoint source nutrient concentrations for the calibration and baseline scenarios were estimated from the HSPF model of the Back River Watershed, using observed data collected from 1995-1997. The Technical Memorandum, *Significant Nutrient Nonpoint Sources in the Back River Watershed*, submitted by the Maryland Department of the Environment (MDE), specifically allocates nitrogen and phosphorus to each of three separate land use/source categories (atmospheric deposition of nitrogen or phosphorus to the water surface is included in the loads attributed to mixed agriculture, forest and other herbaceous, and urban land uses).

Allocations Scenarios

EPA realizes that the above breakout of the total loads for nitrogen and phosphorus to specific land uses is one allocation

scenario. As implementation of the established TMDLs proceed or more detailed information becomes available, Maryland may find other combinations of land use allocations that are more 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.

Based on the foregoing, EPA has determined that the TMDL and the Technical Memorandum for Nitrogen and Phosphorus for Back River are consistent with the regulations and requirements of 40 CFR § 130. Pursuant to 40 CFR § 130.6 and 130.7(d)(2), these TMDLs and the supporting documentation, including the Technical Memorandum, should be incorporated into Maryland's current water quality management plan.

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

In terms of the low-flow TMDL analysis, Maryland used field data for the year 1995 thru 1997 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.

In terms of the average annual flow TMDL analysis, the HSPF model considers; 1) variability in the precipitation patterns estimated from existing National Oceanic and Atmospheric Administration meterological stations, 2) hydrologic response of land area estimated for a simplified set of landuses in the basin, and 3) agricultural information estimated form the Maryland Deparment of Planning (MDP) and land use data, the 1997 agricultural census data and the Farm Service Agency (FSA). This effectively considers natural background, loads from septic tanks, as well as base flow contributions.

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 Back 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.[12] Critical conditions are

[12] 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.

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.

Based on the 1995-1997 field data and current knowledge regarding eutrophication, Maryland identified the period of May 1 through October 31 as the critical period. The specific conditions that describe this critical period are reduced flows in the stream (low-flow), higher concentrations of nutrients, and warmer water temperatures. These conditions combine to create favorable conditions for algal growth and wide fluctuations in DO concentrations which lead to violations of the designated uses and water quality criteria of the Back River. Furthermore, the data showed that chlorophyll-*a* levels were of concern and DO concentrations are violating the water quality criteria. The low-flow TMDL analysis using the CE-QUAL-ICM model adequately considers those critical conditions.

MDE also recognizes that increased nonpoint source loads of nutrients during precipitation events could adversely affect water quality, thus a critical condition itself, and so utilized the data from 1995-1997 that included both a wet year and a dry year. MDE has developed an annual TMDL based on average flow conditions during which the TMDL will be met.

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[13]. Consistent with our discussion regarding critical conditions, the CE-QUAL-ICM 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 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.

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

For both the low-flow and the average annual flow, the TMDL analysis for both nitrogen and phosphorus, MDE states that it explicitly allocates 5% of the urban stormwater load value and reserves this for the MOS.

In addition, MDE uses certain conservative assumptions which are implicitly included in the modeling 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. The high-flow analysis was run under the assumption that summer water temperatures and summer solar radiation would be experienced by the Back River. These conditions are unlikely given that high-flow analyses are typically done during winter and spring months of the year.

7) The TMDLs have been subject to public participation.

The TMDLs of nitrogen and phosphorus to the Back River were open for public comment from December 2, 2005 through January 15, 2005. Only one set of written comments were received by MDE. This was provided along with MDE's response document with the TMDL report.

EPA submitted a copy of the State's final TMDL to the United States Fish and Wildlife Service (USFWS) and to the United States National Marine Fisheries Service (USNMFS) on April 6, 2005. The EPA has not received a response from the USNMFS or USFWS on the proposed TMDLs as of May 27, 2005.

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

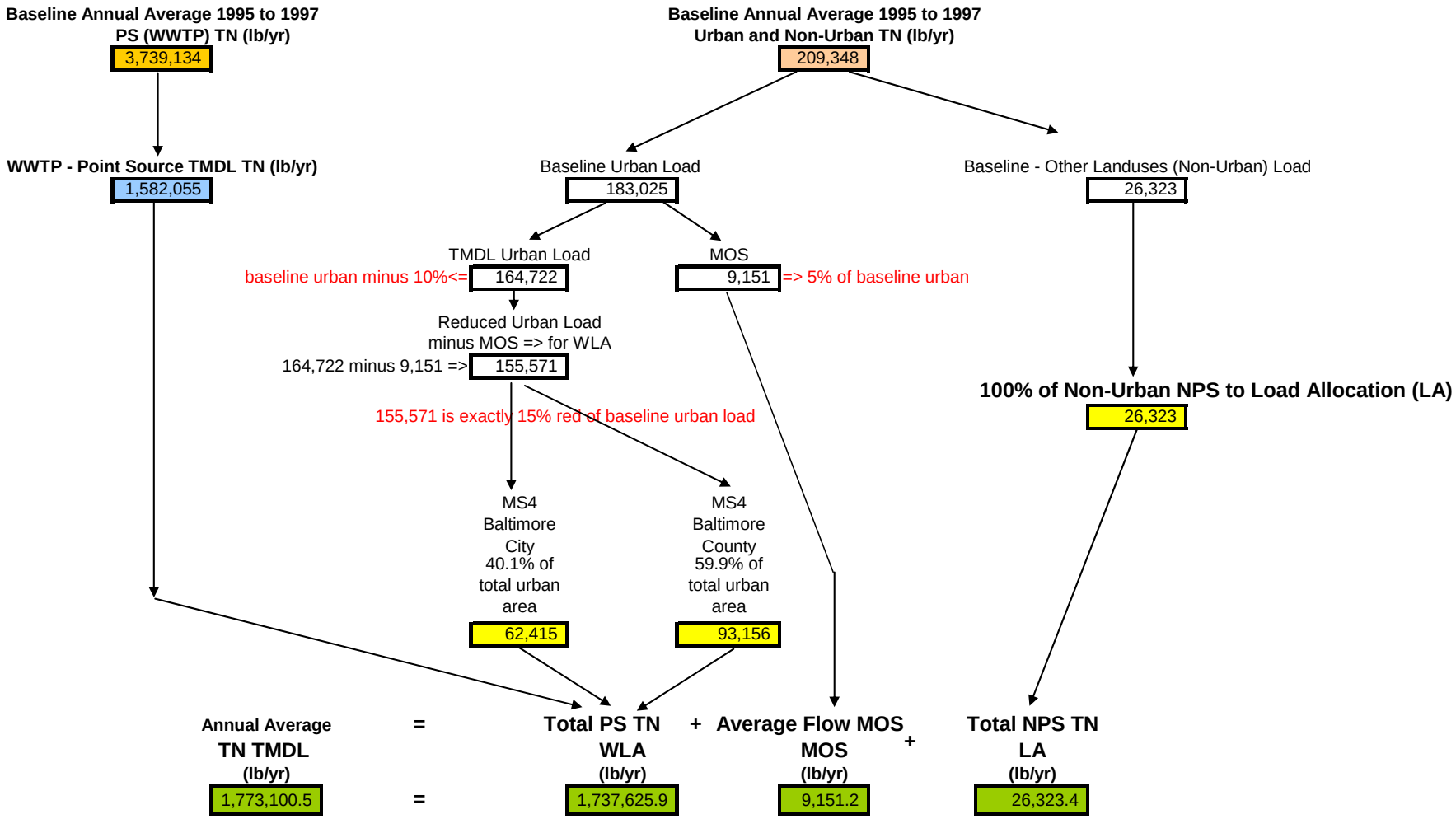
EPA requires that there be a reasonable assurance that the TMDL can be implemented.
MDE has stated that the implementation of nutrient controls will be executed through the Enhanced Nutrient Removal (ENR) strategy and NPDES permits. The ENR strategy builds upon the Biological Nutrient Removal (BNR) program already in place. It provides cost-share grant funds to local governments to retrofit or upgrade waste water treatment plants to remove a greater portion of nutrients from the discharge. The NPDES permits for the Back River WWTP will include nutrient goals that have been established, and upon completion of the upgrade, the permitee shall make a best effort to meet the load goals.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs, including EPA's Clean Water Action Plan and Maryland's Water Quality Improvement Act of 1998, and the State's Chesapeake Bay Agreement's Tributaries Strategies for Nutrient Reduction. Additionally, Maryland's Water Quality Improvement Act, requires that a comprehensive and enforceable nutrient management plan be developed, approved and implemented for all agricultural lands

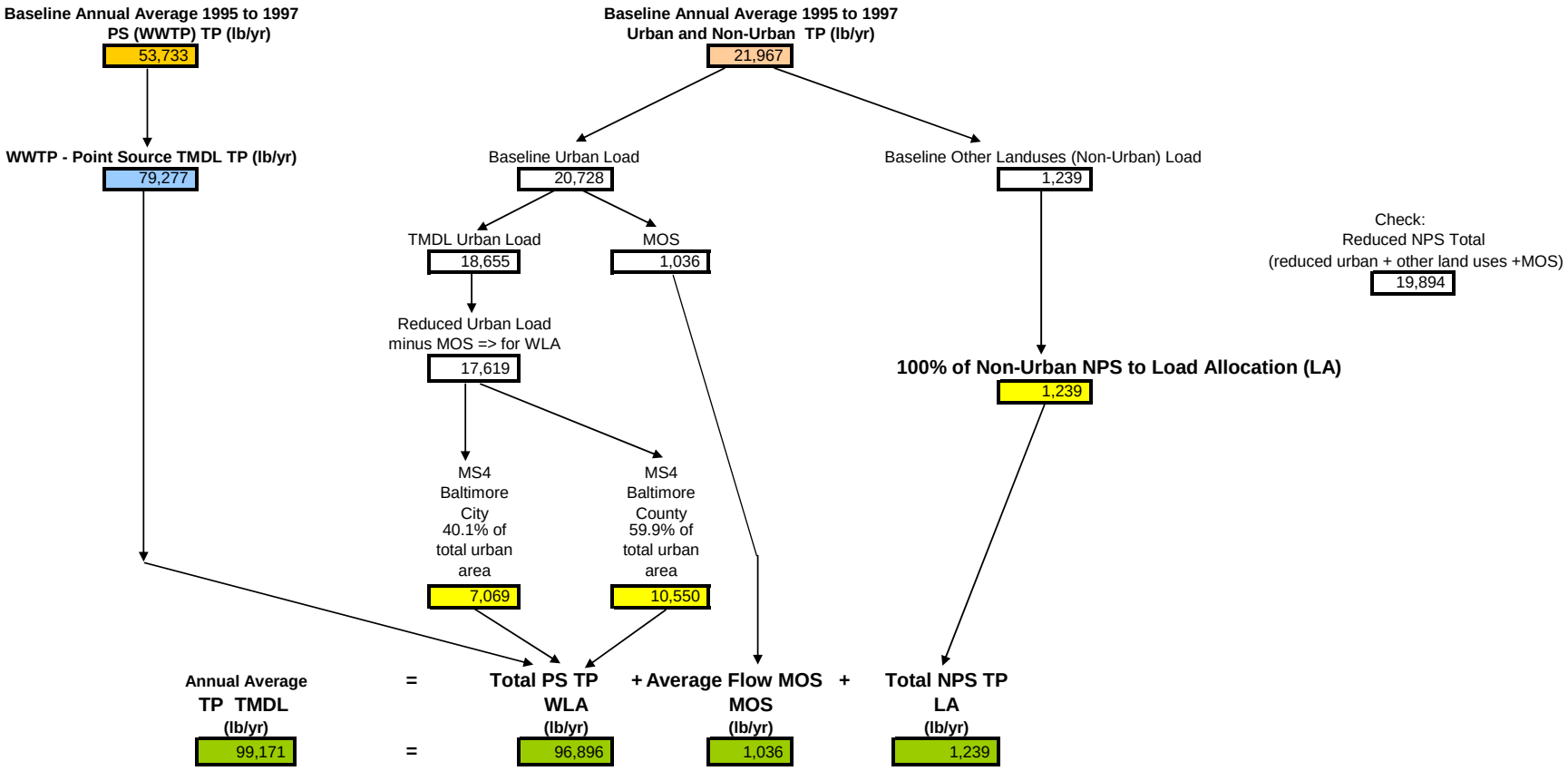
throughout Maryland

In addition, there will be follow-up monitoring within five years as part of Maryland's Watershed Cycling Strategy. This follow-up monitoring will allow Maryland and EPA to determine whether these TMDLs have been implemented successfully.

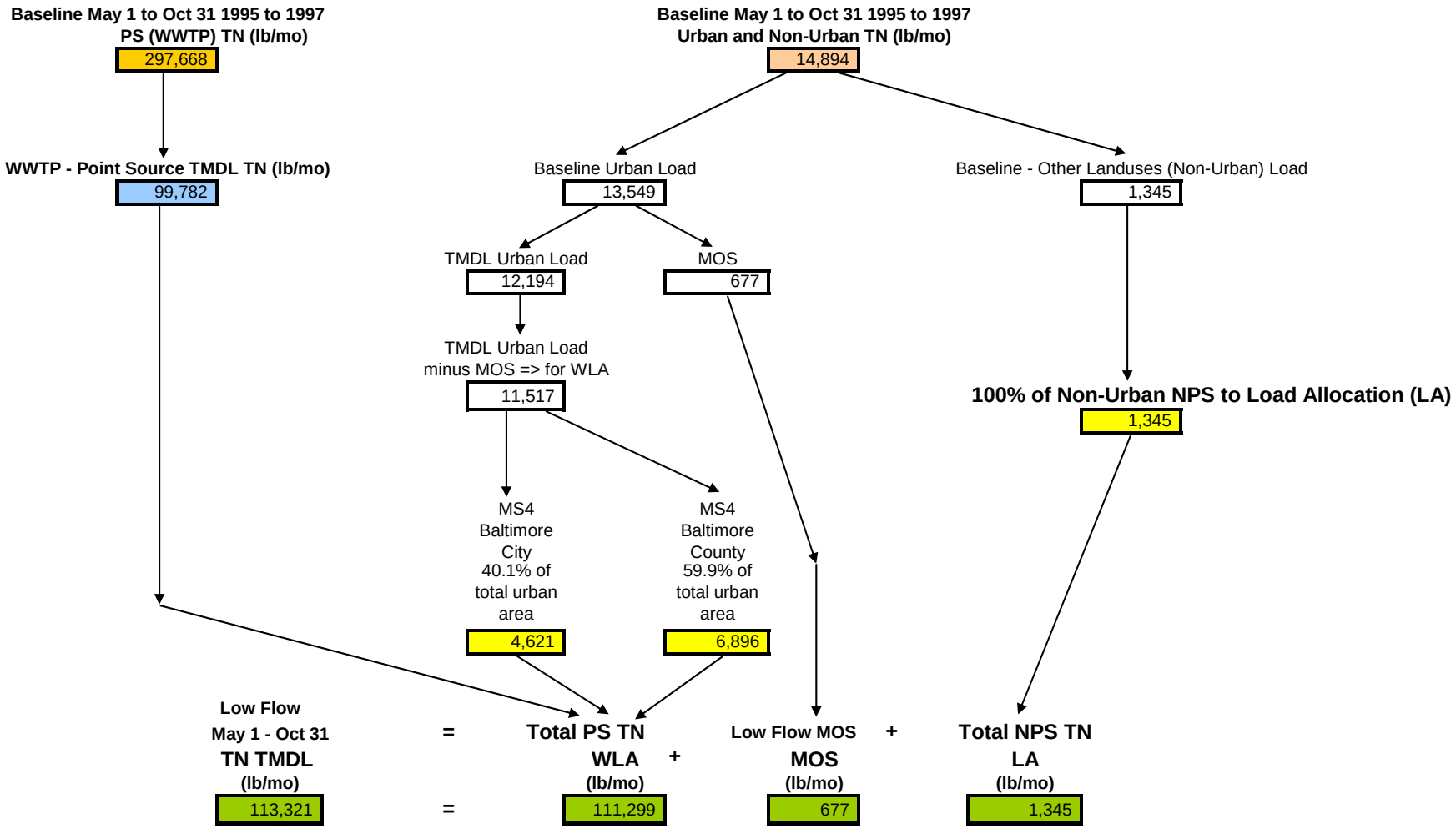
Back River TMDL
Annual Average TN allocations
15% NPS REDUCTION (5% for MOS) **(from Baseline 95 to 97 Total Urban Loads only)**



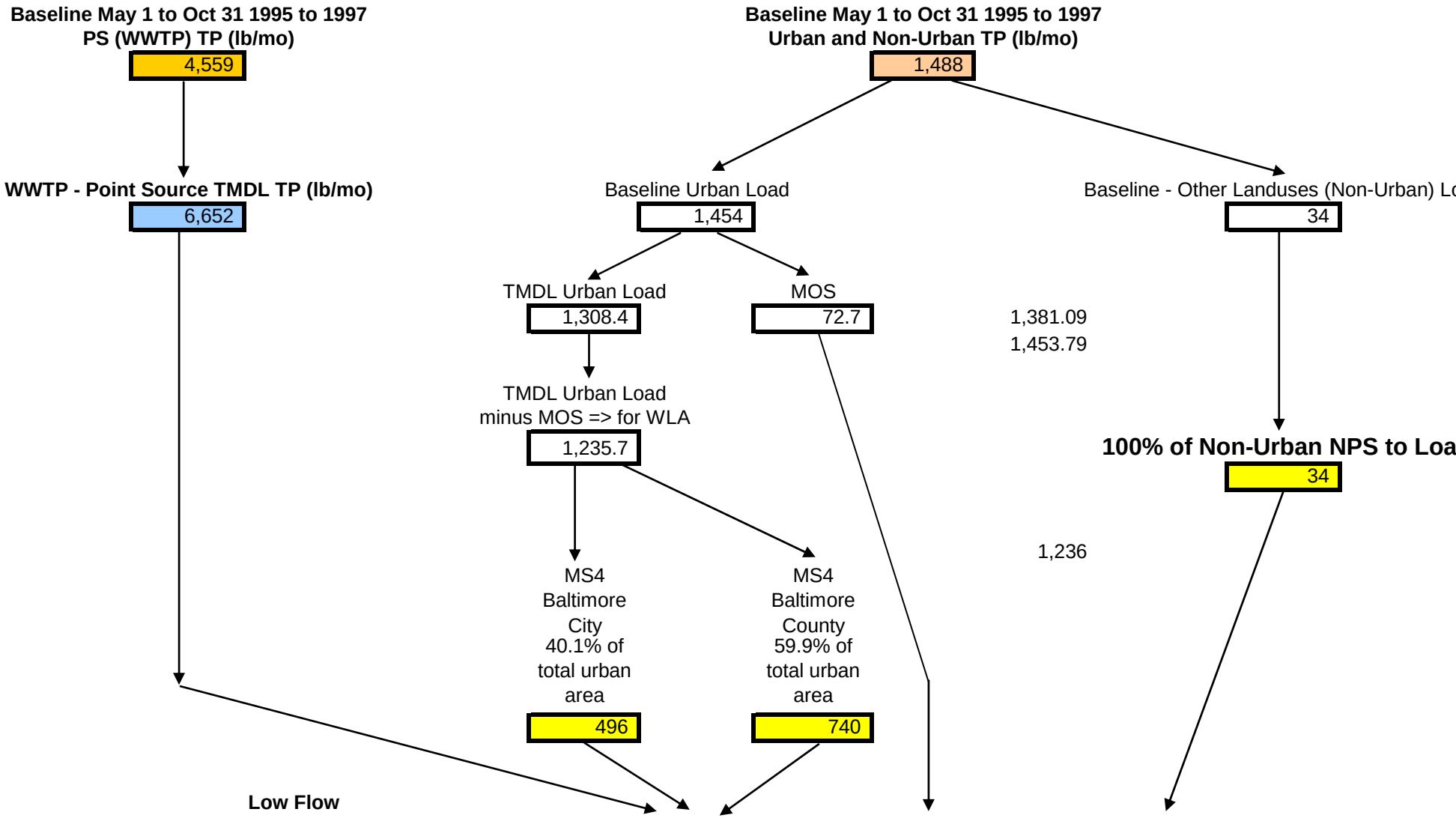
Back River TMDL
Annual Average TP allocations
15% NPS REDUCTION (5% for MOS) (from Baseline 95 to 97 Total Urban Loads only)



Back River TMDL
May 1 to Oct 31 TN allocations
15% NPS REDUCTION (5% for MOS) (from Baseline 95 to 97 Total Urban Loads only)



Back River TMDL
May 1 to Oct 31 TP allocations
15% NPS REDUCTION (5% for MOS) (from Baseline 95 to 97 Total Urban Loads only)



Back River TMDL
May 1 to Oct 31 TP allocations
15% NPS REDUCTION (5% for MOS) (from Baseline 95 to 97 Total Urban Loads only)