Total Maximum Daily Loads of Carbonaceous Biochemical Oxygen Demand (CBOD), Nitrogenous Biochemical Oxygen Demand (NBOD), and Total Phosphorus (TP) for an Unnamed Tributary of La Trappe Creek into which the Town of Trappe Wastewater Treatment Plant Discharges Talbot County, Maryland

FINAL

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LIST OF ABBREVIATIONS

7Q10	7-day consecutive lowest flow expected to occur every 10 years
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CBOD	Carbonaceous Biochemical Oxygen Demand
CFR	Code of Federal Regulations
cfs	cubic feet per second
COMAR	Code of Maryland Regulations
CWA	Clean Water Act
CWAP	Clean Water Action Plan
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
FA	Future Allocation
gpd	Gallons per day
LA	Load Allocation
INPRG	Short for “Input Program”- a mathematical model for free-flowing streams
MDE	Maryland Department of the Environment
mgd	million gallons per day
MOS	Margin of Safety
NBOD	Nitrogenous Biochemical Oxygen Demand
NPDES	National Pollutant Discharge Elimination System
SOD	Sediment Oxygen Demand
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
USGS	United States Geological Survey
UTLTC	Unnamed Tributary of La Trappe Creek
WLA	Waste Load Allocation
WQIA	Water Quality Improvement Act
WQLS	Water Quality Limited Segment
WRAS	Watershed Restoration Action Strategy
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

This document establishes Total Maximum Daily Loads (TMDLs) for two non-tidal portions of the Lower Choptank River watershed: an unnamed tributary of La Trappe Creek (UTLTC) and a pond into which the UTLTC flows (hereinafter referred to as the "UTLTC In-Stream Pond"). The UTLTC and the UTLTC In-Stream Pond are located in Talbot County, Maryland within the Lower Choptank River watershed (02-13-04-03).

The Lower Choptank River watershed (02-13-04-03) was identified on the 1996 303(d) list of water quality limited segments submitted to U.S Environmental Protection Agency (EPA) by the Maryland Department of the Environment (MDE). The watershed was listed as being impaired by nutrients (due to signs of eutrophication expressed as low dissolved oxygen (DO)), fecal coliform, and suspended sediment. The list acknowledged that only a portion of the watershed might be impaired, and that with additional information, the spatial boundaries of the impairment could be refined. This document establishes TMDLs for two non-tidal portions of the watershed: TMDLs of carbonaceous biochemical oxygen demand (CBOD) and nitrogenous biochemical oxygen demand (NBOD) for an unnamed tributary of La Trappe Creek (UTLTC) and a TMDL of phosphorus for the UTLTC In-Stream Pond. The TMDLs described within this document were developed to address localized water quality impairments identified within these two portions of the watershed; the fecal coliform, suspended sediment, and nutrient impairments within other portions of the Lower Choptank River watershed will be addressed at a future date. The water quality impairments and TMDLs specific to these two portions of the watershed are described below.

Unnamed Tributary of La Trappe Creek

Upon consideration of additional water quality data, the Department determined that biochemical oxygen demand (BOD) is the dominant cause of low DO concentration in the UTLTC; therefore, this document establishes TMDLs of carbonaceous biochemical oxygen demand (CBOD) and nitrogenous biochemical oxygen demand (NBOD) for the UTLTC. The water quality goal of the TMDLs is to establish allowable CBOD and NBOD inputs at levels that will ensure the ambient dissolved oxygen (DO) standard is maintained in the UTLTC. The UTLTC is a free-flowing freshwater stream. It is a tributary of La Trappe Creek, which drains to Lower Choptank River.

The TMDL for CBOD and NBOD was developed using a mathematical model for free-flowing streams known as INPRG. This model uses the Streeter-Phelps equation to estimate the DO deficit in the stream segment. The model was used to determine the allowable CBOD and NBOD loadings, which would result in the maintenance of the receiving stream DO standard. The model was also used to investigate seasonal variations in stream conditions and to establish margins of safety that are environmentally conservative. Load allocations were determined for distributing allowable loads between point and nonpoint sources.

The point source allocation was based on the current and projected maximum loadings to be authorized under the National Pollutant Discharge Elimination System (NPDES) permit for the Trappe Wastewater Treatment Plant (WWTP). The overall objective of the TMDL established in

this document is to determine allowable CBOD and NBOD loads to levels that are expected to result in meeting all water quality criteria that support the designated use. The TMDL for 7Q10 low-flow conditions in the UTLTC is 820 lb/month for CBOD and 776 lb/month for NBOD. Because no DO violations are expected during average flow conditions, these TMDLs apply only from May 1 to September 30.

UTLTC In-Stream Pond

This document also establishes a TMDL that addresses control of pollutants causing excessive nuisance algae blooms in the UTLTC In-Stream Pond. Phosphorus is most likely the limiting nutrient for the production of algae in the UTLTC In-Stream Pond. The water quality goal of this TMDL for phosphorus is to reduce long-term phosphorus loads to an acceptable level consistent with the uses and physical characteristics of the UTLTC In-Stream Pond.

The phosphorus TMDL for the UTLTC In-Stream Pond was determined using an empirical method known as the Updated Vollenweider Relationship. The average annual TMDL for phosphorus is 384 lb/yr. The UTLTC In-Stream Pond receives the effluent from the Trappe WWTP via the UTLTC; therefore, the Trappe WWTP is considered a point source to the UTLTC In-Stream Pond. Consequently, the phosphorus allocation is apportioned between nonpoint sources, the Trappe WWTP, a Margin of Safety (MOS) and a future allocation for the Trappe WWTP.

Several factors provide assurance that these TMDLs of CBOD, NBOD, and phosphorus will be implemented. First, the Trappe WWTP has constructed upgrades for biological nitrogen reduction (BNR) and chemical phosphorus removal that should be capable of achieving the waste load allocations in the TMDLs and MDE has issued an NPDES permit to the plant consistent with those allocations. Second, Maryland has adopted a watershed cycling strategy, that will ensure that future water quality monitoring and TMDL evaluations are routinely conducted. In addition, the certainty of implementation of the nonpoint source phosphorus reductions to the UTLTC In-Stream Pond will be enhanced by two specific programs: the Water Quality Improvement Act of 1998 (WQIA), which requires that nutrient management plans be implemented for all agricultural land in Maryland; and the EPA-sponsored Clean Water Action Plan of 1998 (CWAP).

In order to improve the readability of this document, information specific to the UTLTC is separated from information specific to the UTLTC In-Stream Pond under each heading. Details shared by both portions of the watershed will precede the specific information.

1.0 INTRODUCTION

The Clean Water Act (CWA) Section 303(d)(1)(C) and the U.S. Environmental Protection Agency (EPA)'s implementing regulations direct each state to develop Total Maximum Daily Loads (TMDLs) for all impaired waters on the Section 303(d) list. A TMDL reflects the total pollutant loading of an impairing substance a waterbody can receive and still meet water quality standards. States must consider seasonal variations and must include a margin of safety (MOS) to account for uncertainty in the monitoring and modeling processes. Pursuant to 40 CFR 130.2(i), a TMDL can be expressed in mass per time, toxicity, or any other appropriate measure.

TMDLs are established to achieve and maintain water quality standards. A water quality standard is the combination of a designated use for a particular body of water and the water quality criteria designed to protect that use. Designated uses include activities such as swimming, drinking water supply, and shellfish propagation and harvest. Water quality criteria consist of narrative statements and numeric values designed to protect the designated uses. Criteria may differ among waters with different designated uses.

The Lower Choptank River watershed (02-13-04-03) was identified on the 1996 303(d) list of water quality limited segments submitted to U.S Environmental Protection Agency (EPA) by the Maryland Department of the Environment (MDE). The watershed was listed as being impaired by nutrients (due to signs of eutrophication expressed as low dissolved oxygen (DO)), fecal coliform, and suspended sediment. The list acknowledged that only a portion of the watershed might be impaired, and that with additional information, the spatial boundaries of the impairment could be refined. This document establishes TMDLs for two non-tidal portions of the watershed: an unnamed tributary of La Trappe Creek (UTLTC) and a pond into which the UTLTC flows (heretofore referred to as the "UTLTC In-Stream Pond"). The TMDLs described within this document were developed to address localized water quality impairments identified within these two portions of the watershed; the fecal coliform, suspended sediment, and nutrient impairments within other portions of the Lower Choptank River watershed will be addressed at a future date.

Unnamed Tributary of La Trappe Creek

A localized dissolved oxygen (DO) impairment in the UTLTC was identified during the renewal process of the National Pollutant Discharge Elimination System (NPDES) permit for the Trappe Wastewater Treatment Plant (WWTP). Water quality data collected during intensive field surveys of the UTLTC (the receiving stream for the Trappe WWTP) showed low DO concentrations. The Department's analysis demonstrates that the biochemical oxygen demand (BOD) loadings in the stream affect the DO concentrations, and describes the development of TMDLs for carbonaceous biochemical oxygen demand (CBOD) and nitrogenous biochemical oxygen demand (NBOD) to the UTLTC.

UTLTC In-Stream Pond

The intensive field surveys conducted as part of the NPDES permit renewal for the Trappe WWTP also revealed high (average of 82 µg/l) in-stream chlorophyll *a* concentrations just downstream of the UTLTC In-Stream Pond. The Department's analysis demonstrates that total phosphorus loading from the Trappe WWTP effluent affects the algal biomass in the UTLTC In-Stream Pond and, consequently, causes high chlorophyll *a* levels and low DO in downstream waters. Phosphorus is typically the limiting nutrient for the production of algae in freshwater lake systems such as the UTLTC In-Stream Pond.

2.0 SETTING AND WATER QUALITY DESCRIPTION

2.1 General Setting and Source Assessment

The UTLTC is located in Talbot County, Maryland and lies between the Atlantic Ocean and the Piedmont Plateau in the physiographic province called the Atlantic Coastal Plain. The UTLTC consists of three components: the non-tidal UTLTC; the UTLTC In-Stream Pond; and the tidal UTLTC, which begins approximately 20 feet beyond the UTLTC In-Stream Pond. The UTLTC overflows to La Trappe Creek, a tributary of the Lower Choptank River located in Talbot County, Maryland (Figure 1). This document does not address the tidal UTLTC; therefore, information regarding only the non-tidal UTLTC and the UTLTC In-Stream Pond is provided.

Unnamed Tributary of LaTrappe Creek

The mainstem of the UTLTC is approximately 650 meters (about 0.41 miles) long. The watershed of the UTLTC has an area of approximately 252 acres. As shown in Figures 2 and 3, the predominant land uses in the watershed, based on 1997 Maryland Office of Planning land cover data, are agriculture (159.7 acres or 63% of the total area), urban (53.4 acres or 21 % of the total area), forest/herbaceous (29.7 acres or 12% of the total area), and water (9.5 acres or 4% of the total area).

The substance of concern for the UTLTC TMDL is BOD; the major source of BOD is point source loads, especially during low-flow conditions. The only point source in the watershed is the Trappe WWTP, which discharges to the UTLTC at the head of the UTLTC. The Trappe WWTP holds an NPDES permit to discharge 0.144 million gallons per day (mgd) of treated domestic wastewater into the UTLTC during the low-flow period. Future increased discharge of 0.20 of treated domestic wastewater into UTLTC is planned.

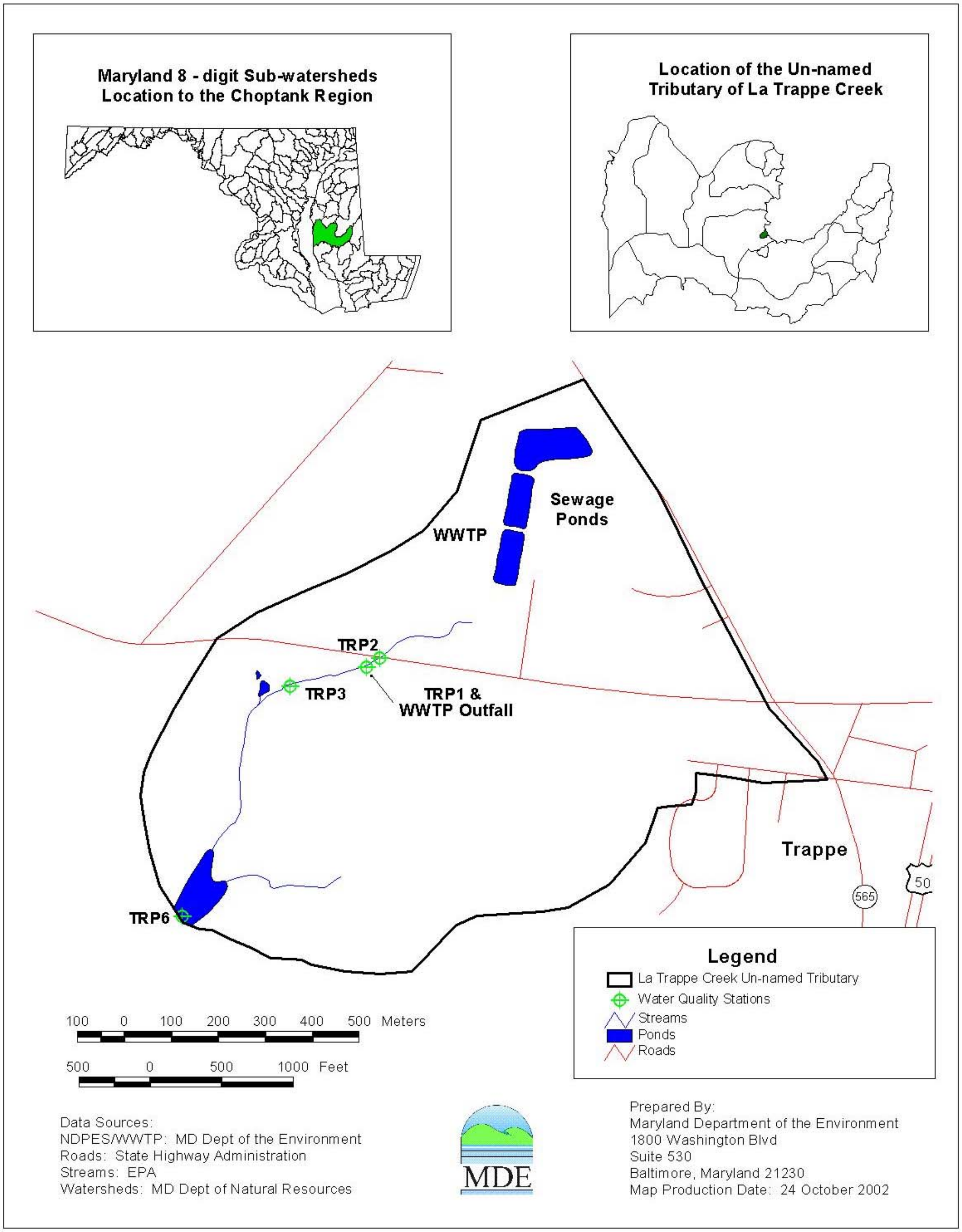

Figure 1: Location of the UTLTC Drainage Basin within Talbot County, MD

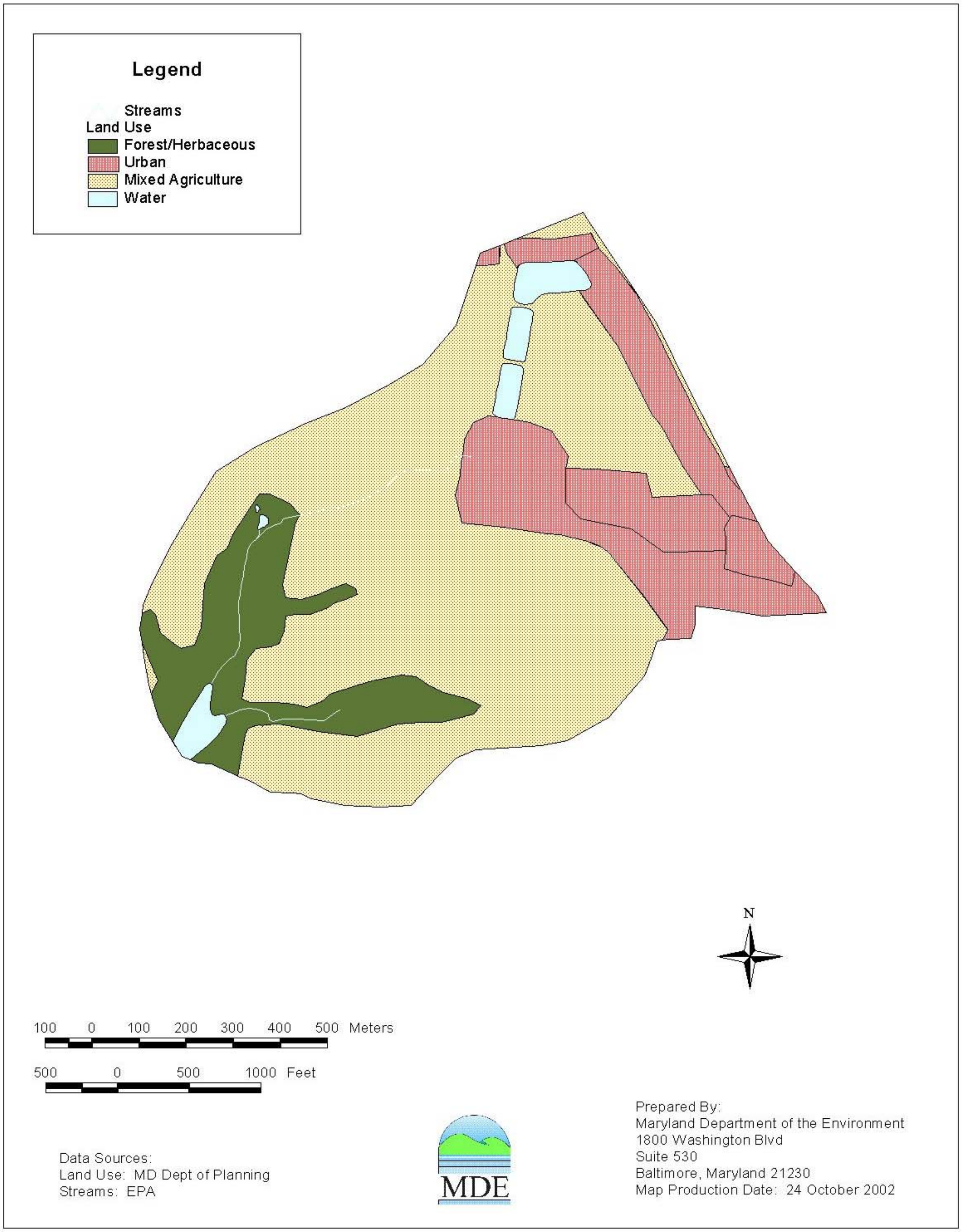

Figure 2: Land Use in the UTLTC Drainage Basin within Talbot County, MD

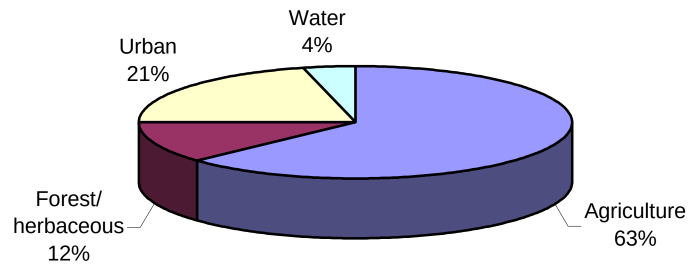

Figure 3: Proportions of Land Use in the UTLTC Drainage Basin

UTLTC In-Stream Pond

The UTLTC In-Stream Pond is a very small impoundment located on the UTLTC in the free-flowing section of the tributary. The UTLTC In-Stream Pond overflows back to the UTLTC and is the designated dividing line between tidal and non-tidal waters of the UTLTC. Inflow to the UTLTC In-Stream Pond is primarily via the UTLTC, which receives effluent from Trappe WWTP. The drainage area contributing to the UTLTC In-Stream Pond is approximately 252 acres (Figure 1). The drainage area contributes very little flow during low-flow period. Discharge from the UTLTC In-Stream Pond is to a continuation of the UTLTC, which becomes tidal after a distance of about 20 feet. Physical characteristics of the UTLTC In-Stream Pond are provided in Table 1.

Location:	Talbot County, MD
Surface Area:	3.93 acres
Length:	660 feet
Maximum Width:	260 feet (based on the National Wetlands Inventory map)
Average Depth (Current):	2.0 feet (based on the National Wetlands Inventory map)
Maximum Depth (Current):	4.0 feet (based on the National Wetlands Inventory map)
Volume:	7.873 acre-feet
Drainage Area to Pond:	252 acres

Table 1: Current Physical Characteristics of the UTLTC In-Stream Pond

As shown above in Figures 2 and 3, the predominant land uses in the watershed, based on 1997 Maryland Office of Planning land cover data, are agriculture (159.7 acres or 63% of the total area), urban (53.4 acres or 21 % of the total area), forest/herbaceous (29.7 acres or 12% of the total area), and water (9.5 acres or 4% of the total area). The soils immediately surrounding the UTLTC In-Stream Pond are marshes (Soil Conservation Service, 1970).

The substances of concern for the UTLTC In-Stream Pond TMDL are nutrients; the source of nutrients include both point source and nonpoint source loads. The only point source in the watershed is the Trappe WWTP, the effluent from which flows to the UTLTC In-Stream Pond via the UTLTC. The Trappe WWTP holds an NPDES permit to discharge 0.144 million gallons per day (mgd) of treated domestic wastewater into the UTLTC. A future increased discharge of 0.2 mgd of treated domestic wastewater into the UTLTC is planned and the installation of biological nutrient removal (BNR) and chemical phosphorus removal upgrades was completed in Spring 2002.

2.2 Water Quality Characterization

Three water quality sampling stations (i.e., TRP2, TRP3 and TRP6) exist within the UTLTC watershed. Figure 4 shows the locations of these water quality sampling sites. Water quality data from these sampling stations was used to characterize the existing water quality for the waterbodies of concern. Water quality data for four parameters (DO, total nitrogen (TN), total phosphorus (TP), and chlorophyll *a*) was collected at these stations in 1998 during the low-flow period of August through September.

Unnamed Tributary of La Trappe Creek

The important issues for the UTLTC TMDLs are the amount of BOD substances entering the system and the resulting DO concentrations. These parameters were measured in the 1998 water quality survey at TRP2 and TRP3, located within the UTLTC.

Dissolved Oxygen

The DO concentrations measured during the sampling period at TRP2 and TRP3 are shown in Table 2. The DO concentrations at TRP2 ranged from 6.7 mg/l to 7.9 mg/l, with an average concentration of 7.3 mg/l. The DO concentrations at TRP3 ranged from 3.5 mg/l to 4.9 mg/l, with an average concentration of 4.3 mg/l.

Sample Date	Station TRP2 (mg/l)	Station TRP3 (mg/l)
8/17/1998	7.4	3.5
8/26/1998	7.9	4.4
9/14/1998	6.7	4.9
Average	7.3	4.3

Table 2: Dissolved Oxygen Concentrations at TRP2 and TRP3 (UTLTC)

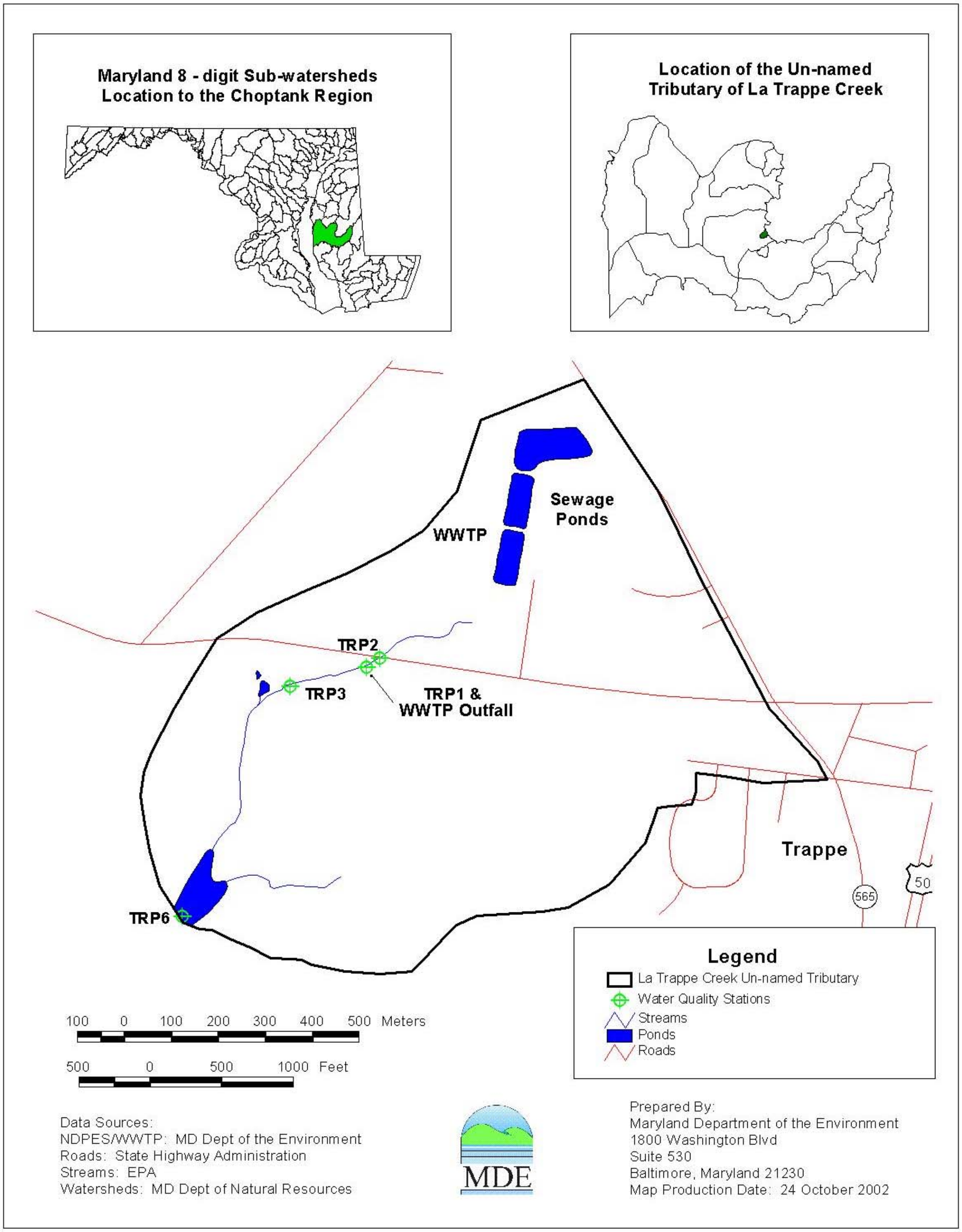

Figure 4: Location of Water Quality Monitoring Stations

Total Nitrogen

The TN concentrations measured during the sampling period at TRP2 and TRP3 are shown in Table 3. The TN concentrations at TRP2 ranged from 5.91 mg/l to 6.56 mg/l, with an average concentration of 6.19 mg/l. The TN concentrations at TRP3 ranged from 5.4 mg/l to 5.53 mg/l, with an average concentration of 5.48 mg/l.

Sample Date	**Station TRP2 (mg/l)**	**Station TRP3 (mg/l)**
8/17/1998	5.91	5.51
8/26/1998	6.56	5.53
9/14/1998	6.10	5.4
Average	6.19	5.48

Table 3: Total Nitrogen Concentrations at TRP2 and TRP3 (UTLTC)

Total Phosphorus

The TP concentrations measured during the sampling period at TRP2 and TRP3 are shown in Table 4. The TP concentrations at TRP2 ranged from 2.76 mg/l to 3.18 mg/l, with an average concentration of 2.91 mg/l. The TP concentrations at TRP3 ranged from 2.39 mg/l to 2.62 mg/l, with an average concentration of 2.72 mg/l.

Sample Date	**Station TRP2 (mg/l)**	**Station TRP3 (mg/l)**
8/17/1998	2.76	2.39
8/26/1998	2.8	2.62
9/14/1998	3.180	3.16
Average	2.913	2.72

Table 4: Total Phosphorus Concentrations at TRP2 and TRP3 (UTLTC)

Chlorophyll a

The chlorophyll *a* concentrations measured during the sampling period at TRP2 and TRP3 are shown in Table 5. The chlorophyll *a* concentrations at TRP2 ranged from 2.6 µg/l to 5.4 µg/l, with an average concentration of 4.3 µg/l.

Sample Date	**Station TRP2 (µg/l)**	**Station TRP3 (µg/l)**
8/17/1998	2.6	12
8/26/1998	5.0	3.9
9/14/1998	5.4	2.3
Average	4.3	6.1

Table 5: Chlorophyll *a* Concentrations at TRP2 and TRP3 (UTLTC)

UTLTC In-Stream Pond

The important issues for the UTLTC In-Stream Pond TMDL are the amount of nutrients entering the system, the chlorophyll *a* concentrations (a surrogate for algal blooms), and the resulting DO concentrations. These parameters were measured in the 1998 Water Quality Survey at station TRP6. Although TRP6 is located at the UTLTC In-Stream Pond's discharge point and not *in situ*, samples collected at this station are considered reliable indicators of the water quality conditions within the UTLTC In-Stream Pond.

Dissolved Oxygen

The DO concentrations measured during the sampling period at TRP6 are shown in Table 6. The DO concentrations at TRP6 ranged from 3.6 mg/l to 4.9 mg/l, with an average concentration of 4.3 mg/l.

Sample Date	Station TRP6 (mg/l)
8/17/1998	3.6
8/26/1998	4.9
9/14/1998	4.8
Average	4.3

Table 6: Dissolved Oxygen Concentrations at TRP6 (UTLTC In-Stream Pond)

Total Nitrogen

The TN concentrations measured during the sampling period at TRP6 are shown in Table 7. The TN concentrations at TRP6 ranged from 2.87 mg/l to 5.50 mg/l, with an average concentration of 3.83 mg/l.

Sample Date	Station TRP6 (mg/l)
8/17/1998	5.50
8/26/1998	2.87
9/14/1998	3.12
Average	3.83

Table 7: Total Nitrogen Concentrations at TRP6 (UTLTC In-Stream Pond)

Total Phosphorus

The TP concentrations measured during the sampling period at TRP6 are shown in Table 8. The TP concentrations at TRP6 ranged from 1.74 mg/l to 1.92 mg/l, with an average concentration of 1.8 mg/l.

Sample Date	Station TRP6 (mg/l)
8/17/1998	1.7
8/26/1998	1.74
9/14/1998	1.92
Average	1.8

Table 8: Total Phosphorus Concentrations at TRP6 (UTLTC In-Stream Pond)

Chlorophyll a

The chlorophyll *a* concentrations measured during the sampling period at TRP6 are shown in Table 9. The chlorophyll *a* concentrations at TRP6 ranged from 54 µg/l to 128 µg/l, with an average concentration of 82 µg/l.

Sample Date	Station TRP6 (µg/l)
8/17/1998	128
8/26/1998	54
9/14/1998	64
Average	82

Table 9: Chlorophyll *a* Concentrations at TRP6 (UTLTC In-Stream Pond)

2.3 Water Quality Impairment

Unnamed Tributary of La Trappe Creek

The Maryland water quality standards Surface Water Use Designation [Code of Maryland Regulations (COMAR) 26.08.02.07] for the UTLTC is Use I - *water contact recreation, fishing, and protection of aquatic life and wildlife*. According to the numeric criteria for DO for Use I waters, concentrations may not be less than 5.0 mg/l at any time (COMAR 26.08.02.03-3A(2)) unless resulting from natural conditions (COMAR 26.08.02.03.A(2). The summer months minimum DO concentration observed in the UTLTC during the 1998 sampling was 3.5 mg/l.

UTLTC In-Stream Pond

The Maryland water quality standards Surface Water Use Designation (COMAR 26.08.02.07) for the UTLTC In-Stream Pond is Use I - *water contact recreation, fishing, and protection of aquatic life and wildlife*. According to the numeric criteria for DO for Use I waters, concentrations may not be less than 5.0 mg/l at any time (COMAR 26.08.02.03-3A(2)) unless resulting from natural conditions (COMAR 26.08.02.03.A(2). The summer months minimum DO concentration observed in the UTLTC In-Stream Pond water quality samples was 3.6 mg/l.

Furthermore, Maryland's general water quality criteria prohibit pollution of waters of the State by any material in amounts sufficient to create nuisance or interfere with designated uses (COMAR 26.08.02.03B2). Additionally, COMAR 26.08.03.01.B3 recognizes that certain surface waters are eutrophic and directs that all discharges to these surface waters shall be treated as necessary to reduce eutrophic effects. Excessive eutrophication, indicated by elevated levels of chlorophyll *a*, can produce nuisance levels of algae and interfere with designated uses such as fishing and swimming. The UTLTC In-Stream Pond was identified as eutrophic and use impaired, utilizing a trophic classification index and data from water quality samples taken in 1998. The chlorophyll *a* levels in the UTLTC In-Stream Pond ranged from 54 µg/l to 128 µg/l. The substance causing this water quality violation is phosphorus. Refer to Section 4.2.1 for information regarding how the impairing substance (phosphorus) was determined.

3.0 TARGETED WATER QUALITY GOAL

<u>Unnamed Tributary of La Trappe Creek</u>

The UTLTC is a Use I designated water body according to the Code of Maryland Regulations 26.08.02. The DO standard for a Use I water is 5.0 mg/l at any time. The summer months minimum DO concentration observed in the UTLTC during the 1998 sampling was 3.5 mg/l. The overall objective of the TMDLs of CBOD and NBOD established in this document for the UTLTC is to reduce BOD loads to levels that are expected to result in meeting all water quality criteria that support the Use I designation.

<u>UTLTC In-Stream Pond</u>

The UTLTC In-Stream Pond is classified as Use I - *Water Contact Recreation, and Protection of Aquatic Life.* The DO standard for a Use I water is 5.0 mg/l at any time. The summer months minimum DO concentration observed in the UTLTC In-Stream Pond water quality samples was 3.6 mg/l. The chlorophyll *a* endpoint of 25 µg/l selected for the UTLTC In-Stream Pond is in the lower range of eutrophy, which is an appropriate trophic state at which to manage this warm-water pond impoundment that is used primarily as an aquatic habitat. The chlorophyll *a* levels ranged from 54 µg/l to 128 µg/l, indicating eutrophic conditions.

Other states have adjusted their trophic-state expectation for lakes or impoundments with differing uses. Minnesota, for example, uses an ecoregion-based approach. Heiskary (2000) reports that individuals utilizing lakes for recreational purposes (e.g., water contact, fishing) demanded relatively clear, less enriched lakes in the Northern Lakes and Forest and North Central Hardwood Forest ecoregions. In the Western Corn Belt Plains and Northern Glaciated Plains ecoregions, however, users accepted relatively greater enrichment and less clarity.

The UTLTC In-Stream Pond lies in the Mid-Atlantic Coastal Plain (MACP) ecoregion, which extends from central New Jersey to northern Georgia. Topography is low and flat, soils are sandy, the dominant land use is agricultural, and there are few natural lakes (none in Maryland). Impoundments tend to be shallow with large watershed/surface area ratios, resulting in a relatively high degree of allochthonous nutrient loading. Morphometry thus favors eutrophy. The MACP ecoregion is topographically and functionally similar to the two agricultural ecoregions Heiskary describes in Minnesota.

The overall objective of the TMDL established in this document for the UTLTC In-Stream Pond is to reduce phosphorus loads to levels that are expected to result in meeting all water quality criteria that support the Use I designation. Specifically, one goal is to improve the trophic status of the UTLTC In-Stream Pond by reducing the total phosphorus loads. This is predicted in turn to reduce excessive plant and algae growth, which leads to violations of the numeric DO criteria, and the violation of various narrative criteria associated with eutrophication.

4.0 TOTAL MAXIMUM DAILY LOADS AND ALLOCATIONS

Information pertaining to the development and allocation of CBOD and NBOD TMDLs to the UTLTC is presented in subsections 4.1 through 4.1.7. Information pertaining to the development and allocation of the phosphorus TMDL to the UTLTC In-Stream Pond is presented in subsections 4.2 through 4.2.7.

<u>Unnamed Tributary of La Trappe Creek</u>

4.1 Overview for the UTLTC

This section describes how the TMDLs and load allocations for point sources were developed for the UTLTC. Subsection 4.1.1 describes the modeling framework used to simulate water quality constituent interactions and hydrology. Subsections 4.1.2 and 4.1.3 summarize the scenarios that were explored using the model. These scenarios investigate water quality responses assuming different low-flow stream conditions and load allocations. Subsections 4.1.4 and 4.1.5 present the modeling results in terms of TMDLs, and allocate the TMDL to the point source. Subsection 4.1.6 explains the rationale for the MOS. Finally, the pieces of the equation are combined in a summary accounting of the TMDL in subsection 4.1.7.

4.1.1 Analytical Framework for Determining CBOD and NBOD Loads to the UTLTC

The computational framework, or model, chosen for determining the TMDLs of CBOD and NBOD to the UTLTC was the INPRG water quality model. INPRG is a steady-state mathematical model, developed within MDE for the impact assessment of point and nonpoint source load discharges of material, which exert an oxygen demand in free-flowing, streams. The model runs required an input of CBOD and NBOD to incorporate the total BOD loads. The CBOD value was calculated by multiplying the five-day BOD by 1.5; the NBOD value were calculated multiplying the Total Kjeldahl Nitrogen (TKN) concentration by 4.6. The model prepares input data and runs a free-flowing stream model based upon the Streeter-Phelps equation. The model calculates the daily average DO concentrations in the stream by considering the oxidation of CBOD and NBOD and reaeration only, and predicts receiving stream CBOD, NBOD, and DO concentrations for selected stream input conditions. For more information on

INPRG, please refer to Appendix A.

The spatial domain represents the watershed that is included in the model, and extends approximately 670 meters (0.42 miles) from its headwaters to the confluence with the UTLTC In-Stream Pond. Three modeling segment stations were selected, with Station 1 in the upper boundary of the model spatial domain, just below the Trappe WWTP outfall, Station 2 approximately 180 meters southwest of Station 2, and Station 3 just above the confluence with the pond in the lower boundary (see Figure 5). Neither model segment has an associated nonpoint source load entering the system, due to the assumed zero value for the seven-day, 10-year, low-flow in the system (a.k.a., 7Q10 conditions).

The in-stream data accounts for atmospheric deposition to the land, nonpoint source runoff from urban development, agriculture, and forestland, and infiltration from septic tanks. Because there are no U.S. Geological Survey (USGS) gauging stations located on the receiving stream, the freshwater flows used in the model were obtained from the USGS gage 0149200 located on Beaver Dam Branch at Matthews, Maryland.

The Trappe WWTP is the only NPDES permitted point source in the UTLTC watershed. The Trappe WWTP is a lagoon treatment system with chlorination disinfecting process. The plant is in the process of implementing Biological Nutrient Removal (BNR) technology, with additional phosphorus removal to be incorporated. The point source values used in this document come from the monitoring results measured at water quality station TRP1, the Trappe WWTP outfall. The nonpoint source loads of nutrients and BOD enter the system at the upstream boundary located at water quality modeling point 1 and downstream tributaries of the UTLTC. These nonpoint source loads are assumed negligible for the low-flow TMDL analysis. No nonpoint source runoff was assumed for the low-flow summer period.

The INPRG model was calibrated using the August data (8/17/98 and 8/26/98) and verified by September data (9/17/98) collected by MDE’s Field Operations Program staff. For more information on INPRG calibration and verification, see Appendix A.

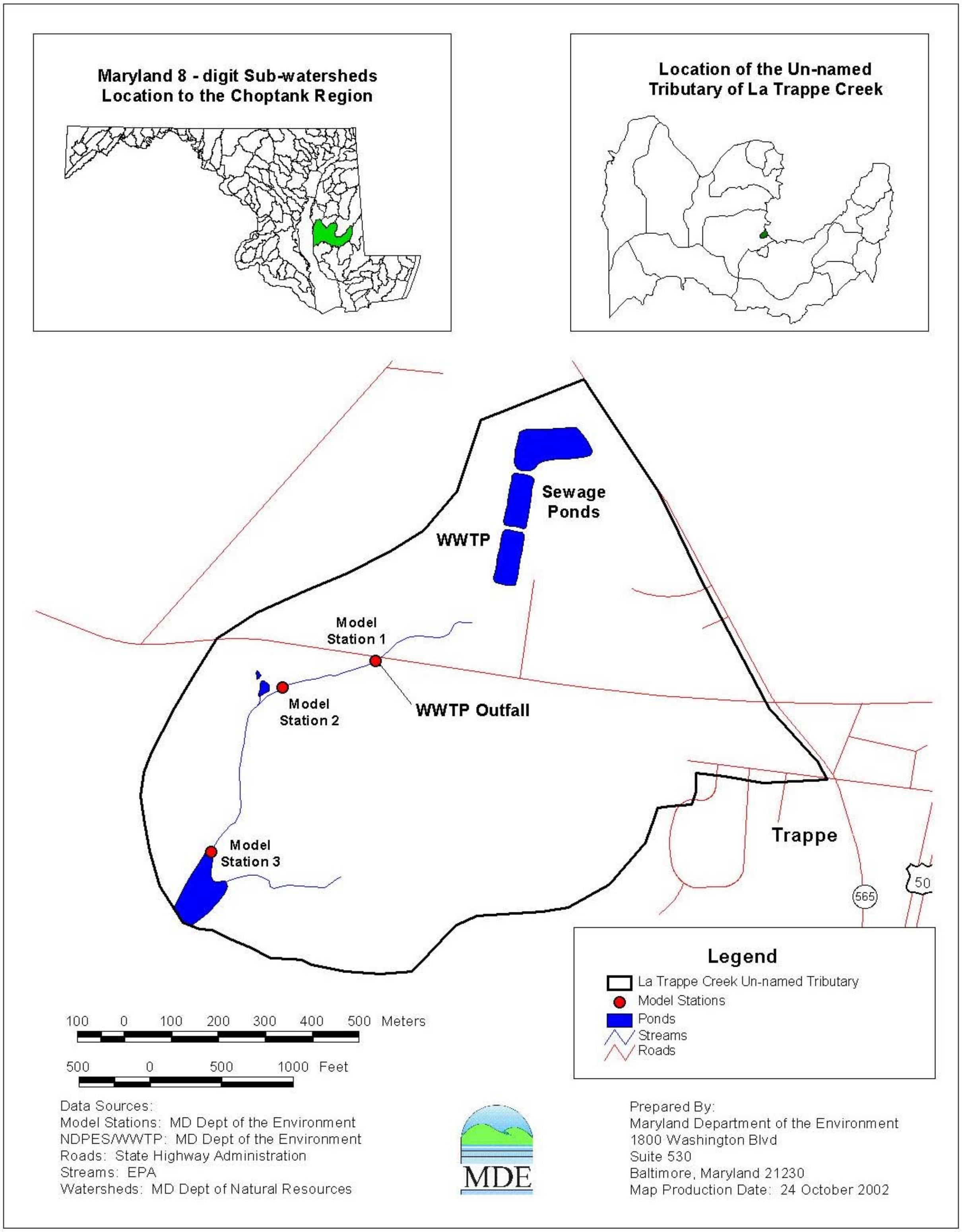

Figure 5: Location of Model Segmentation Stations

In addition to accounting for the sources of the substances of concern, the processes that deplete DO were also considered. These processes include those that consume oxygen (sinks) as well as those that generate oxygen (sources). These processes and some additional factors are presented in Figure 6. BOD reflects the amount of oxygen consumed through two processes: CBOD and NBOD. CBOD is the reduction of organic carbon material to its lowest energy state, carbon dioxide, through the metabolic action of microorganisms (principally bacteria). NBOD is the term for the oxygen required for nitrification, which is the biological oxidation of ammonia to nitrate. The BOD values seen throughout this document represent the amount of oxygen consumed by the oxidation of carbonaceous and nitrogenous waste materials over a five-day period at 20 °C. This is referred to as a five-day, 20 °C BOD, and is the standard reference value utilized internationally by both design engineers and regulatory agencies. The five-day, 20 °C BOD represents primarily consumption of carbonaceous material and minimal nitrogenous material. The ultimate BOD represents the total oxygen consumed by carbonaceous and nitrogenous material, over an unlimited length of time.

Another factor influencing DO concentrations is the sediment oxygen demand (SOD). As with BOD, SOD is a combination of several processes. Primarily it is the aerobic decay of organic materials that settle to the bottom of the stream. SOD is usually considered negligible in free-flowing streams because frequent scouring during storm events usually prevents long-term accumulation of organic materials. However, for the UTLTC, a SOD value of 1.5 $g/m^2/d$ was selected to calibrate the model according to EPA's "Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling". Since there is no dilution at the point of discharge and frequent scouring is unlikely, depletion of DO could be caused by the SOD. For more information, see Appendix A.

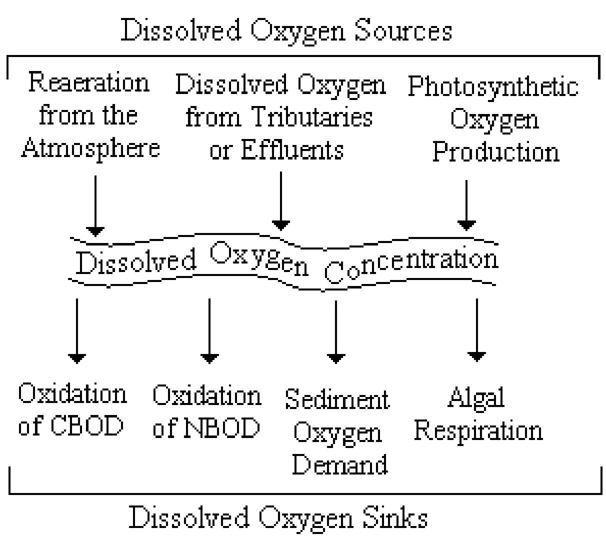

Figure 6: Sources and Sinks for Dissolved Oxygen in the UTLTC

4.1.2 Scenario Descriptions for the UTLTC

To project the water quality response of the system, the calibrated model was subjected to several different scenarios under selected stream flow conditions. The scenarios are grouped into three categories: an existing condition scenario, representing the stream with current capacity of the Trappe WWTP; an intermediate condition representing the system with the projected maximum future point source loads and average flow nonpoint source loads; and a final condition scenario, representing the system with the projected maximum future point source loads and low-flow nonpoint source loads.

Existing Condition Scenario (Scenario 1)

Scenario 1 represents the system during summer low-flow critical conditions. In this scenario, the system was examined for in-stream DO response when subjected to point source loads for the current design capacity and corresponding nonpoint source loads without violating target DO standards. A flow rate of zero cubic feet per second (cfs), which represents the 7Q10 flow, at USGS gage 01492000 located on Beaver Dam Branch at Matthews, Maryland was used. As described above in Section 4.1.1, the flows entering at the upstream boundary and from tributaries were estimated based on proportional drainage areas and gage data from the USGS gage 01492000. The nonpoint source loads reflect observed water quality concentrations in the UTLTC watershed during the summer stream surveys of 1998. However, nonpoint source loads will be neglegible under 7Q10 flow conditions. Point source loads were computed under the assumption that the Trappe WWTP would be discharging at its current permitted design capacity (0.144 mgd) and the estimated NPDES permit limits, which will not violate the water quality criteria of receiving water. This scenario represents summer conditions.

Intermediate Condition Scenario (Scenario 2)

Scenario 2 represents the system during the average flow conditions for the period May 1 through September 30. In this scenario, the system was examined for in-stream DO response when subjected to future point source loads and nonpoint source loads corresponding to average flow without violating target DO standards. This average flow was estimated based upon proportional drainage areas and mean flow data from May through September from the USGS gage 01492000. The nonpoint source loads reflect an assumed CBOD concentration of 6.9 mg/l and an assumed NBOD concentration of 4.1 mg/l in the UTLTC watershed during average flow conditions. An average flow of 0.397 cfs was used.

Final Condition Scenario (Scenario 3)

In Scenario 3, the system was subjected to point source loads corresponding to the expanded design capacity. This scenario is intended to examine the in-stream DO response when subjected to maximum future point source loads and nonpoint source loads corresponding to low-flow conditions, without violating DO standards. This scenario will also determine the proposed TMDL, including the margin of safety and future allocations. Please note that the nonpoint source loads were negligible for this scenario due to no background or tributary flows. Point source loads were computed under the assumption that the Trappe WWTP would be discharging at its planned future flow of 0.20 mgd and the estimated NPDES permit limits which will not violate the water quality criteria of receiving water. This scenario also represents summer low-flow conditions. The point and nonpoint source loads for all scenarios can be seen in Table 10.

	Scenario 1	Scenario 2	Scenario 3	Scenario 3 – Scenario 1
Nonpoint Source Loads				
CBOD (lb/day)	-	14.8	0	0
NBOD (lb/day)	-	9.0	0	0
Flow (cfs)	0	0.397	0	0
Point Source Loads				
CBOD (lb/day)	18.0	25.0	25.0	7.0
NBOD (lb/day)	16.6	23.0	23.0	6.4
Flow (mgd)	0.144	0.20	0.20	0.056
CBOD Margin of Safety (lb/day)	0.00	0.0	2.33	2.33
NBOD Margin of Safety (lb/day)	0.00	0.0	2.87	2.87

Table 10: Point and Nonpoint Source Flows and Loads used in the Model Scenario Runs

4.1.3 Model Results for the UTLTC

Existing Condition Scenario (Scenario 1)

Current WWTP flow: Assumes 7Q10 conditions, summer nonpoint source concentrations, and current monthly summertime NPDES permitted flows and concentrations at the Trappe WWTP. A wastewater flow of 144,000 gallons per day (gpd) was assumed for the Trappe WWTP, with CBOD and NBOD loads based on a five-day BOD concentration of 10 mg/l and a TKN concentration of 3 mg/l. As shown in Figure 6, the DO standard is not violated under this scenario.

Intermediate Condition Scenario (Scenario 2)

Average flow: Assumes average stream flow conditions and average nonpoint source conditions. An increased wastewater flow of 200,000 gpd was assumed for the Trappe WWTP, with CBOD and NBOD loads based on a five-day BOD concentration of 10 mg/l and a TKN concentration of 3 mg/l. The results of this scenario, as seen in Figure 7, indicate an in-stream DO concentration well above 6.9 mg/l during the average flow conditions.

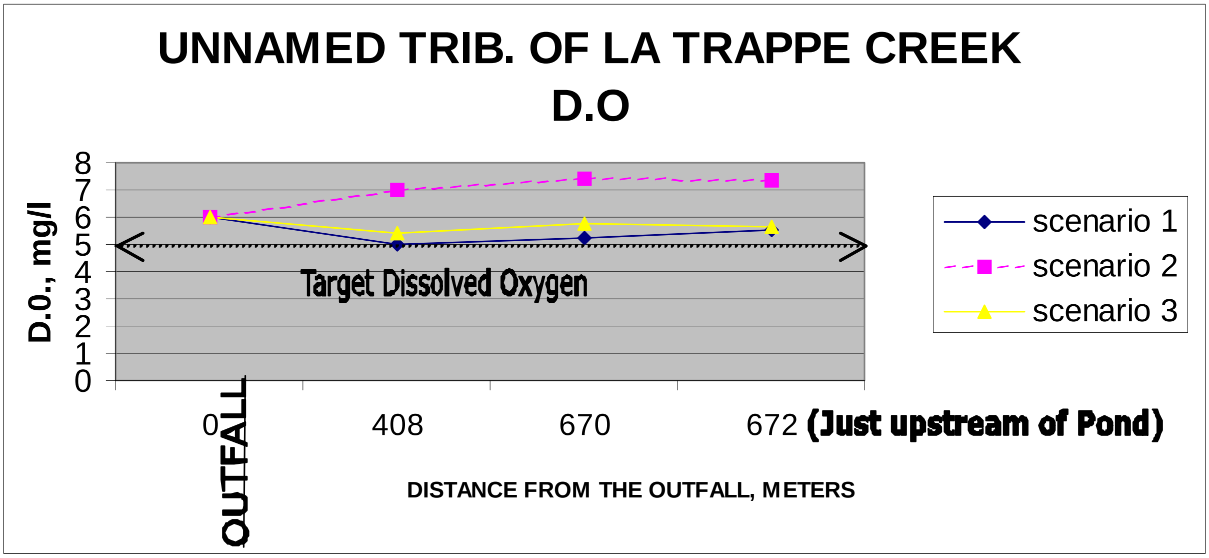

Figure 7: Results of Model Scenario Runs 1, 2 and 3 for Dissolved Oxygen

Final Condition Scenario (Scenario 3)

Future Projected WWTP flow: Assumes 7Q10 conditions. A wastewater flow increase to 200,000 gpd was assumed for the Trappe WWTP, with CBOD and NBOD loads based on a five-day BOD concentration of 10 mg/l and a TKN concentration of 3 mg/l.

As shown in Figure 7, the results of Scenario 3 indicate a critical DO sag close to 5.0 mg/l when the nonpoint source loads are neglegible. Scenario 3 therefore, provides the TMDL waste load allocations, future growth, as well as a margin of safety. For detailed analysis of the model scenario runs, see Appendix A.

4.1.4 TMDL Loading Cap for the UTLTC

Scenario 1 showed that the DO standard in the UTLTC is not violated during low stream flow conditions in the summer, when the water temperatures are warmer and there is less water flowing in the system. Scenario 2 indicated that no DO violations are expected during average flow conditions. Scenario 3 showed that the DO standard is met with a future allocation (FA) and a MOS included. Thus, the modeling analyses indicate that, under future projected conditions with the proposed CBOD and NBOD TMDLs, water quality standards are maintained for all flow conditions. This TMDL only applies from May 1 to September 30. Scenario 3 represents the final TMDL loading scenario.

The resultant TMDL loading for CBOD and NBOD is:

CBOD TMDL (May 1 to September 30)	**820 lb/month**
NBOD TMDL (May 1 to September 30)	**776 lb/month**

4.1.5 Load Allocations Between Point and Nonpoint Sources for the UTLTC

The point source load allocations for CBOD and NBOD are represented as future monthly summer loads (based on future permitted flow) from the Trappe WWTP. The total monthly load allocation was calculated directly from future daily average permit limits multiplied by 30 days. To implement the point source allocations, permit limits will continue to be expressed as daily average limits and will be calculated by dividing the allocated TMDL monthly load by 30. To ensure that sampling variability issues are addressed, the limits will also require (at a minimum) the same minimum sampling frequencies associated with the current permit limits. This load allocation is also based on the understanding that the Trappe WWTP will continue to discharge a minimum daily average DO concentration of no less than 5.0 mg/l. NPDES permit limits for the five-day BOD and TKN at the facility were developed to be protective of the DO standards applicable to the UTLTC.

The current contribution by nonpoint sources during summer months is assumed as neglegible. There is no significant contribution both by overland flow and base flow by the UTLTC drainage area. The point source and nonpoint source allocations for CBOD and NBOD are summarized below in Table 11.

	Nonpoint Source (lb/month)	Point Source (lb/month)	Total (lb/month)
CBOD	**0**	**750**	**750**
NBOD	**0**	**690**	**690**

Table 11: Point Source and Nonpoint Source Load Allocations for the UTLTC

The above allocations are made on the basis of the 7Q10 flow condition, which in this case represents a stream flow comprised solely of the Trappe WWTP effluent and no runoff loads due to rainfall. Although the nonpoint source loads may exceed the stated allocation of zero at times during the summer months (such as during storm events), the modeling indicates that such flow conditions would not result in violations of water quality standards. The allocations presented demonstrate how TMDLs could be implemented to achieve water quality standards; however, MDE expressly reserves the right to allocate the TMDLs among different sources in any manner that is reasonably calculated to achieve water quality standards.

4.1.6 Future Allocation and Margin of Safety for the UTLTC

Future allocations represent assimilative surplus loading capacity that is either currently available, or projected to become available due to planned implementation of environmental controls or other changes. It was determined that, in addition to the Trappe WWTP's current 0.144 mgd flow, 0.056 mgd could be introduced from the plant without violating the in-stream DO standards.

TMDLs must include a MOS in recognition of the uncertainties in our scientific and technical understanding of water quality in natural systems. Specifically, 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 is not known. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of protection of the environment. Based on EPA guidance, the MOS can be achieved through one of two approaches: (1) reserve a portion of the loading capacity as a separate term in the TMDL, or (2) incorporate the MOS as part of the design conditions for the waste load allocations and the load allocations computations (EPA, April 1991). The CBOD and NBOD TMDLs for the UTLTC employ both of these approaches.

In calculating minimum DO levels, MDE assumes a 90th % highest observed summertime water temperature of 25.4^{o} C. In the TMDLs, loading capacities of 70 lb/month of CBOD and 86 lb/month of NBOD were set aside for a MOS. The MOS at the Trappe WWTP was calculated as 25% of the difference between the weekly and monthly effluent permit limits. This is considered an appropriate MOS because it is unlikely that the Trappe WWTP will go above its monthly limit more than a quarter of the time during a month. In addition to the set-aside CBOD and NBOD MOS, the design conditions for the waste load allocation to point sources, load allocation to nonpoint sources, and the future allocation computations include two implicit MOSs. First, the 7Q10 flow was used to determine the final TMDL load allocations. Because the 7Q10 flow constitutes a worst-case scenario, its use builds a conservative assumption into the TMDL. Second, all the modeling was performed using the NPDES monthly permit limits for effluent concentrations. The monthly limits are conservative because they represent an upper limit, which the WWTP will strive to fall below in order to avoid paying a fine. In addition, the future allocations implicitly include a MOS for the point sources only. The point source loadings could allow an increased flow of 0.056 mgd. The future allocation and MOS can be seen in Table 12.

	Future Allocation (lb/month)	Margin of Safety (lb/month)
CBOD	210	70
NBOD	193	86

Table 12: Future Allocation and Margin of Safety for the UTLTC

4.1.7 Summary of Total Maximum Daily Loads for the UTLTC

Because no DO violations are expected during average high-flow conditions (as indicated by Scenario 2), these TMDLs for the UTLTC - applicable during the low stream flow period of May 1 to September 30 - equated with illustrative allocations are:

For CBOD (lb/month)

TMDL	**=**	**LA**	**+**	**WLA**	**+**	**FA**	**+**	**MOS**
820	**=**	**0**	**+**	**540**	**+**	**210**		**70**

For NBOD (lb/month)

TMDL	=	LA	+	WLA	+	FA	+	MOS
776	**=**	**0**	**+**	**497**	**+**	**193**		**86**

Where:

LA = Load Allocation or Nonpoint Source
WLA = Waste Load Allocation or Point Source
FA = Future Allocation
MOS = Margin of Safety

UTLTC In-Stream Pond

4.2 Overview for the UTLTC In-Stream Pond

This section describes how the TMDLs and load allocations for point and nonpoint sources were developed for the UTLTC In-Stream Pond. Subsection 4.2.1 describes the analysis for determining that phosphorus is likely to be the limiting nutrient in the UTLTC In-Stream Pond, as well as the methodological framework for estimating a permissible phosphorus load. Subsection 4.2.2 summarizes the analysis used to establish the maximum allowable phosphorus load. Subsection 4.2.3 provides a discussion of the analytical results. Subsections 4.2.4 and 4.2.5 describe the translation of the analytical results into statements of a TMDL and allocations. Subsection 4.2.6 describes the future allocation and the MOS. Subsection 4.2.7 summarizes the TMDL and allocations to the point source, nonpoint sources, the future allocation, and a MOS.

4.2.1 Analytical Framework for Determining Phosphorus Loads to the UTLTC Receiving Pond

The UTLTC In-Stream Pond suffers from excessive nutrient enrichment. The TMDL for phosphorus to the UTLTC In-Stream Pond is based on widely-accepted empirical method known as the Updated Vollenweider-OECD Normalized P Loading/Chlorophyll Response Relationship. This relationship predicts the degree of a lake's eutrophication as a function of the areal phosphorus loading. R.A. Jones and G.F. Lee (1986) developed this relationship after reevaluating and expanding on the work done on about 20 lakes - many located in Europe - by R. A. Vollenweider (1968). Jones and Lee used about 300 lakes, mainly located in North America, to establish a linear relationship between the log of the normalized phosphorus loading (L_p) and the log of the chlorophyll *a* concentration (Figure 8). This method is advantageous for a number of reasons: it is based on real data collected from a wide range of lakes; its application is conceptually simple and does not require the assumptions of many unknown parameters; and it is recognized by the scientific community as reasonable method of predicting the trophic status of lakes.

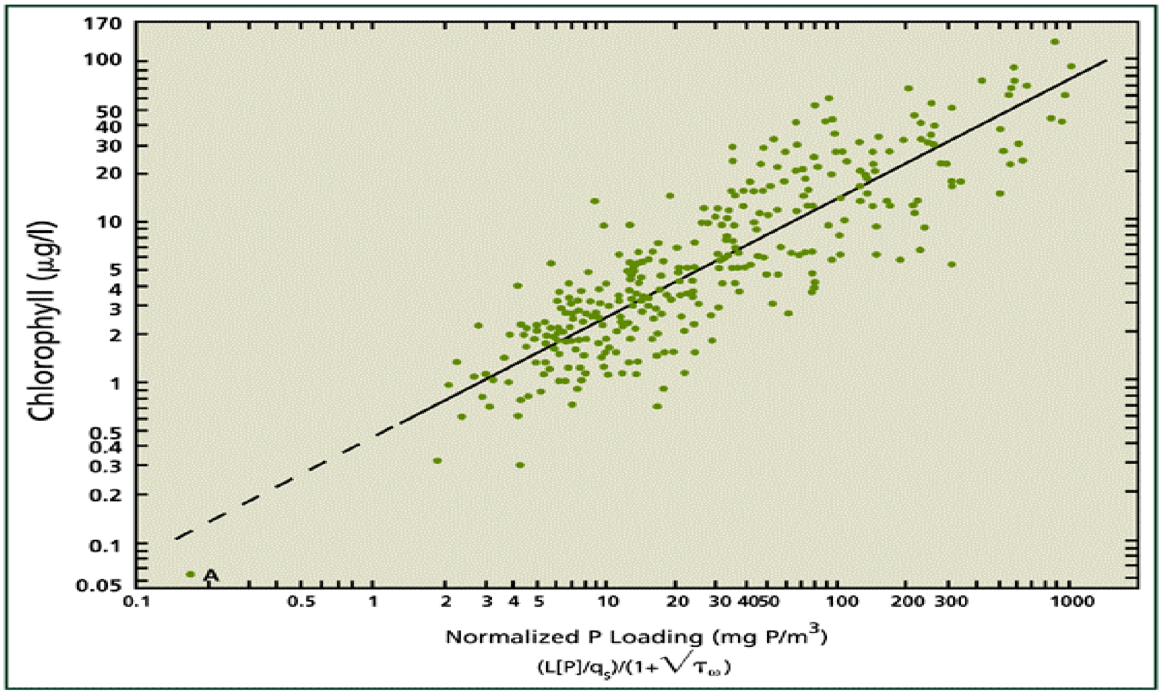

Figure 8: Updated Vollenweider-OECD Normalized P Loading/Chlorophyll Response Relationship

Nitrogen and phosphorus are essential nutrients for algae growth. However, common types of algae require different amounts of these two nutrients. If one nutrient is available in great abundance relative to the other nutrient, the less-available nutrient restricts the amount of plant matter that can be produced, regardless of the amount of the other nutrient that is available. The less-available nutrient is referred to as the "limiting nutrient". Applying the Updated Vollenweider-OED Relationship necessitates that phosphorus be the limiting nutrient. Thus, before considering the application of the Vollenweider Relationship, it is necessary to examine the ratio of nitrogen to phosphorus to identify the limiting nutrient.

In general, an N:P ratio in the range of 5-10:1 by mass is associated with plant growth being limited by neither phosphorus nor nitrogen. If the N:P ratio is greater than 10, phosphorus tends to be limiting, and if the N:P ratio is less than 5, nitrogen tends to be limiting (Chianudani et al., 1974). An N:P ratio of less than 5 was computed using the water quality data collected at sampling station TRP6, which indicates that nitrogen is currently limiting in the UTLTC In-Stream Pond. However, the UTLTC In-Stream Pond is anticipated to become phosphorus limited after phosphorus removal is completed through the upgrade at the Trappe WWTP. Accordingly, the use of the Updated Vollenweider-OECD Normalized P Loading/Chlorophyll Response Relationship is justified. Supporting data is provided in Table B1 and B2 of Appendix B.

4.2.2 Updated Vollenweider-OECD Normalized P Loading/Chlorophyll Response Relationship Analysis for the UTLTC In-Stream Pond

The relationship shown above in Figure 8 establishes a linear relationship between the log of the phosphorus loading (L_p) and the log of the chlorophyll *a* concentration. The normalized P loading rate is expressed as:

$(L_p / q_s)/(1+\tau_w^{\ 0.5})$, where q_s is the mean depth/the hydraulic residence time and τ_w is the hydraulic residence time

The computation and results of the relationship are summarized below. See Appendix B for details of the computations and supporting data.

Pond Mean Depth ($\bar{Z}$):

The application of the Vollenweider assumes the pond's physical dimensions. The surface area of Pond was estimated as 3.77 acres (15920 m^2).

Pond Volume: 9711 m^3 (Appendix B, Page B-3)

Pond Surface Area: 15920 m^2

Pond Mean Depth ($\bar{Z}$): (Volume)/(Surface Area) = 0.61 m (Appendix B, Page B-3)

Phosphorus Loading to Pond (L_p):

The total phosphorus loading is estimated as 728,100 gms per year (Appendix B, Page B-4). Expressing this value as a loading per surface area of the pond gives 45.7 *g/m²yr*.

Annual Phosphorus Load (L_p) with the current point source load is: 45.7 g/m^2 yr. Details are provided in Appendix B, Page B-5.

Annual Phosphorus Load (L_p) with the reduced point source load is: 10.94 g/m^2 yr. Details are provided in Appendix B, Page B-4.

Pond's Hydraulic Residence Time (τ_w) with the Current Point Source Load

The hydraulic residence time is computed as volume/outflow; the time it would take to drain the pond. Assuming a volume of 9711 m^3, and a discharge rate of 608,700 m^3/yr, the hydraulic residence time would be 9711 m^3/608,700 m^3/yr = 0.0159 yr x 365 d/yr = 5.8 days.

Pond's Hydraulic Residence Time (τ_w): 0.0159 years (5.8 days)

Ratio of Mean Depth to Hydraulic Residence Time (Z/τ_w)

The mean depth of Pond (Z) is 0.61 m, and the hydraulic residence time (τ_w) is 0.0159 yr. The ratio was computed as: 0.61m / 0.0159 yr = 38.4 m/yr.

Ratio of Mean Depth to Hydraulic Residence Time (Z/τ_w): 38.4 m/yr

Pond's Hydraulic Residence Time (τ_w) with the Reduced Point Source Load

The hydraulic residence time is computed as volume/outflow; the time it would take to drain the pond. Assuming a volume of 9711 m^3, and a discharge rate of 686,900 m^3/yr, the hydraulic residence time would be 9711 m^3/686,900 m^3/yr = 0.0141 yr x 365 d/yr = 5.1 days.

Pond's Hydraulic Residence Time (τ_w): 0.0141 years (5.1 days)

Ratio of Mean Depth to Hydraulic Residence Time (Z/τ_w) with the Reduced Point Source Load

The mean depth of Pond (Z) is 0.61 m, and the hydraulic residence time (τ_w) is 0.0141 yr. The ratio was computed as: 0.61m / 0.0141 yr = 43.3 m/yr.

4.2.3 Updated Vollenweider-OECD Normalized P Loading/Chlorophyll Response Relationship Results for the UTLTC In-Stream Pond

The normalized phosphorus loadings using the equation shown on page 24 are 1057 mg P/m3 for the current conditions and 226 mg P/m3 for the reduced TMDL loadings. Details are provided in Appendix B, pages B-4 and B-5. The expected chlorophyll *a* levels for these two conditions were then estimated using the log-log plot of the normalized phosphorus loading versus the chlorophyll *a* response shown in Figure 8. Projected chlorophyll *a* levels as shown in Figure 9 below are 80 - 85 µg/l under the current loading and 25 µg/l under the reduced TMDL load.

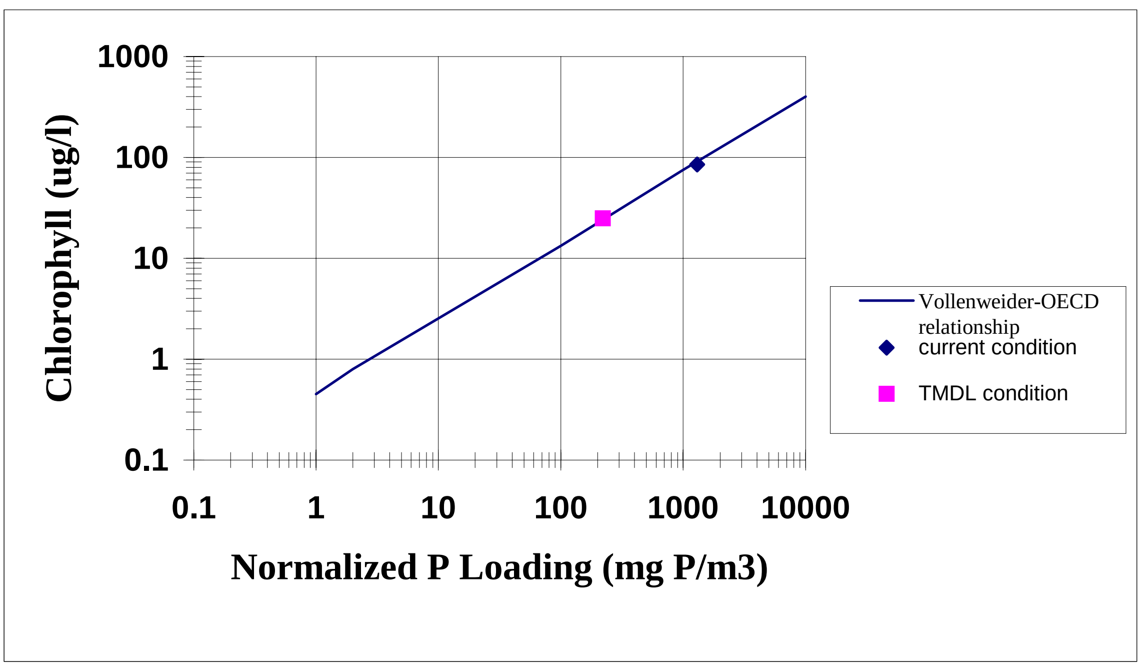

Figure 9: Updated Vollenweider-OECD Normalized P Loading/Chlorophyll Response Relationship Results

The reduced loadings shown above in Figure 8 should result in a 76% reduction in phosphorus loadings and, subsequently, a reduction in chlorophyll *a* levels from approximately 80 - 85 µg/l to approximately 25 µg/l. Refer to Figure 10 for a graphical representation of the reduction in phosphorus loading.

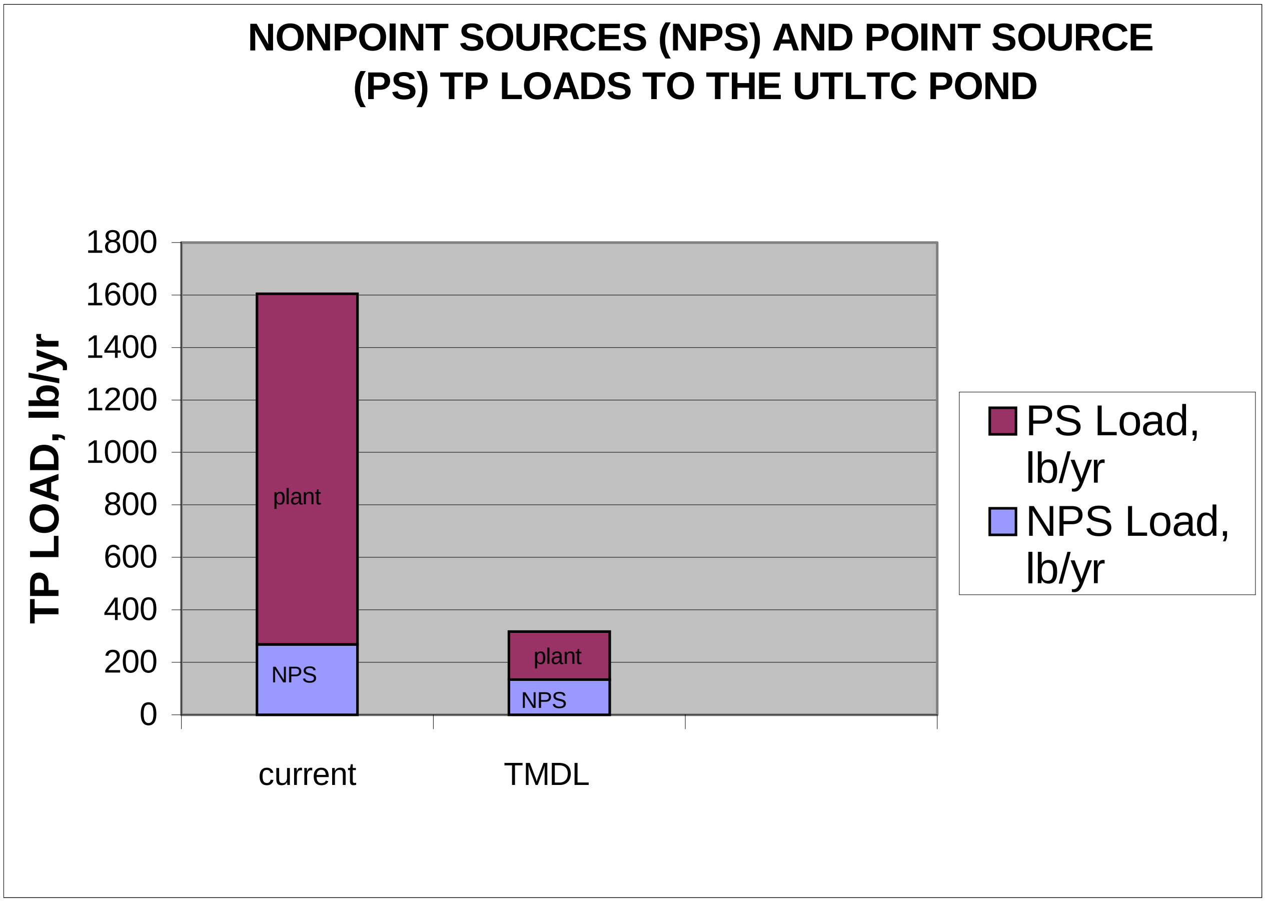

Figure 10: Representation of Nonpoint Sources and Point Sources Loads to the UTLTC In-Stream Pond

4.2.4 TMDL of Phosphorus to the UTLTC In-Stream Pond Computation

The TMDL of phosphorus to the UTLTC In-Stream Pond appropriately considers seasonal variations by estimating loading rates over the entire year. This captures the dry weather loading rates, which generally occur during the warmer months when algae production is most prevalent. It also captures the wet-weather loading rates, which contribute significant sediment-bound sources of phosphorus. The Updated Vollenweider-OECD Normalized P Loading/Chlorophyll Response Relationship specifically uses long-term loading estimates to avoid adopting a single transient loading pulse, which would yield erroneous results.

Computing the Phosphorus TMDL

Allowable total phosphorus loading = 174,160 g/yr = 10.94 g/m^{2}yr (refer to Figure 8).
Converted to pounds per year: (174,160 g/yr) / (453.6 g/lb) = 384 lb/yr

PHOSPHORUS TMDL 174,160 g/yr = 384 lb/yr (For details refer Appendix B).

4.2.5 Load Allocations Between Point and Nonpoint Sources for the UTLTC In-Stream Pond

The watershed that drains to UTLTC In-Stream Pond contains one surface water discharge, the Trappe WWTP. The model estimates the significant nonpoint source loads using Chesapeake Bay Program, Phase IV Areal Loading Rates for various land uses. All significant point and nonpoint sources are included in the allocation, and are described further in the technical memorandum entitled *Significant Point and Nonpoint Phosphorus Sources in the Pond Watershed, Talbot County, Maryland*. Given the small size of the watershed, the assignment of load reductions to specific subwatersheds is considered to be an implementation planning element, which is beyond the scope of this TMDL.

4.2.6 Future Allocations and Margin of Safety for the UTLTC In-Stream Pond

A MOS is required as part of a TMDL in recognition of the fact that there are many uncertainties in scientific and technical understanding of water quality in natural systems. Specifically, 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 (i.e., TMDL = WLA + LA + FA + MOS). The second approach is to incorporate the MOS as part of the design conditions for the WLA and the LA computations.

Maryland has adopted an explicit MOS for phosphorus. Following the first approach, the load allocated to the MOS was computed as 10% of the total allowable load. This value is considered reasonable in that it implies an additional 10% reduction in phosphorus loading beyond what would be expected to meet the goal.

Maryland has also incorporated conservative assumptions that effectively constitute an additional, implicit, MOS. The point source loads could allow a future allocation of 51 lb/yr, which corresponds to additional flow of 0.056 mgd from the Trappe WWTP. For details refer Appendix B.

4.2.7 Summary of Total Maximum Daily Load for the UTLTC In-Stream Pond

The annual TMDL for Phosphorus (lb/yr):

TMDL	=	WLA	+	LA	+	FA	+	MOS
384	=	132	+	163	+	51	+	38

Table 13: Future Allocation and Margin of Safety (lb/yr)

On average, this TMDL represents a daily phosphorus load of 1.26 lb/day.

Where: LA = Nonpoint Source
WLA = Point Source
MOS = Margin of Safety
FA = Future Allocation

5.0 ASSURANCE OF IMPLEMENTATION

This section provides the basis for reasonable assurances that the CBOD, NBOD, and phosphorus TMDLs will be achieved and maintained. Several factors provide assurance that these TMDLs of CBOD, NBOD, and phosphorus will be implemented. First, the Trappe WWTP has constructed upgrades for biological nitrogen reduction (BNR) and chemical phosphorus removal that should be capable of achieving the waste load allocations in the TMDLs and MDE has issued an NPDES permit to the plant consistent with those allocations. Second, Maryland has adopted a watershed cycling strategy, which will ensure that future water quality monitoring and TMDL evaluations are routinely conducted. In addition, the certainty of implementation of the nonpoint source phosphorus reductions to the UTLTC In-Stream Pond will be enhanced by two specific programs: the Water Quality Improvement Act of 1998 (WQIA), which requires that nutrient management plans be implemented for all agricultural land in Maryland; and the EPA-sponsored Clean Water Action Plan of 1998 (CWAP).

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 phosphorus nutrient management plans be developed and implemented by 2004. Implementation of the nutrient management plan will also result in a reduction of nonpoint CBOD and NBOD loads.

Maryland's CWAP has been developed in a coordinated manner with the State's 303(d) process. All Category I watersheds 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 high priority for funding assessment and restoration activities to these watersheds. Enforceable NPDES permits that will be written for the wastewater dischargers in this basin provide confidence in assuring implementation of this TMDL. The implementation of point source CBOD and NBOD controls will be executed through the use of NPDES permit for the Trappe WWTP. 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 these regions over a five-year period. The cycle begins with intensive monitoring, followed by computer modeling, TMDL development, implementation activities, and follow-up evaluation. The choice of a five-year cycle is motivated by the five-year federal NPDES permit cycle. This continuing cycle ensures that, within five years of establishing a TMDL, intensive follow-up monitoring will be performed. Thus, the watershed cycling strategy establishes a TMDL evaluation process that assures accountability.

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