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Water Quality Analysis of Eutrophication for Bynum Run, Harford County, Maryland

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List of Abbreviations

BOD	Biochemical Oxygen Demand
COMAR	Code of Maryland Regulation
CWA	Clean Water Act
DNR	Department of Natural Resources
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
MBSS	Maryland Biological Stream Survey
MDP	Maryland Department of Planning
MDE	Maryland Department of the Environment
mg/l	Milligrams Per Liter
mi ²	Square miles
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
USGS	U.S. Geological Survey
WQLS	Water Quality Limited Segment
<i>µg</i> /l	Micrograms Per Liter

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EXECUTIVE SUMMARY

Section 303(d) of the federal Clean Water Act (CWA) and the U.S. Environmental Protection Agency's (EPA) implementing regulations direct each state to identify and list waters, known as water quality limited segments (WQLSs), in which current required controls of a specified substance are inadequate to achieve water quality standards. This list of impaired waters is commonly referred to as the "303(d) list". For each WQLS, the State is to either establish a Total Maximum Daily Load (TMDL) of the specified substance that the waterbody can receive without violating water quality standards, or demonstrate that water quality standards are being met.

Bynum Run (basin code 02130704), located in Harford County, Maryland, was identified on the State's list of WQLSs as impaired by sediments (1996 listing), nutrients (1996 listing), and impacts to biological communities (2002 listing). This document, upon EPA approval, addresses the nutrient impairment in Bynum Run; the sediment and biological impairments will be addressed at a future date.

An analysis of recent monitoring data shows that the dissolved oxygen criterion and designated uses associated with nutrients are being met in Bynum Run. This analysis supports the conclusion that a TMDL for nutrients is not necessary to achieve water quality in this case. Barring the receipt of contradictory data, this report will be used to support the nutrients listing change for the Bynum Run from Category 5 ("waterbodies impaired by one or more pollutants requiring a TMDL") to Category 2 ("Surface waters that are meeting some standards and have insufficient information to determine attainment of other standards"), when the Maryland Department of the Environment (MDE) proposes the revision of Maryland's 303(d) list for public review in the future. Although the waters of Bynum Run do not display signs of eutrophication, the State reserves the right to require future controls in the Bynum Run watershed if evidence suggests nutrients from the basin are contributing to downstream water quality problems.

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1.0 INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and the U.S. Environmental Protection Agency's (EPA) implementing regulations direct each State to identify and list waters, known as water quality limited segments (WQLSs), in which current required controls of a specified substance are inadequate to achieve water quality standards. This list of impaired waters is commonly referred to as the "303(d) list". For each WQLS, the State is to either establish a Total Maximum Daily Load (TMDL) of the specified substance that the waterbody can receive without violating water quality standards, or demonstrate that water quality standards are being met.

In addition to the development of a TMDL, there are four other scenarios that may be used to address an impaired waterbody: 1) more recent data indicating that the impairment no longer exists (*i.e.*, water quality standards are being met); 2) more recent and updated water quality modeling which demonstrates that the segment is now attaining standards; 3) refinements to water quality standards, or the interpretation of those standards, which result in standards being met; or 4) correction to errors made in the initial listing.

Bynum Run (basin code 02130704) was identified on the 303(d) list, submitted to EPA by the Maryland Department of the Environment (MDE), as being impaired by nutrients (1996), sediments (1996) and impacts to biological communities (2002). This report provides more recent information that supports the removal of the nutrients listing for Bynum Run when the 303(d) list is revised; therefore, the aforementioned first scenario most closely applies, with the qualification that initial listing for nutrients was suspected due to the lack of data. The sediment and biological impairments will be addressed at a future date.

The remainder of this report lays out the general setting of the waterbody within the Bynum Run watershed, presents a discussion of the water quality characteristics in the basin, and provides conclusions with regard to the current water quality characteristics and the current standards. The data will demonstrate that the Bynum Run is achieving water quality standards.

2.0 GENERAL SETTING

The Bynum Run watershed is located in the center of Harford County. The watershed drains into Bush River. The main transportation corridors in the watershed are Maryland-Route 24, which runs the length of the watershed, and Interstate-95 in the southern portion. The drainage area of Bynum Run watershed is 14,358 acres.

The land use in the Bynum Run watershed is predominantly urban and forest. There are 2,958 acres (21%) park and forest lands evenly dispersed throughout the watershed. The watershed contains 9,664 acres (67%) of urban land use. Agricultural land uses are dispersed through out the watershed, constituting 1,736 acres (12%). The land use distribution is based on 2002 Maryland Department of Planning (MDP) land use/land cover data. The Bynum Run land use coverage is displayed in Figure 2.

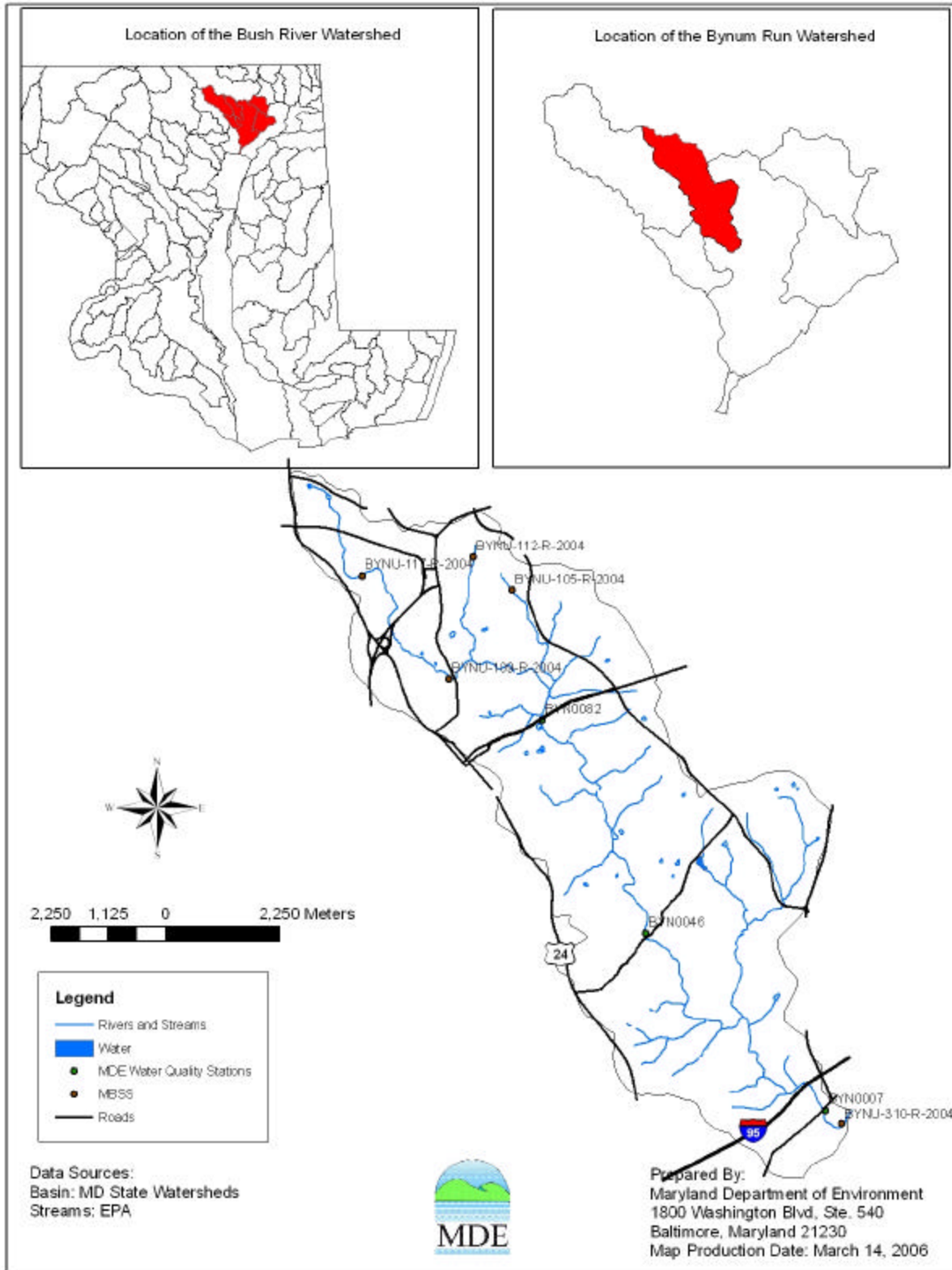


Figure 1: Bynum Run Location Map and Monitoring Stations

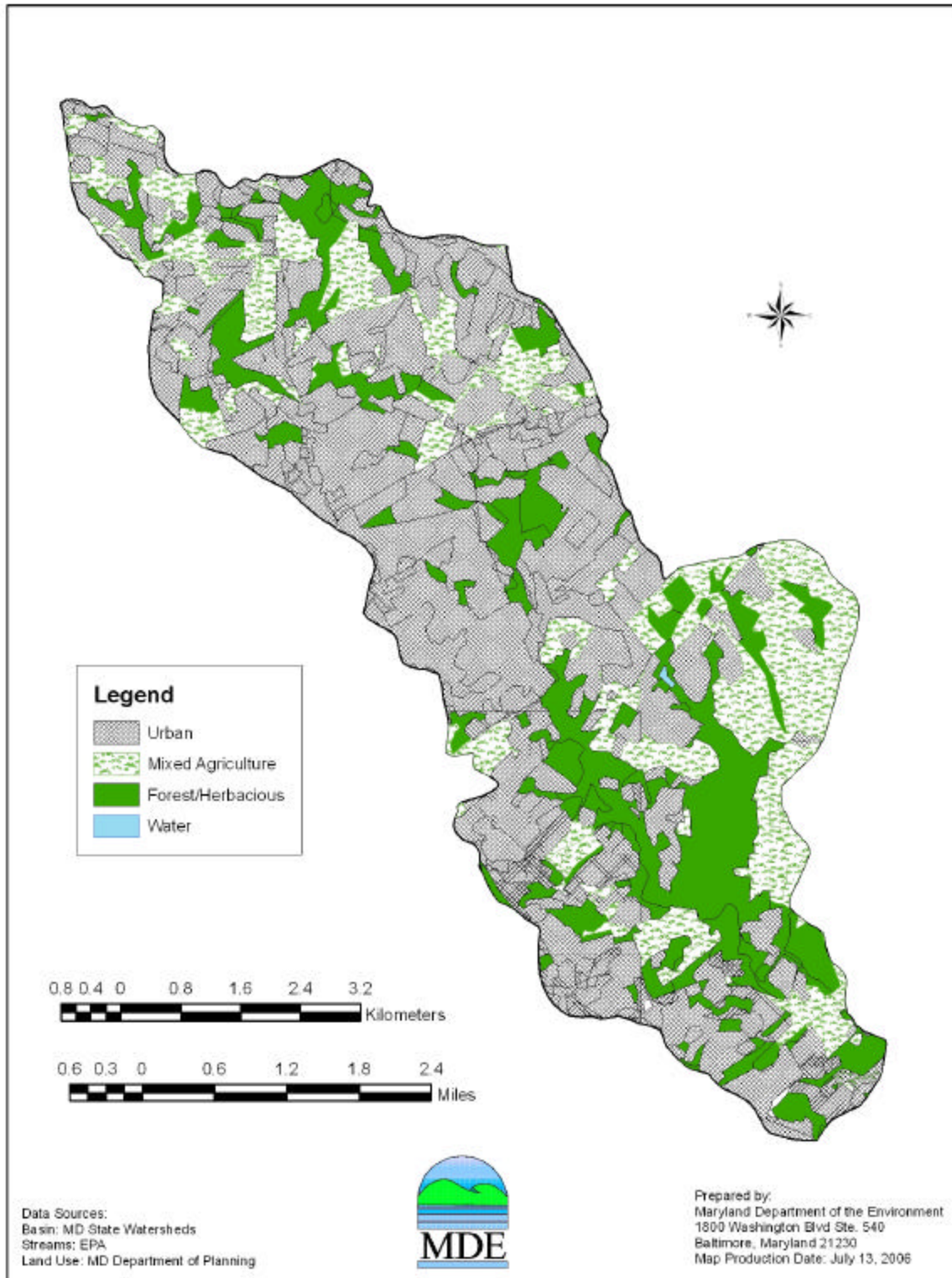


Figure 2: Land Use Map of the Bynum Run Watershed

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3.0 WATER QUALITY CHARACTERIZATION

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 Maryland Surface Water Use Designation for the Bynum Run is Use III, non-tidal cold water (Code of Maryland Regulations (COMAR) 26.08.02.08 (I)). The dissolved oxygen (DO) criteria to protect Use III water may not be less than 5 mg/l at any time, with a minimum daily average of not less than 6 mg/l (COMAR 26.08.02.03-3D(2)). The water quality data presented in this section will show DO concentrations meet the appropriate criteria.

Maryland's water quality standards presently do not impose a limit on the concentration of nutrients in the water column. Rather, Maryland manages nutrients indirectly by limiting their effects expressed in terms of excess algal growth and low DO. Because biochemical oxygen demand (BOD) also consumes DO, this potentially confounding factor must be considered in the analysis if low DO is observed.

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 26.08.02.03B(2)). 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 analysis demonstrates no excessive algal growth as indicated by low chlorophyll *a* values in the data set.

Data solicitation was conducted in September 2005. All readily available water quality data were considered for this analysis. Water quality data from MDE surveys conducted along Bynum Run during October 1998 through September 1999 were used to perform this analysis. Water quality data from five Maryland Biological Stream Survey (MBSS) stations during March 2004 were also used. Other available resources (Department of Natural Resources (DNR), U.S. Geological Survey (USGS), Chesapeake Bay Program data) were also investigated to determine if there were other available stations in the Bynum Run watershed. Table 1 shows the list of MDE stations with their geographical coordinates and descriptive location in the Bynum Run watershed. Figure 3 provides graphical representation of the collected data for the parameters discussed below.

Table 1: Locations of Water Quality Stations Monitored During 1998-2004 in Bynum Run.

STATION	SOURCE	LATITUDE	LONGITUDE
BYNU-117-R-2004	MBSS	39.5673	-76.3712
BYNU-310-R-2004	MBSS	39.4697	-76.2621
BYNU-105-R-2004	MBSS	39.56452	-76.3368
BYNU-112-R-2004	MBSS	39.57047	-76.3456
BYNU-109-R-2004	MBSS	39.54886	-76.3513
BYN0007	MDE	39.472	-76.2659
BYN0046	MDE	39.5036	-76.3067
BYN0082	MDE	39.5415	-76.33

3.1 Dissolved Oxygen

From October 1998 through September 1999 sampling period, DO concentrations ranged from 7.8 mg/l to 14.3 mg/l, well above the criterion. One sample taken separately in March 2004 by the MBSS Program had a DO concentration of 3.2 mg/l. The range was more variable with a single value at BYNU-310-12-2004 below the criterion. Other samples taken at this time were well-above the criterion (7.0 – 10.3 mg/l). The closest station to BYNU-310-R-2004 is BYN0007 which had very satisfactory DO in 1998-1999 (8.0-14.3 mg/l). Therefore, this individual sample, representing only 2.5% of the data is not considered indicative of a pattern of use impairment. The five MBSS samples taken in March 2004 are not represented in Figure 3. All of the data is presented in Tabular form in Appendix A.

3.2 Biochemical Oxygen Demand (BOD)

Because BOD also consumes DO, this potentially confounding factor must be considered in the analysis if low DO is observed. During the October 1998 through September 1999 sampling period, BOD concentrations ranged from 0.6 mg/l to 4.7 mg/l. Again, please refer to Figure 3 for graphical representations of these data; data tables are presented in Appendix A.

3.3 Chlorophyll *a*

Chlorophyll *a* data were collected during the entire period from October 1998 through September 1999 covering algal growing season, when concentrations are at their peak. Observed chlorophyll *a* concentrations are low and do not reach levels higher than 9 µg/L.

The low chlorophyll *a* concentrations found in Bynum Run suggests that chlorophyll *a* photosynthesis and respiration will have no significant effect on observed DO values. Nothing out of the ordinary was observed during sampling event. These data are summarized in Figure 3. Tabular data are presented in Appendix A.

3.4 Nutrients

During the October 1998 through September 1999 sampling period, total phosphorus (TP) concentrations in the tidal waters ranged from 0.0069 mg/l to 1 mg/l and total nitrogen (TN) concentrations ranged from 0.55 mg/l to 2.64 mg/l. Please refer to Figure 3 for graphical representations of this data; data tables are presented in Appendix A.

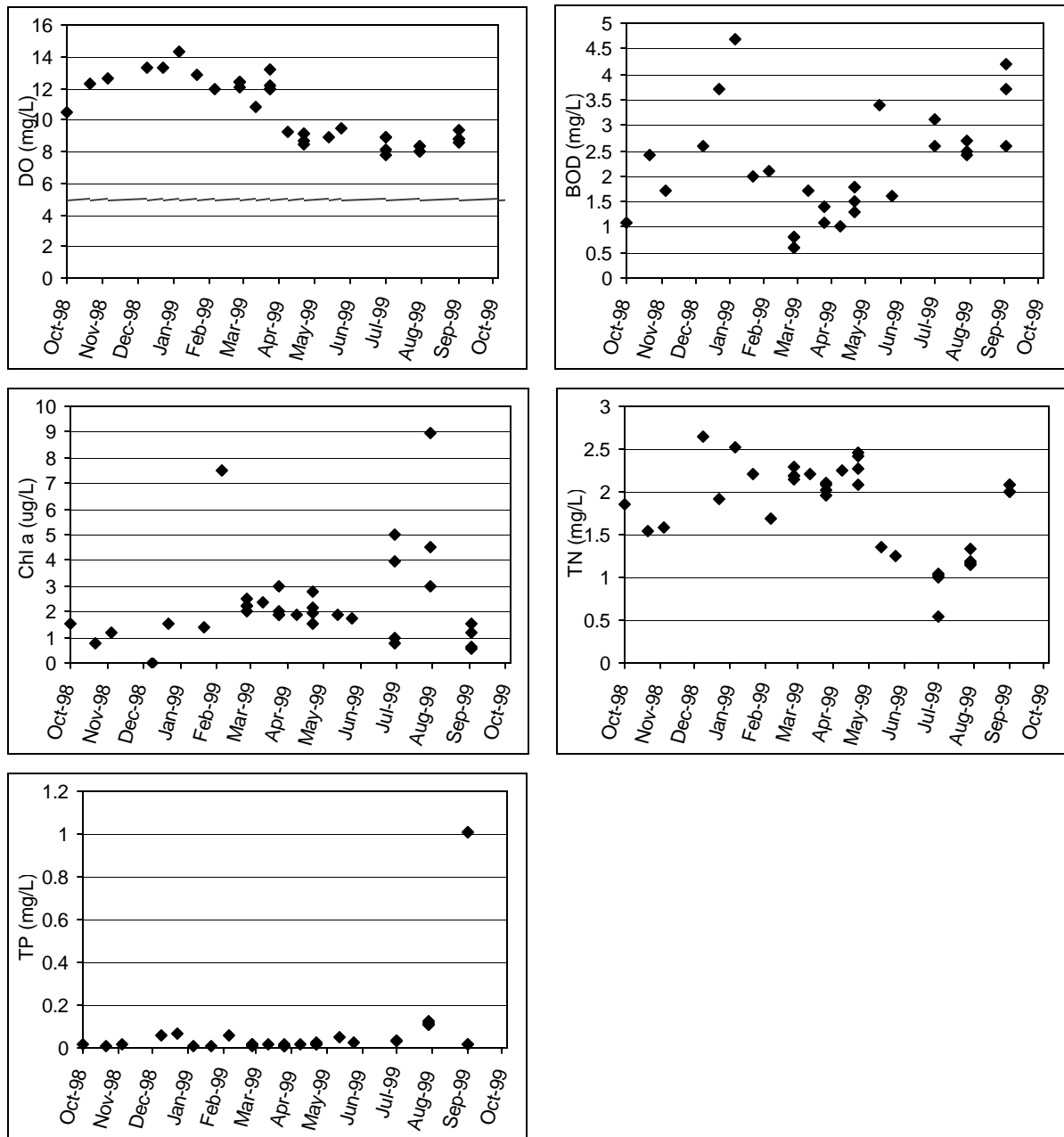


Figure 3: Bynum Run Water Quality Data from October 1998 through March 2004

4.0 CONCLUSION

The data presented above clearly demonstrate that excessive algal growth does not exist in Bynum Run, as indicated by low chlorophyll *a*. Similarly, 97.5% of the DO concentrations are well above the criterion of 6.0 mg/l daily average. Based on 305(b) guidance, MDE applies a “rule-of-thumb” that a waterbody is impaired by a contaminant in the water column when greater than 10% of the samples exceed the applicable criteria. This water quality analysis shows only 2.5% violation of criteria within the watershed if the 6.0 mg/l daily average criterion is applied with the synoptic surveys conducted during the 1998-2004. This result does not exceed the 10% rule EPA guidance suggests as a standard for impairment. Barring the receipt of contradictory data, this report will be used to support a nutrients listing change for the Bynum Run from Category 5 (“waterbodies impaired by one or more pollutants requiring a TMDL”) to Category 2 (“Surface waters that are meeting some standards and have insufficient information to determine attainment of other standards”), when the Maryland Department of the Environment (MDE) proposes the revision of Maryland’s 303(d) list for public review in the future. Although the waters of Bynum Run do not display signs of eutrophication, the State reserves the right to require future controls in the Bynum Run watershed if evidence suggests nutrients from the basin are contributing to downstream water quality problems.

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REFERENCES

Code of Maryland Regulations, 26.08.02.08(I), 26.08.02.03-3D(2), 26.08.02.03B(2)

Maryland Department of the Environment, 2004 FINAL List of Impaired Surface Waters [303(d) List] and Integrated Assessment of Water Quality in Maryland.

Maryland Department of Planning. Digital Land Use/Land Cover Data for Maryland. 2002.

U.S. Environmental Protection Agency. Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports). EPA-841-B97-002. 1997.

Appendix A: Tabular Water Quality Data

Station	Sampling Date	BOD, mg/l	TN, mg/l	TP mg/l	DO mg/l	Chla_a µg/l
BYN0007	10/29/1998	1.1	1.86	0.0165	10.5	1.4952
BYN0007	11/18/1998	2.4	1.54	0.0069	12.3	0.7476
BYN0007	12/2/1998	1.7	1.58	0.0140	12.6	1.1748
BYN0007	1/5/1999	2.6	2.64	0.0547	13.3	0
BYN0007	1/19/1999	3.7	1.91	0.0660	13.3	1.4952
BYN0007	2/1/1999	4.7	2.53	0.0095	14.3	
BYN0007	2/17/1999	2	2.20	0.0074	12.9	1.359273
BYN0007	3/4/1999	2.1	1.68	0.0548	11.9	7.476
BYN0007	3/25/1999	0.8	2.14	0.0190	12.1	2.2428
BYN0007	4/8/1999	1.7	2.21	0.0137	10.8	2.3496
BYN0007	4/21/1999		1.96	0.0127	12.2	1.9936
BYN0007	5/6/1999	1	2.25	0.0137	9.2	1.869
BYN0007	5/19/1999	1.5	2.09	0.0195	8.7	2.8035
BYN0007	6/9/1999	3.4	1.35	0.0465	8.9	1.902982
BYN0007	6/21/1999	1.6	1.25	0.0251	9.5	1.7444
BYN0007	7/28/1999	2.6	0.55	0.0307	8.1	3.9872
BYN0007	8/26/1999	2.5	1.34	0.1093	8.0	4.4856
BYN0007	9/29/1999	2.6	2.08	0.0173	8.6	1.4952
BYN0046	3/25/1999	0.6	2.19	0.0127	12.4	2.2428
BYN0046	3/25/1999	0.6	2.19	0.0125	12.4	2.492
BYN0046	4/21/1999	1.4	2.03	0.0075	12.0	1.869
BYN0046	4/21/1999	1.4	2.10	0.0073	12.0	1.869
BYN0046	5/19/1999	1.8	2.28	0.0140	9.1	1.9224
BYN0046	5/19/1999	1.8	2.42	0.0158	9.1	2.136
BYN0046	7/28/1999	3.1	1.05	0.0330	8.9	0.9968
BYN0046	7/28/1999		1.03	0.0316	8.9	0.7476
BYN0046	8/26/1999	2.7	1.15	0.1091	8.3	
BYN0046	8/26/1999		1.16	0.1144	8.3	2.9904
BYN0046	9/29/1999	3.7	1.99	1.0094	8.8	0.59808
BYN0046	9/29/1999		1.99	1.0092	8.8	0.52332
BYN0082	3/25/1999	0.8	2.30	0.0167	12.4	1.9936
BYN0082	4/21/1999	1.1	2.09	0.0088	13.2	2.9904
BYN0082	5/19/1999	1.3	2.46	0.0232	8.5	1.4952
BYN0082	7/28/1999		0.99	0.0359	7.8	4.984
BYN0082	8/26/1999	2.4	1.19	0.1242	8.0	8.9712
BYN0082	9/29/1999	4.2	2.09	0.0142	9.3	1.150154
BYNU-117-R-2004	3/16/2004				10.3	
BYNU-112-R-2004	3/16/2004				8.9	
BYNU-310-R-2004	3/17/2004				3.2	
BYNU-109-R-2004	3/16/2004				9.8	
BYNU-105-R-2004	3/16/2004				7.0	