Water Quality Analysis of Eutrophication for the Tidal Bird River, Baltimore County, Maryland

FINAL

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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
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
WQLS	Water Quality Limited Segment
μg/l	Micrograms Per Liter

EXECUTIVE SUMMARY

Section 303(d) of the federal Clean Water Act (CWA) and the U.S. Environmental Protection Agency (EPA)'s 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.

Bird River (basin code 02-13-08-03) was identified on the State's 1996 list of WQLSs as impaired by nutrients and sediments. This document addresses the nutrient impairment in the tidal portion of Bird River; the sediment impairment 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 Bird River. This analysis supports the conclusion that a TMDL for nutrients is not necessary to achieve water quality in this case. Barring any contradictory future data, this report will be used as supporting material when Maryland Department of the Environment (MDE) proposes the revision of Maryland's 303(d) list for public review. Although the waters of Bird River do not display signs of eutrophication, the State reserves the right to require future controls in the Bird River watershed if evidence suggests nutrients from the basin are contributing to downstream water quality problems.

1.0 INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and the U.S. Environmental Protection Agency (EPA)'s 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 successful implementation 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.

Bird River (basin code 02-13-08-03) was first identified on the 1996 303(d) list, submitted to EPA by the Maryland Department of the Environment (MDE), as being impaired by nutrients and sediments. This report provides more recent information that supports the removal of the nutrients listing for Bird River 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 impairment will be addressed at a future date.

The remainder of this report lays out the general setting of the waterbody within the Bird River 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 establish that the Bird River is achieving water quality standards.

2.0 GENERAL SETTING

Bird River is located in Baltimore County, Maryland in the tidal portion of the Gunpowder River watershed and flows south into the Chesapeake Bay. Bird River is approximately 7 miles in length, with a watershed area of approximately 25.9 mi^2 (non-water) or 16,600 acres (Figure 1). The land uses in the watershed are mixed agricultural (2,605 acres or 15.7% of the area), forest (6,285 acres or 37.9% of the area), and urban (7,195 acres or 43.4% of the area). Please refer to Figure 2 for a map of these land uses (MDP, 2000).

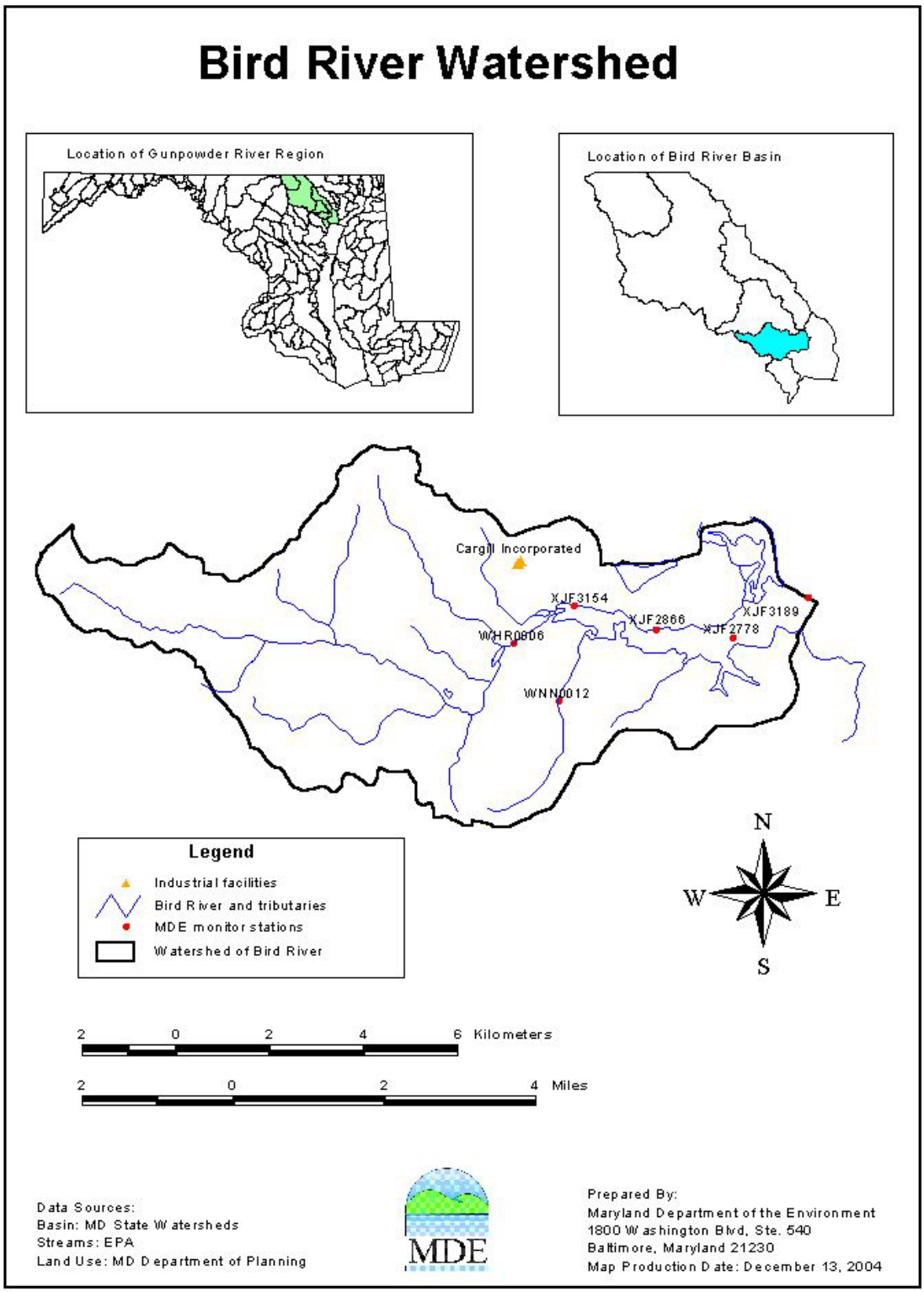

Figure 1: Bird River Location Map and Monitoring Stations

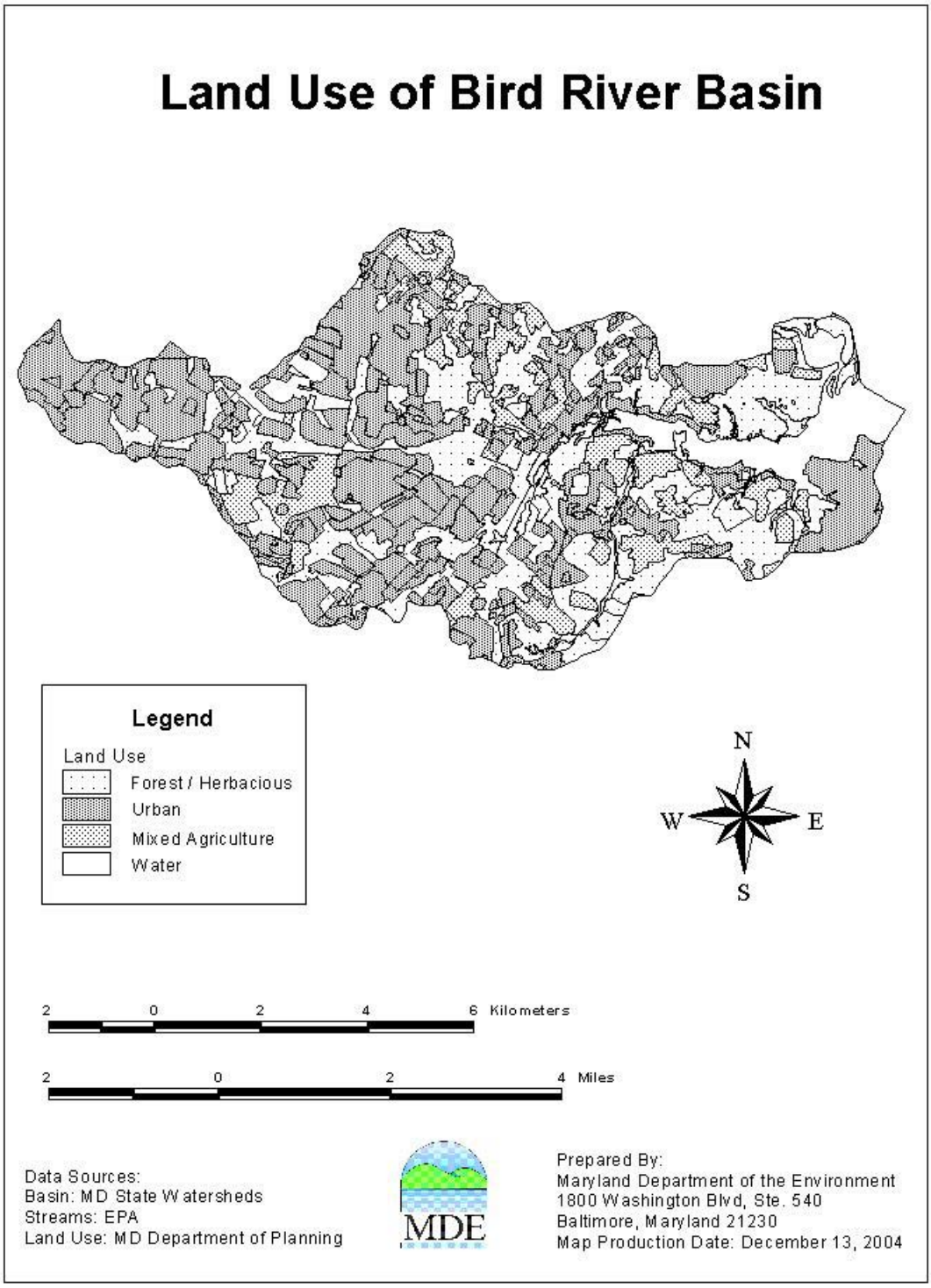

Figure 2: Land Use Map of the Bird River Watershed

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.

Maryland's water quality standards presently do not impose a limit on the concentration of nutrients in the water column[1]. Rather, Maryland manages nutrients indirectly by limiting their effects expressed in terms of excess algal growth and low dissolved oxygen (DO). Because biochemical oxygen demand (BOD) also consumes DO, this potentially confounding factor must be considered in the analysis if low DO is observed.

The Maryland Surface Water Use Designation (Code of Maryland Regulations (COMAR) 26.08.02.07) for the tidal portion of Bird River is Use II – w*ater used for shellfish harvesting*. According to Maryland's numeric criterion for DO, concentrations may not be less than 5.0 mg/l at any time (COMAR 26.08.02.03-3C(2)), unless resulting from natural conditions (COMAR 26.08.02.03.A(2)). The water quality data presented in this section will show the designated use of this water body is being met as it relates to nutrients.

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; therefore, a desired peak chlorophyll a level of 50 µg/l has been established for tidal waters. The chlorophyll *a* level is based on the designated use, guidelines set forth by Thomann and Mueller (1987) and by the EPA Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2, Part 1 (1997).

All readily available water quality data for the last five years pertaining to the tidal portion of Bird River were considered for this analysis. Water quality data from MDE surveys conducted at four stations along Bird River during October 1999 through August 2000 (which covers both the high-flow and the low-flow conditions) were used to perform this analysis. Other available resources (USGS, Bay Program data) were also investigated to determine if there were other available stations in the Bird River watershed. No data from other sources were found. Table 1 shows the list of MDE stations with their geographical coordinates and descriptive location in the Bird River watershed. Figure 3 provides graphical representation of the collected data for the parameters discussed below.

1 Maryland does limit the ammonia form of nitrogen from the Waste Water Treatment Plants due to its toxic effects on some aquatic organisms.

Table 1: Locations of Water Quality Stations Monitored During 1999-2000 in Bird River.

Station Code	Latitude Degrees	Longitude Degrees
XJF2778	39 22.729	76 22.221
XJF2866	39 22.830	76 23.354
XJF3154	39 23.121	76 24.568
XJF3189	39 23.185	76 21.112
WNR0006 *	39 22.678	76 25.466
WNN0012 *	39 21.990	76 24.812

* These are non-tidal stations presented here for informational purposes, but are not within the subject segment

3.1 Nutrients

During the October 1999 through August 2000 sampling period, total phosphorus (TP) concentrations in the tidal waters ranged from 0.047 mg/l to 0.177 mg/l and total nitrogen (TN) concentrations ranged from 0.631 mg/l to 2.071 mg/l. Please refer to Figure 3 for graphical representations of this data; data tables are presented in Appendix A.

3.2 Dissolved Oxygen

During the October 1999 through August 2000 sampling period, DO concentrations ranged from 5.4 mg/l to 11.0 mg/l. The data shows that none of the concentrations fell below the criterion of 5 mg/l during the entire sampling period. This data is summarized in Figure 3. Tabular data is presented in Appendix A.

3.3 Chlorophyll *a*

Chlorophyll *a* data was collected during the entire period from October 1999 through August 2000 covering algal growing season, when concentrations are at their peak. Observed chlorophyll *a* concentrations are low (< 35 µg/l) and do not reach levels higher than the water quality threshold of 50 µg/l in the tidal portion of Bird River.

The low chlorophyll *a* concentrations found in Bird River 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. This data is summarized in Figure 3. Tabular data is presented in Appendix A.

3.4 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 1999 through August 2000 sampling period, BOD concentrations ranged from 2.8 mg/l to 6.1 mg/l. Again, please refer to Figure 3 for graphical representations of this data; data tables are presented in Appendix A. Please note that DO concentrations were always above 5 mg/l during the sampling period.

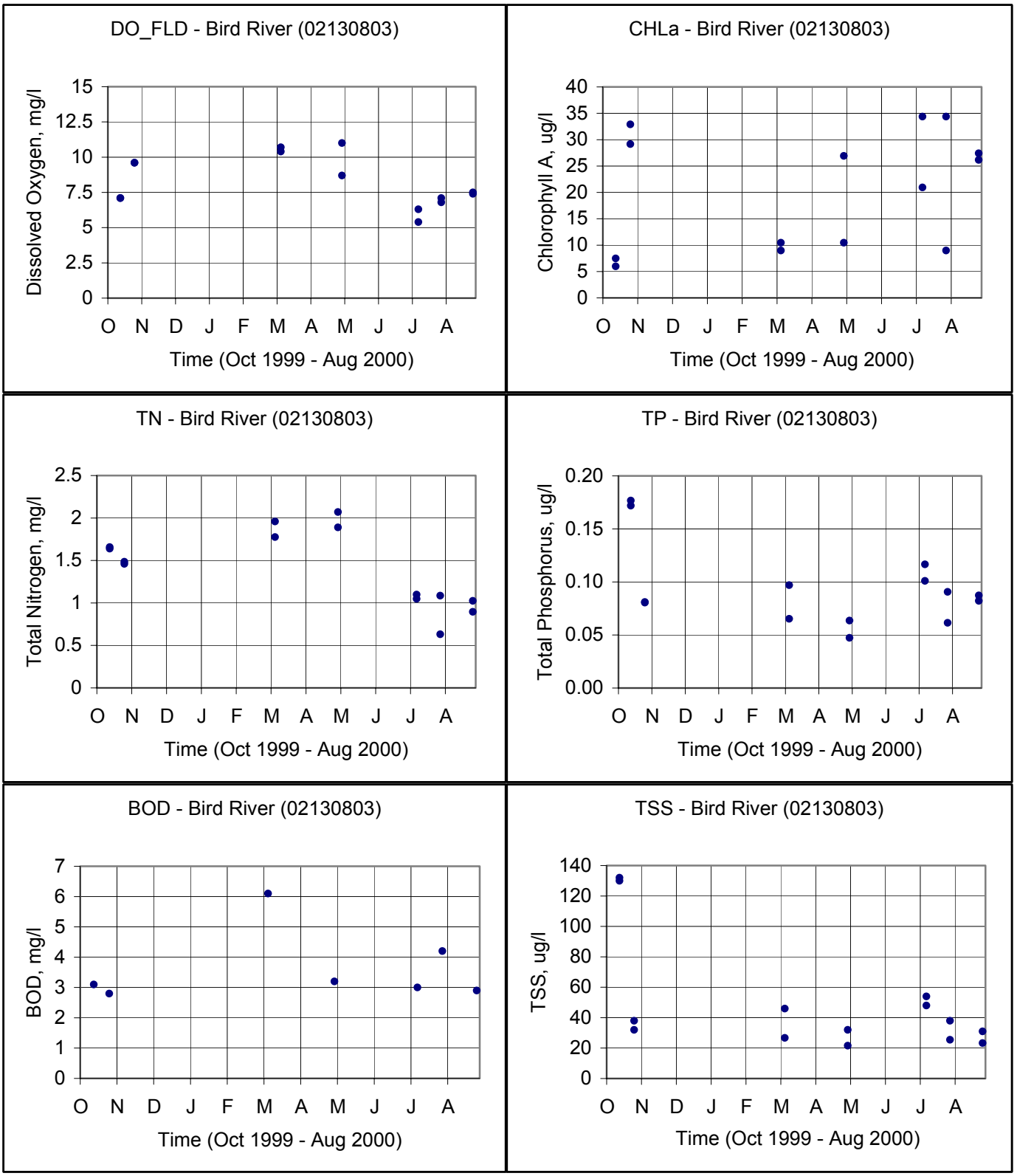

Figure 3: Bird River Water Quality Data from October 1999 through August 2000 (Tidal Stations only)

4.0 CONCLUSION

The data presented above clearly demonstrates that excessive algal growth does not exist in the tidal portion of Bird River, as indicated by low chlorophyll *a*. Similarly, DO concentrations are well above the criterion of 5.0 mg/l. Based on the synoptic surveys conducted during 1999-2000, the water quality data indicates that Bird River has no eutrophication-related water quality impairments. Barring any contradictory future data, this information provides sufficient justification to revise Maryland's 303(d) list to remove nutrients as an impairing substance in relation to Bird River.

REFERENCES

Code of Maryland Regulations, 26.08.02.07, 26.08.02.03-3C(2), 26.08.02.03A(2), 26.08.02.03B(2)

Maryland Department of Planning. Digital Land Use/Land Cover Data for Maryland. 2000.

Thomann, Robert V., John A. Mueller "Principles of Surface Water Quality Modeling and Control, " HarperCollins Publisher Inc., New York, 1987.

U.S. Environmental Protection Agency, "Technical Guidance Manual for Developing Total Maximum Daily Loads, Book2: Streams and Rivers, Part 1: Biochemical Oxygen Demand/ Dissolved Oxygen and Nutrients/ Eutrophication," Office of Water, Washington D.C., March 1997.

Appendix A: Tabular Water Quality Data

STATION	DATE	BOD-5 MG/L	DO_FLD MG/L	TN, MG/L	TP, MG/L	TSS, MG/L	CHL A, µG/L	Tidal/Non-tidal
WHR0006	11/15/99	1.5	9.1	0.9	0.02	2.4	1.7	Non-tidal
WHR0006	11/29/99	4.2	10.6	1.1	0.04	14	2.5	Non-tidal
WHR0006	12/13/99		11.2	1.2	0.03	15	2.0	Non-tidal
WHR0006	1/12/00	1.1	11.7	1.4	0.04	22	2.5	Non-tidal
WHR0006	2/22/00	1.6	12.0	1.4	0.03	24.7		Non-tidal
WHR0006	2/28/00	5.2	10.7	1.6	0.13	113		Non-tidal
WHR0006	3/7/00	5.5	10.8	1.2	0.02	5.6	2.0	Non-tidal
WHR0006	4/5/00	2.4	9.4	1.4	0.05	22	5.5	Non-tidal
WHR0006	5/2/00	1.7	7.4	1.4	0.03	21	2.0	Non-tidal
WHR0006	5/23/00	2.1	7.4	1.5	0.07	33	3.4	Non-tidal
WHR0006	6/5/00	3.9	7.4	1.5	0.04	12.5	2.2	Non-tidal
WHR0006	7/11/00	2.0	5.6	1.5	0.05	13	7.2	Non-tidal
WHR0006	8/1/00	3.0	6.7	1.2	0.05	14	6.7	Non-tidal
WHR0006	8/30/00	2.3	7.8	1.3	0.09	38	7.5	Non-tidal
WNN0012	3/7/00		11.4	1.8	0.03	3.2		Non-tidal
WNN0012	4/5/00		10.2	1.3	0.05	10.5	10.5	Non-tidal
WNN0012	5/2/00		9.0	1.9	0.06	18.7	3.0	Non-tidal
WNN0012	7/11/00		6.2	2.0	0.08	11.5	3.0	Non-tidal
WNN0012	8/1/00		6.6	1.9	0.07	13		Non-tidal
WNN0012	8/30/00		7.0	1.6	0.07	11	1.5	Non-tidal
XJF2778	3/7/00	6.1	10.4	2.0	0.10	46	10.5	Tidal
XJF2778	5/2/00	3.2	11.0	1.9	0.06	32	26.9	Tidal
XJF2778	7/11/00	3.0	5.4	1.1	0.12	48	34.4	Tidal
XJF2778	8/1/00	4.2	7.1	1.1	0.09	38	34.4	Tidal
XJF2778	8/30/00	2.9	7.4	1.0	0.09	31	26.2	Tidal
XJF2866	10/25/99	2.8	9.6	1.5	0.08	38	29.2	Tidal
XJF2866	10/25/99		9.6	1.5	0.08	32	32.9	Tidal
XJF3154	10/12/99	3.1	7.1	1.7	0.18	132	7.5	Tidal
XJF3154	10/12/99		7.1	1.6	0.17	130	6.0	Tidal
XJF3189	3/7/00		10.7	1.8	0.07	26.7	9.0	Tidal
XJF3189	5/2/00		8.7	2.1	0.05	21.6	10.5	Tidal
XJF3189	7/11/00		6.3	1.0	0.10	54	20.9	Tidal
XJF3189	8/1/00		6.8	0.6	0.06	25.5	9.0	Tidal
XJF3189	8/30/00		7.5	0.9	0.08	23.3	27.4	Tidal