Water Quality Analysis of Sedimentation for Piney Run Reservoir in Carroll County, Maryland

FINAL

Prepared by:

Maryland Department of the Environment
Montgomery Park Business Center
1800 Washington Boulevard, Suite 540
Baltimore, Maryland 21230-1718

Submitted to:

Water Protection Division
U.S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

September 2003

Submittal Date: November 4, 2003
EPA Concurrence Date: December 18, 2003
Document version: September 17, 2003

FINAL

Table of Contents

List of Figures

List of Tables

List of Abbreviations

COMAR	Code of Maryland Regulation
CWA	Clean Water Act
DNR	Department of Natural Resources
EPA	Environmental Protection Agency
MDE	Maryland Department of the Environment
NLF	Northern Lakes and Forest
SCS	Soil Conservation Service
TMDL	Total Maximum Daily Load
TSI	Trophic State Index
WQLS	Water Quality Limited Segment

EXECUTIVE SUMMARY

Section 303(d) of the federal Clean Water Act (CWA) and the U.S. Environmental 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. 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.

Piney Run Reservoir in the South Branch Patapsco River watershed (basin number 02-13-09-08) was identified on Maryland's 1998 list of WQLSs as being impaired by sediments and nutrients. This report provides an analysis of monitoring data and reports, which shows that sedimentation is not a problem in Piney Run Reservoir. This analysis supports the conclusion that a TMDL for sediments is not necessary to achieve water quality standards in this case. Barring the receipt of any contradictory data, this report will be used to support the removal of the sediment listing of Piney Run Reservoir from Maryland's list of WQLSs when MDE proposes a revision of the 303(d) list for public review in the future. Although Piney Run Reservoir does not display signs of sediment impairment, the State reserves the right to require additional pollution controls in the Piney Run Reservoir watershed if evidence suggests that sediments from the basin are contributing to downstream water quality problems. The nutrient impairment will be addressed separately.

1.0 INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and 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 some cases, a segment that is previously identified as a WQLS may not require the development and implementation of a TMDL. Based on EPA's guidance for water quality based decisions, the reasons obviating the need for a TMDL are as follows: (1) more recent data indicate that the impairment no longer exists (*i.e.*, water quality standards are being met); (2) more recent and updated water quality modeling demonstrates that the waterbody attains standards; (3) refinements to water quality standards or the interpretation of those standards result in the attainment of the standard; and (4) correction to errors made in the original listing. Reason 4 applies to the present case.

Piney Run Reservoir in the South Branch Patapsco River watershed (basin number 02-13-09-08) was identified on Maryland's 1998 303(d) list of WQLSs as being impaired by nutrients and sediments. The sediment listing was prompted by a Lake Management Survey in Piney Run Reservoir (Maryland Department of Environment [MDE], 1994). The listing of Piney Run Reservoir as impaired by sediments resulted from a survey recommendation in the Maryland Lake Management Survey Report (1994) suggesting the implementation of shore erosion controls without any actual evidence of biological impacts or loss of recreational use. This report provides an updated interpretation of the 1994 questionnaire that supports the removal of Piney Run Reservoir from the 303(d) list when it is revised. The nutrient impairment will be addressed separately.

The remainder of this report describes the general setting of the Piney Run Reservoir watershed, presents a discussion of the water quality characterization process, and provides conclusions with regard to the characterization. The data establish that Piney Run Reservoir is not impaired by sediments.

2.0 GENERAL SETTING

Piney Run Reservoir is an impoundment located near Eldersburg in Carroll County, Maryland (Figure 1). The impoundment, which is owned by Carroll County, lies on Piney Run, a tributary of the South Branch Patapsco River. An earthen dam was installed in 1974 for the purpose of water supply, flood control, and to create the reservoir for recreational uses.

Piney Run Reservoir lies in the Piedmont physiographic province, which occurs between the Appalachian Mountains and the Atlantic Coastal Plain on the East Coast. The soils immediately

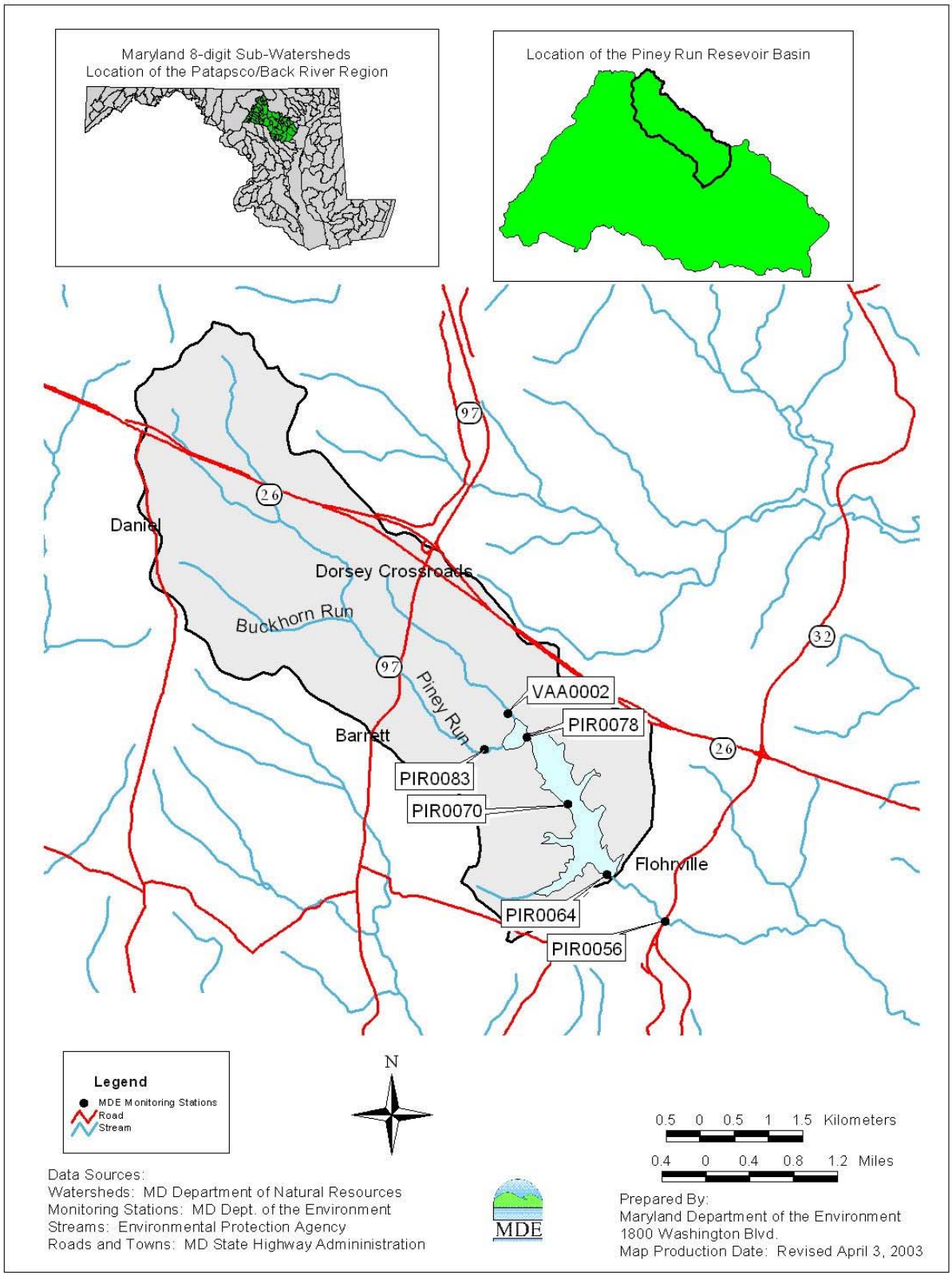

Figure 1. Location Map of Piney Run Reservoir in Carroll County, MD

Document version: September 17, 2003

surrounding the Reservoir are the Glenelg-Chester-Manor association (Soil Conservation Service (SCS), 1969). These soils are generally well drained, chiefly rolling and hilly, micaceous soils that are deep over mica schist. The outer watershed area is comprised of soils of the Glenelg-Manor-Mt. Airy association. These soils are well-drained, mainly hilly soils that are deep and moderately deep over schist.

Topography in the Piedmont ecoregion is rolling to moderately hilly, soils are varied, the land use is a mixture of forest, agricultural and developed, and there are few natural lakes (none in Maryland).

Inflow to the reservoir is primarily via Piney Run and one unnamed tributary draining under White Rock Road northeast of Piney Run. Discharge from the reservoir is to Piney Run, which discharges to the South Branch Patapsco River. Land use in the watershed draining to Piney Run Reservoir is predominantly agricultural (Figure 2). Land use distribution in the watershed is approximately 24% urban, 22% forested/herbaceous, 4% open water, and about 50% agricultural (Figure 3) (Maryland Department of Planning, 2000).

Several relevant statistics for Piney Run Reservoir are provided below in Table 1.

Table 1. Current Physical Characteristics of Piney Run Reservoir

Location:	Carroll County, MD lat. 39.39^{o} long. 76.98^{o}
Surface Area:	298 acres = (12,763,080ft^{2}) = (1,185,729m^{2})
Length:	1.24 mi
Maximum Width:	1200 feet
Average Reservoir Depth:	26 feet
Maximum Depth:	54.4 feet
Purpose	Water Supply, Recreation and Flood Control
Basin Code	02-13-09-08
Volume of Reservoir:	7,748 acre-feet (9,557,017 m^{3})
Drainage Area to Reservoir:	10.4 mi^{2}
Average Discharge:	12.8 cfs

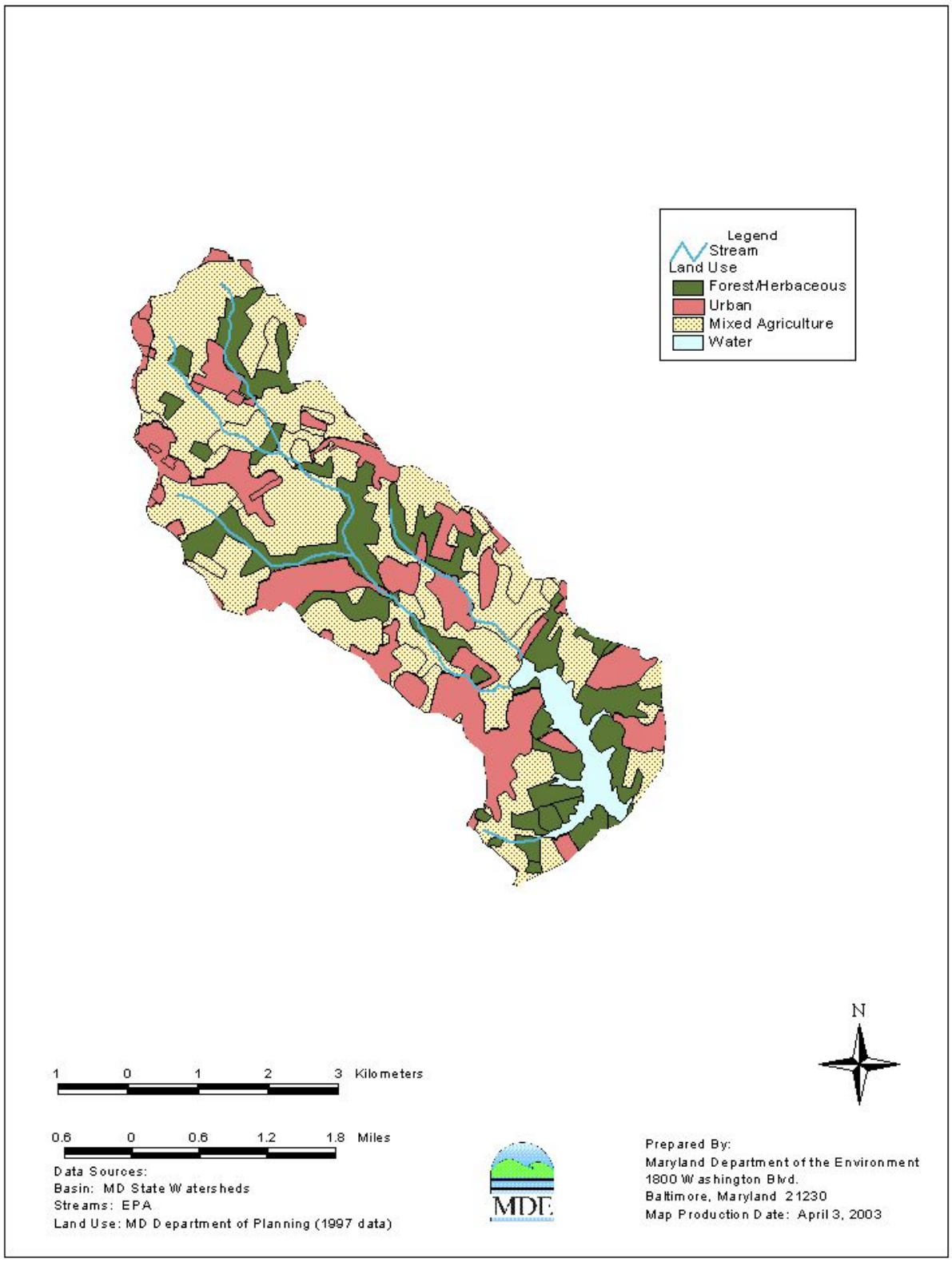

Figure 2. Predominant Land Use in the Piney Run Reservoir Watershed

Document version: September 17, 2003

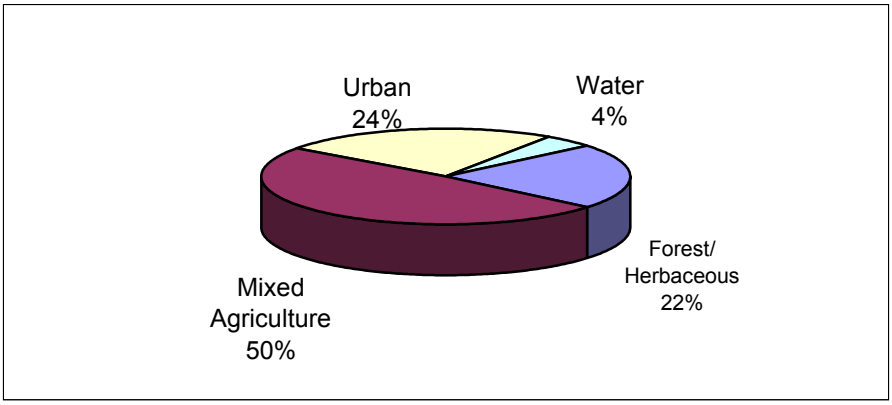

Figure 3. Land Use in Drainage Basin of Piney Run Reservoir

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 established to protect that use. Designated uses include activities such as swimming, drinking water supply, and trout 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.

A Maryland Lake Management Survey report (March, 1994) recommended implementation of shore erosion controls for the Piney Run Reservoir. As a result of this recommendation, Piney Run Reservoir was added to Maryland's 1998 303(d) list even though there was no evidence of biological impacts or loss of recreational or water supply uses.

Piney Run Reservoir, an impoundment on a tributary of the Piney Run near Eldersburg, has been designated a Use III-P water body, pursuant to which it is protected for water contact recreation, natural trout, and use as a public water supply. See Code of Maryland Regulations (COMAR) 26.08.02.08J. Maryland's General Water Quality Criteria prohibit pollution of waters of the State by any material in amounts sufficient to create a nuisance or interfere directly or indirectly with designated uses. See COMAR 26.08.02.03B(2).

Excessive sedimentation, indicated by accelerated infilling of the impoundment and/or reduced water clarity due to suspended sediments, can interfere with designated uses such as fishing and swimming. Detailed water quality data, including Carroll County Water Resource Planning Monitoring data from 1991 to 2001 and all available assessed data are presented in Appendix A.

3.1 Sedimentation

Prior to construction of Piney Run Reservoir in 1974, the SCS surveyed cross sections in the reservoir area. Monuments were established at each end of the cross section. The cross sections were then plotted at a vertical scale of 1 in = 10 ft and a horizontal scale of 1 in = 50 ft. The cross sections were identified by the point numbers at each end of the section. Detailed water

quality data are presented in Appendix A. Carroll County Water Resource Planning Monitoring data from 1991 to 2001 were also examined.

A sedimentation study of the reservoir was performed in December 1988 and January 1989 to repeat the field surveying of some of these cross sections and compare the results with the 1974 survey. The new survey was conducted using depth measurements within the reservoir. To evaluate the amount of sedimentation in the reservoir, some of the SCS cross sections were repeated. Sedimentation was expected in the area where the tributaries discharge into the reservoir; therefore, the survey was designed to concentrate efforts in these locations.

The 21 surveyed cross sections showed little evidence of deposition within the reservoir (Carroll County, 1989). Only minor variations in bottom elevations were detected. These variations, which were not consistent across the sections, were probably due more to differences in measurement technique than to sediment deposition. When the 1974 cross sections were surveyed prior to the filling of the reservoir, it was possible to survey the cross sections by locating changes in slope. After inundation, however, the changes in slope could no longer be seen. Thus, it was necessary to survey the sections at a set interval. The differences between the location of the points surveyed probably accounts for most of the minor variations in cross sections observed between the old and new data. The lack of significant sediment deposition in the reservoir was verified by field observations. A field trip to the reservoir was conducted which concentrated on three tributaries to the reservoir totaling over 80 percent of the upstream watershed. These included the main branch of Piney Run just downstream of White Rock Road; a smaller tributary to the reservoir draining under White Rock road northeast of Piney Run; and a tributary along the east side of the reservoir where stream channel erosion had been observed. In all three cases, while some deposition was found, the amount of deposition did not appear to be significant.

As part of a study to assess the compatibility of recreation and water supply, Carroll County developed a spreadsheet model (Carroll County, 1989) to evaluate the impact of nonpoint source (NPS) pollution on the Piney Run Reservoir, and to evaluate the impacts generated by land use changes in the watershed and Piney Run park.

A comparison was made between the expected annual sediment load from the County's NPS modeling and the sedimentation survey to compare modeling output with field measured data. The total suspended sediment load computed from the model was calculated for the period from 1975 to 1988. The total load represents only 0.4 percent of the original reservoir volume.

The predicted sediment accumulation compares favorably with the field survey results. The low volume of accumulated sediment in the reservoir probably results from the widespread use of no-till farming throughout the watershed (Carroll County, 1989).

3.2 Water Clarity

Water clarity was measured in Piney Run Reservoir using a Secchi disk. To measure water clarity using a Secchi disk, the disk is first lowered through the water column until it is no longer visible, and then it is raised until it reappears. The Secchi depth is the average of these two points. Deeper Secchi depths correspond to better water clarity, while shallower Secchi depths correspond to poorer water clarity. Figure A-1 in Appendix A shows the trends over time for all stations. Since 1998, increasing water clarity is apparent at all of the stations; moreover, maximum observed Secchi depths at all stations (e.g., 33 feet for the station nearest the in-take) have occurred since 1998. In addition, fewer than 50% of measurements since 1998 have been shallower that 6.1 feet, which is the approximate boundary between mesotrophic and eutrophic conditions on Carlson's Trophic State Index (Carlson, 1977) (Table A-2). The presence of the submersed freshwater plant *Hydrilla verticillata* and the recent drought may have influenced the water clarity in the Reservoir.

4.0 CONCLUSION

The interpretation of the data data presented in this report demonstrate that there is no sediment impairment in Piney Run Reservoir. Sedimentation surveys suggest sediment deposition has not been a significant problem in the past for the Reservoir. Additionally, Secchi depth data indicate that water clarity in the Reservoir is within acceptable ranges. Barring any contradictory future data, this information provides sufficient justification to remove the sediment impairment listing of Piney Run Reservoir from Maryland's 303(d) list when it is revised in the future.

REFERENCES

Carlson, R.E. 1977. A trophic state index for Reservoirs. Limnology and Oceanography 22:361-369.

Carroll County Bureau of Special Projects and Water Resources Management. Piney Run Recreation/Water Supply Compatibility Study, Final Report, 1989.

Carroll County, Water Resource Planning Division. An assessment of water quality conditions in the Piney Run Reservoir, 2001.

COMAR 26.08.02.08, 26.08.02.03-3E, 26.08.02.03A(2), 26.08.02.02.03B(2).

Maryland Department of the Natural Resources. Maryland Reservoir Water Quality Assessment, 1991 Final report, 1995.

U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Carroll County, Maryland, August 1994.

Appendix

Table A1. Physical Water Quality Data for Piney Run Reservoir (Collected by MDE)

SAMPLING STATION IDENTIFIER	DATE START SAMPLING	TIME START SAMPLING	CONDUCTIVITY FIELD VALUE µMHOS/CM	WATER TEMPERATURE °C	SECCHI DEPTH METERS	DEPTH WATER SAMPLE TAKEN METERS	FIELD PH	DISSOLVED OXYGEN FIELD VALUE MG/L
PIR0078	03/13/2000	9:25	150	6.9	1.4	0.5	7.1	11.2
PIR0078	03/13/2000	9:25	150	6.9	1.4	1	7.1	11.2
PIR0078	03/13/2000	9:25	150	6.8	1.4	2.6	7.1	11.2
PIR0070	03/13/2000	9:35	150	7.5	1.8	0.5	7.2	11.4
PIR0070	03/13/2000	9:35	150	7.5	1.8	1	7.2	11.4
PIR0070	03/13/2000	9:35	150	7.3	1.8	3	7.2	11.3
PIR0070	03/13/2000	9:35	150	7.2	1.8	5	7.1	11.2
PIR0070	03/13/2000	9:35	150	7.1	1.8	7	7.1	11.2
PIR0070	03/13/2000	9:35	150	6.9	1.8	9	7.1	11.2
PIR0064	03/13/2000	9:50	150	7.9	1.8	0.5	7.3	11.6
PIR0064	03/13/2000	9:50	150	7.9	1.8	1	7.3	11.6
PIR0064	03/13/2000	9:50	150	7.8	1.8	4	7.2	11.6
PIR0064	03/13/2000	9:50	150	7.5	1.8	7	7.1	11.5
PIR0064	03/13/2000	9:50	150	7.2	1.8	10	7.1	11.1
PIR0064	03/13/2000	9:50	150	7.9	1.8	13	7.3	10.8
PIR0078	04/10/2000	8:30	150	10.7	2.2	0.5	7.3	10.1
PIR0078	04/10/2000	8:30	150	10.7	2.2	1	7.3	10.1
PIR0078	04/10/2000	8:30	150	10	2.2	2.4	7.3	10.2
PIR0070	04/10/2000	8:45	150	11.1	2.6	0.5	7.4	10.1
PIR0070	04/10/2000	8:45	150	11.1	2.6	1	7.4	10.2
PIR0070	04/10/2000	8:45	150	11.1	2.6	3	7.3	10.1
PIR0070	04/10/2000	8:45	150	11.1	2.6	6	7.3	10.1
PIR0070	04/10/2000	8:45	150	11	2.6	7.4	7	10.1
PIR0064	04/10/2000	9:00	150	11.4	2.6	0.5	7.5	10.2
PIR0064	04/10/2000	9:00	150	11.4	2.6	1	7.4	10.2
PIR0064	04/10/2000	9:00	150	11.4	2.6	4	7.4	10.1
PIR0064	04/10/2000	9:00	150	11.3	2.6	8	7.3	10.1
PIR0064	04/10/2000	9:00	150	10.9	2.6	10	7.1	9.6
PIR0064	04/10/2000	9:00	150	11.4	2.6	12.6	7.4	8.9
PIR0078	05/08/2000	9:45	155	22	3.1	0.5	7.8	9.8
PIR0078	05/08/2000	9:45	155	21.4	3.1	1	7.7	9.9
PIR0078	05/08/2000	9:45	155	20.4	3.1	1.5	7.7	10.2
PIR0070	05/08/2000	10:00	150	24.7	5	0.5	7.7	9.4
PIR0070	05/08/2000	10:00	150	21.4	5	1	7.7	9.9
PIR0070	05/08/2000	10:00	150	18.3	5	2	7.7	10.3
PIR0070	05/08/2000	10:00	150	16.5	5	3	7.6	10.3
PIR0070	05/08/2000	10:00	150	15.6	5	4	7.6	10.4

SAMPLING STATION IDENTIFIER	DATE START SAMPLING	TIME START SAMPLING	CONDUCTIVITY FIELD VALUE µMHOS/CM	WATER TEMPERATURE °C	SECCHI DEPTH METERS	DEPTH WATER SAMPLE TAKEN METERS	FIELD PH	DISSOLVED OXYGEN FIELD VALUE MG/L
PIR0070	05/08/2000	10:00	150	14.8	5	5	7.4	10
PIR0070	05/08/2000	10:00	155	14.3	5	6	7.2	9.5
PIR0070	05/08/2000	10:00	155	13.7	5	7.6	7.1	8.8
PIR0064	05/08/2000	10:15	150	22.5	7.5	0.5	7.6	9.1
PIR0064	05/08/2000	10:15	150	16.5	7.5	1	7.3	8.8
PIR0064	05/08/2000	10:15	150	14.9	7.5	3	7.1	9
PIR0064	05/08/2000	10:15	150	13.5	7.5	5	7	8.8
PIR0064	05/08/2000	10:15	155	12.6	7.5	7	6.9	8.2
PIR0064	05/08/2000	10:15	155	11.9	7.5	9	6.6	6.9
PIR0064	05/08/2000	10:15	160	10.8	7.5	11	6.5	4.3
PIR0064	05/08/2000	10:15	150	20.6	7.5	13.4	7.3	1
PIR0078	07/24/2000	10:20	151	25.5	3	0.5	9.7	11.2
PIR0078	07/24/2000	10:20	151	25.5	3	1	9.7	11.2
PIR0078	07/24/2000	10:20	153	25.4	3	2.1	9.8	12.2
PIR0070	07/24/2000	10:35	148	25.6	5	0.5	9.5	10
PIR0070	07/24/2000	10:35	148	25.6	5	1	9.5	10
PIR0070	07/24/2000	10:35	148	25.6	5	3	9.4	9.9
PIR0070	07/24/2000	10:35	149	23.8	5	5	7.6	8.4
PIR0070	07/24/2000	10:35	159	17.6	5	7	6.6	0.13
PIR0070	07/24/2000	10:35	167	14.8	5	8.5	6.7	0.17
PIR0064	07/24/2000	10:50	147	25.5	6.5	0.5	9.2	9
PIR0064	07/24/2000	10:50	147	25.5	6.5	1	9.2	9
PIR0064	07/24/2000	10:50	145	25.3	6.5	2	9	9
PIR0064	07/24/2000	10:50	147	20.4	6.5	4	7.6	8.9
PIR0064	07/24/2000	10:50	154	17.4	6.5	6	6.6	10.1
PIR0064	07/24/2000	10:50	159	13.8	6.5	8	6.6	0.4
PIR0064	07/24/2000	10:50	168	12.7	6.5	10	6.6	0.12
PIR0064	07/24/2000	10:50	147	25.5	6.5	12	9.2	0.13
PIR0078	08/07/2000	9:10	143	25.6		0.5	9.4	
PIR0078	08/07/2000	9:10	147	25.6		1	9.6	
PIR0078	08/07/2000	9:10	143	25.5		2	9.6	
PIR0078	08/07/2000	9:10	143	25.5		3	9.5	
PIR0070	08/07/2000	9:25	143	25.8	5.5	0.5	9.3	
PIR0070	08/07/2000	9:25	144	25.8	5.5	1	9.3	
PIR0070	08/07/2000	9:25	144	25.7	5.5	2	9.3	
PIR0070	08/07/2000	9:25	146	25.7	5.5	3	9.3	
PIR0070	08/07/2000	9:25	140	25.6	5.5	4	9.2	
PIR0064	08/07/2000	10:00	140	25.9	5	0.5	9.1	
PIR0064	08/07/2000	10:00	141	25.6	5	1	9.2	
PIR0064	08/07/2000	10:00	144	25.6	5	2	9.2	
PIR0064	08/07/2000	10:00	143	25.5	5	3	8.7	

SAMPLING STATION IDENTIFIER	DATE START SAMPLING	TIME START SAMPLING	CONDUCTIVITY FIELD VALUE µMHOS/CM	WATER TEMPERATURE °C	SECCHI DEPTH METERS	DEPTH WATER SAMPLE TAKEN METERS	FIELD PH	DISSOLVED OXYGEN FIELD VALUE MG/L
PIR0064	08/07/2000	10:00	140	25.8	5	4	9.2	
PIR0078	09/05/2000	9:30	154	24.6	1	0.5	9.8	10.5
PIR0078	09/05/2000	9:30	153	24.6	1	1	9.8	10.5
PIR0078	09/05/2000	9:30	152	24.3	1	1.8	9.1	7.7
PIR0070	09/05/2000	9:45	149	24.9	5	0.5	9.4	8.8
PIR0070	09/05/2000	9:45	149	24.9	5	1	9.4	8.8
PIR0070	09/05/2000	9:45	149	24.9	5	2	9.4	8.8
PIR0070	09/05/2000	9:45	149	24.9	5	3	9.4	8.8
PIR0070	09/05/2000	9:45	148	24.6	5	4	9.1	7.8
PIR0070	09/05/2000	9:45	150	24.1	5	5	7.5	5.4
PIR0070	09/05/2000	9:45	156	23.1	5	6	6.9	1.4
PIR0070	09/05/2000	9:45	165	18.8	5	7.6	6.7	0.1
PIR0064	09/05/2000	10:55	148	25.5	5	0.5	9.4	8.8
PIR0064	09/05/2000	10:55	148	25.5	5	1	9.4	8.8
PIR0064	09/05/2000	10:55	148	25.5	5	2	9.4	8.8
PIR0064	09/05/2000	10:55	148	25.5	5	3	9.4	8.8
PIR0064	09/05/2000	10:55	150	24	5	4	7.3	8.6
PIR0064	09/05/2000	10:55	155	22.6	5	5	6.8	5.1
PIR0064	09/05/2000	10:55	157	21	5	6	6.6	1.3
PIR0064	09/05/2000	10:55	158	19.1	5	7	6.7	0.4
PIR0064	09/05/2000	10:55	164	16.7	5	8	6.7	1.4
PIR0064	09/05/2000	10:55	169	14.6	5	9	6.7	0.1
PIR0064	09/05/2000	10:55	182	13.7	5	10	6.8	0.1
PIR0064	09/05/2000	10:55	197	13	5	11	7	0.1
PIR0064	09/05/2000	10:55	148	25.5	5	12.3	9.4	0.2

Figure A-1
(Adapted from Carroll County, 2001)

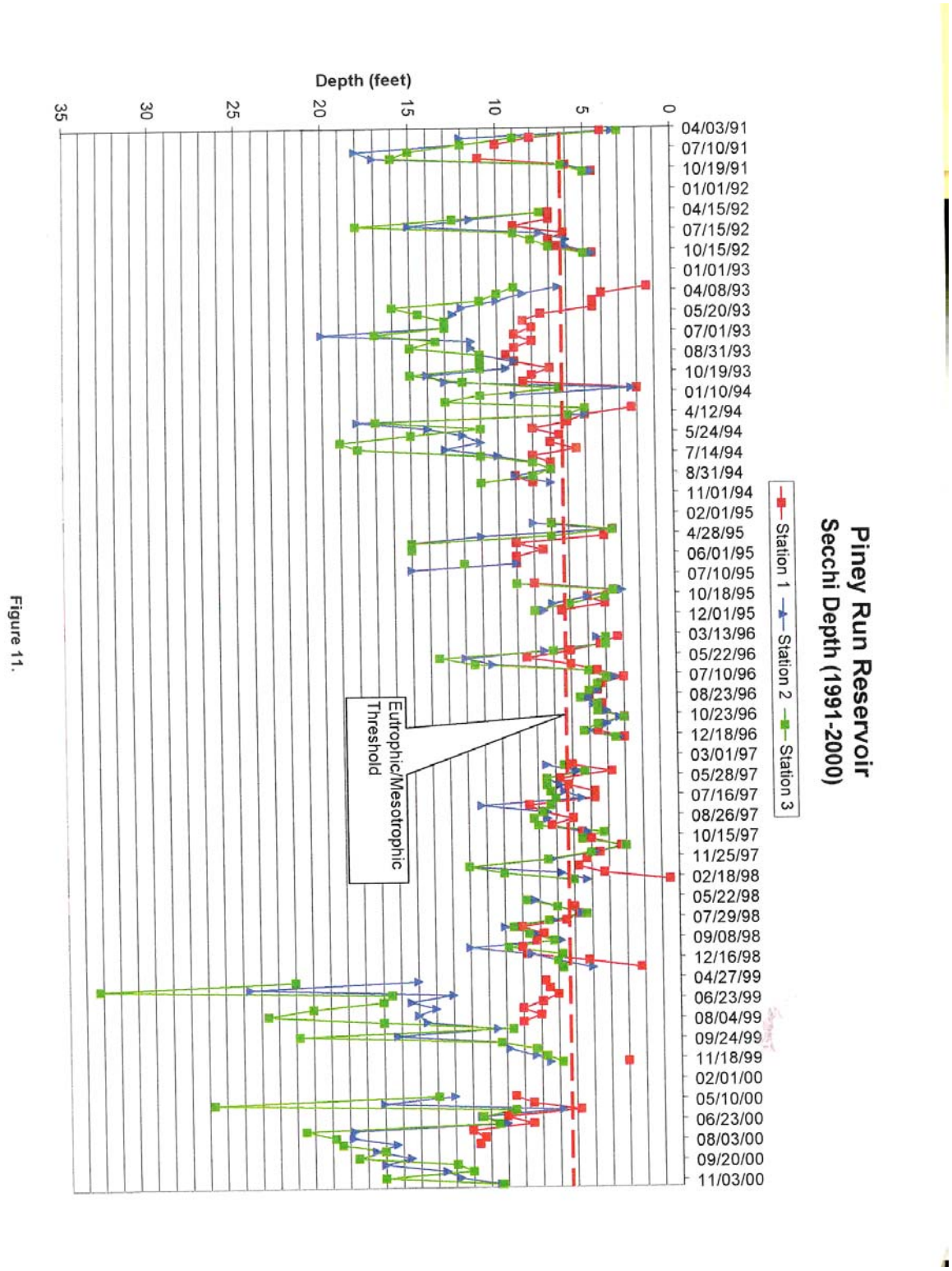

Figure 11.

Table A-2. Piney Run Reservoir Secchi Depth (in feet) Measurements as Collected by Carroll County, 1991-2000

	STATION 1	STATION 2	STATION 3
Number of Samples	112	127	127
Geometric Mean	5.93	8.50	9.07
Mean	6.46	9.54	10.36
Maximum	12.00	24.60	33.20
Minimum	0.50	2.30	3.00
Median	6.50	8.50	9.00

Note: Secchi depth measurements collected by Mr. Ellsworth Acker were used in this analysis before this monitoring program began in 1994 (Carroll County, Water Resource Planning Division, 2001).