FINAL

Water Quality Analysis of Nutrients (Phosphorus) for the Potomac River Lower North Branch in Allegany County, Maryland

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WQA – Eutrophication
Potomac River LNB
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List of Abbreviations

BSID	Biological Stressor Identification
COMAR	Code of Maryland Regulations
CWA	Clean Water Act
DNR	Department of Natural Resources
DO	Dissolved Oxygen
EPA	United States Environmental Protection Agency
EPT	*Ephemeroptera*, *Plecoptera*, and *Trichoptera*
MBSS	Maryland Biological Stream Survey
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MGS	Maryland Geological Survey
mg/l	Milligrams Per Liter
NPDES	National Pollution Discharge Elimination System
NRCS	National Resources Conservation Service
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSI	Trophic State Index
WWTP	Waste Water Treatment Plant
WQA	Water Quality Analysis
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'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 listed on the *Integrated Report of Surface Water Quality in Maryland* (Integrated Report), 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 via a Water Quality Analysis (WQA) that water quality standards are being met (CFR 2010). In 2002, the State began listing biological impairments on the Integrated Report. Maryland Department of the Environment (MDE) has developed a biological assessment methodology to support the determination of proper category placement for 8-digit watershed listings.

The Potomac River Lower North Branch (LNB) watershed (basin code 02141001), located in Allegany County, was identified on the 2008 Integrated Report under Category 5 as impaired by nutrients and sediment (1996 listings), methyl mercury, and impacts to biological communities (2002 listings) (MDE 2008a). The 2008 Integrated Report specified that the designated use impaired by nutrients is Protection of Aquatic Life. The 1996 suspended sediment listing was refined in the 2008 Integrated Report to a listing for total suspended solids. Similarly, the 1996 nutrients listing was refined in the 2008 Integrated Report, and phosphorus was identified as the specific impairing substance. Consequently, for the purpose of this report the terms "nutrients" and "phosphorus" will be used interchangeably. The 2008 Integrated Report also restricted the impairment for biological impacts to 1st through 4th order streams in the watershed. EPA approved water quality assessments (WQA) for low pH and cadmium (1996 listings) establishing that water quality criteria are being met (listed in Category 2 of the 2008 Integrated Report). The listings for sediments and impacts to biological communities will be addressed separately at a future date.

A data solicitation for information pertaining to pollutants, including nutrients, in the Potomac River LNB watershed was conducted by MDE in 2009, and all readily available data from the period of 2000 through 2009 have been considered. Currently, there are no specific numeric criteria for nutrients in Maryland's water quality standards for Aquatic Life Use. Nutrients typically do not have a direct impact on aquatic life; rather, their impact is mediated through excessive algal growth which can lead to low dissolved oxygen, poor habitat, or shifts in species composition.

Recently, MDE developed a biological stressor identification (BSID) methodology to identify the most probable cause(s) of biological impairments in 1st through 4th order streams in Maryland 8-digit watersheds based on the suite of available physical, chemical, and land use data (MDE 2009a). The BSID analysis for the Potomac River LNB watershed identified neither nitrogen nor phosphorus as potential biological stressors. Therefore, because the BSID determined that biological impairments in 1st through 4th order streams in the Potomac River LNB watershed are

not associated with nutrients, it is concluded that excess eutrophication is not a cause of the biological impairments in the watershed.

Although an analysis of the Department of Natural Resources (DNR) CORE/TREND biological monitoring data cannot confirm that the Potomac River LNB mainstem is supporting its aquatic life use, analyses of observed dissolved oxygen (DO) in the Potomac River mainstem show no violation of the DO criterion. A comparison of nitrogen and phosphorus concentrations at LNB CORE/TREND stations with concentrations at other CORE/TREND stations shows that nutrient concentrations in LNB mainstem are relatively low, strongly indicating that nutrients are not potential stressors of the biological community in the LNB mainstem. Therefore, it is concluded that nutrients in general and phosphorus in particular are not impairing the Aquatic Life Use in the Potomac River LNB mainstem.

The weight of evidence provided by the results of the BSID study, combined with the analysis of dissolved oxygen monitoring data presented in this report, indicate that the Potomac River LNB watershed protection of aquatic life use is not being impaired by nutrients. This WQA supports the conclusion that a TMDL for nutrients is not necessary to achieve water quality standards in the Potomac River LNB. Although the waters of the Potomac River LNB do not display signs of eutrophication, the State reserves the right to require future controls if evidence suggests that nutrients from the watershed are contributing to downstream water quality problems. For instance, reductions will be required to meet allocations assigned to the Potomac Tidal Fresh Bay Water Quality Segment by the Chesapeake Bay TMDL, established by EPA on December 29, 2010.

Barring the receipt of contradictory data, this report will be used to support a revision of the phosphorus listing for the Potomac River LNB watershed, from Category 5 ("waterbody is impaired, does not attain the water quality standard, and a TMDL is required") to Category 2 ("waterbodies meeting some [in this case nutrients-related] water quality standards, but with insufficient data to assess all impairments") when MDE proposes the revision of the Integrated Report. The listings for sediments, impacts to biological communities, and methyl mercury in fish tissue will be addressed separately at a future date.

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 required 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 (CFR 2010).

A segment identified as a WQLS may not require the development and implementation of a TMDL if more recent information invalidates previous findings. The most common scenarios that would eliminate the need for a TMDL are: 1) analysis of more recent data indicating that the impairment no longer exists (i.e., water quality standards are being met); 2) results of a more recent and updated water quality modeling which demonstrates that the segment is attaining standards; 3) refinements to water quality standards or to the interpretation of those standards accompanied by analysis demonstrating that the standards are being met; or 4) identification and correction of errors made in the initial listing.

The Potomac River Lower North Branch (LNB) watershed (basin code 02141001), located in Allegany County, was identified on the 2008 Integrated Report under Category 5 as impaired by nutrients and sediment (1996 listings), methyl mercury, and impacts to biological communities (2002 listings) (MDE 2008a). The 2008 Integrated Report specified that the designated use impaired by nutrients and sediment is Aquatic Life and Wildlife. The 1996 suspended sediment listing was refined in the 2008 Integrated Report to a listing for total suspended solids. Similarly, the 1996 nutrients listing was refined in the 2008 Integrated Report, and phosphorus was identified as the specific impairing substance. Consequently, for the purpose of this report the terms "nutrients" and "phosphorus" will be used interchangeably. The 2008 Integrated Report also restricted the impairment for biological impacts to 1st through 4th order streams in the watershed. EPA approved water quality assessments (WQA) for low pH and cadmium (1996 listings) establishing that water quality criteria are being met (listed in Category 2 of the 2008 Integrated Report). The listings for sediments, impacts to biological communities, and methyl mercury in fish tissue will be addressed separately at a future date.

The Maryland Surface Water Use Designation in the Code of Maryland Regulations (COMAR) for the mainstem of the Potomac River LNB has been designated as Use I-P (*Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply*). Mill Run (near Rawlings) and its tributaries in Allegany County, and an unnamed tributary near Pinto also have this use designation. All other tributaries in the Potomac River LNB watershed are Use III-P (*Nontidal Cold Water and Public Water Supply*) (COMAR 2010a,b,c). Use III-P designates waters as suitable for the growth and propagation of trout and capable of supporting self-sustaining trout populations and their associated food organisms. Use III-P also includes all uses designated for Use I (*Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life*) (COMAR 2010a,c).

This report provides an analysis of recent data that supports the removal of the nutrients (phosphorus) listing for the Potomac River LNB watershed when MDE proposes the revision of the State's Integrated Report. The remainder of this report lays out the general setting of the Potomac River LNB watershed area, presents a discussion of the water quality characteristics in the basin in terms of the existing water quality standards for aquatic life relating to nutrients, and presents an analysis of the available nutrient data. This analysis supports the conclusion that the waters of the Potomac River LNB watershed do not display signs of eutrophication or nutrient over-enrichment.

2.0 GENERAL SETTING

Location

The Potomac River LNB watershed is located in the North Branch Potomac River sub-basin within Maryland (021410). The North Branch of the Potomac River delineates the border between Maryland and West Virginia from its origin at the Fairfax Stone in West Virginia to its confluence with the South Branch of the Potomac near Oldtown, Maryland. The Lower North Branch is defined as the reach extending from the Savage River to the confluence with the South Branch Potomac River. Its land area is segmented by the watersheds of Wills Creek and Evitts Creek, which enter the LNB in Cumberland (Figure 1). The watershed covers 73,144 acres in Allegany County, Maryland.

Geology/Soils

The Potomac River LNB watershed is situated in the Ridge and Valley Province of Maryland, which extends from South Mountain in Washington County to Dans Mountain in western Allegany County. The Province is characterized by folded and faulted sedimentary rocks, layered limestone and shale, and mountainous soils composed of clay, clay loams, and sandy and stony loams. Two distinct topographic and geological zones occur in the Ridge and Valley Province. The Great Valley, which in Maryland is also called the Hagerstown Valley, lies in the eastern portion of the province. It is an extensive lowland that formed on Cambrian and Ordovician age limestones and shales. The terrain becomes more rugged to the west of Powell Mountain, an area also known as the AlleganyRidge. This region is characterized by often steep and deeply carved ridges that trend to the Northeast with elevations ranging up to 2,800 feet. Here the bedrock consist of sandstones and shales from the Silurian to Mississippian ages, with limestones from the Silurian to Devonina ages occurring in some of the valleys (MDE 2000, MGS 2009, Vokes and Ewards 1974, DNR 2005).

The soil series in the Potomac River LNB watershed include the Elliber- Dekalb-Opequon association, Weikert-Gilpin association, Gilpin-Dekalb-Cookport association, and the Weikert-Calvin-Lehew association. The soils in the Elliber- Dekalb-Opequon association are well-drained. Elliber soils are found on the tops and sides of ridges. They are deep over cherty limestone and tend to be very stony, containing large quantities of chert fragments. The mostly very stony Dekalb soils are moderately deep over sandstone. The Opequon soils generally occur on the sides of the limestone ridges and contain stones or flagstones. Weikert soils are dominantly shallow over shale bedrock and can be very stony and somewhat excessively drained. The generally shallow and stony Gilpin soils tend to be well-drained. Cookport soils are often very stony and have a firm, dense fragipan that hinders drainage (NRCS 1977).

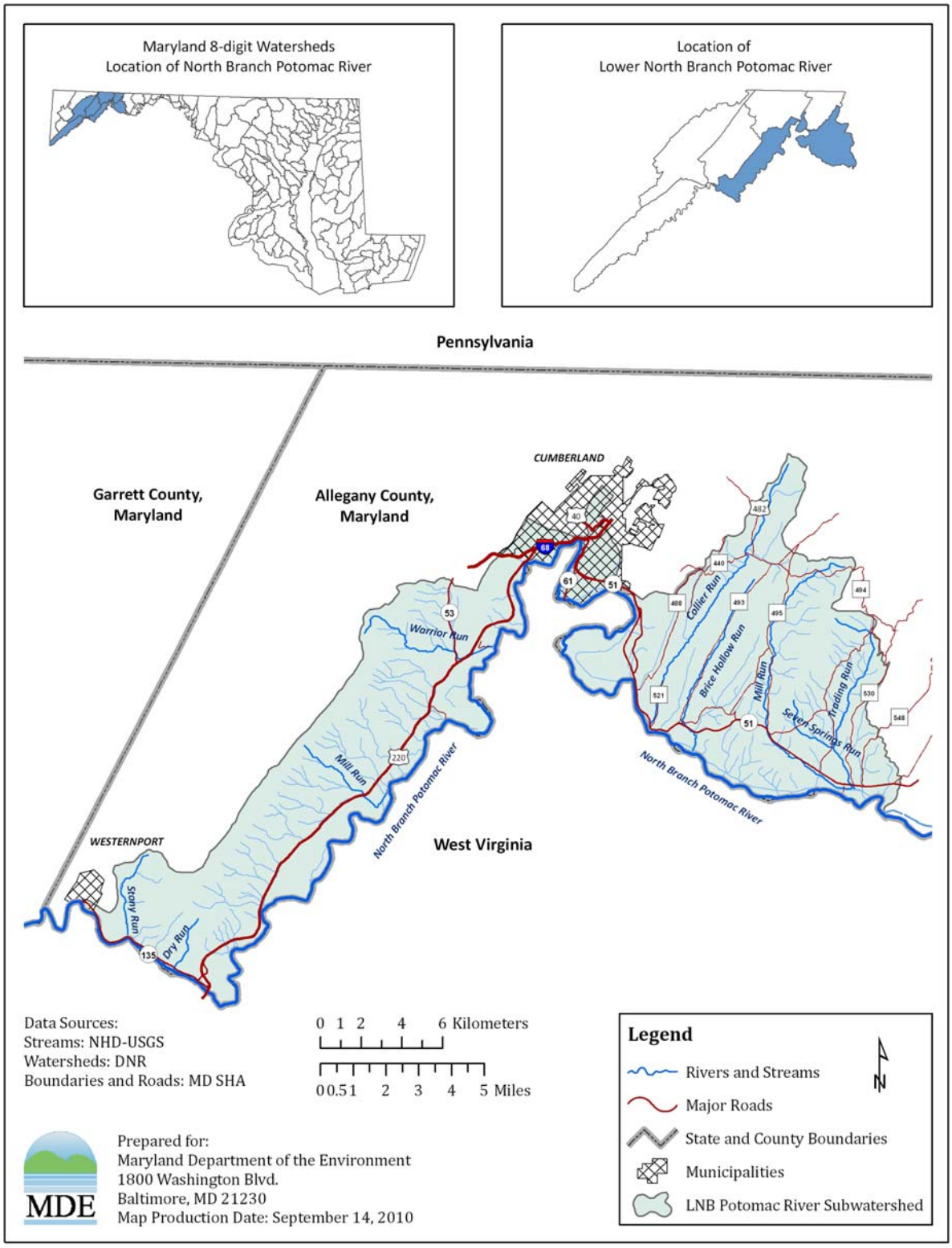

Figure 1. Location Map of the Potomac River LNB Watershed

Land Use

The Potomac River LNB watershed consists primarily of forest land use (76.9%), but also includes some small concentrated pockets of urban land (14.6%), crop land (4.4%), and pasture (4.0%), as per the Chesapeake Bay Program Phase 5.2 (CBP P5.2) watershed model (US EPA 2008). A detailed summary of the watershed land use areas is presented in Table 1, and a land use map is provided in Figure 2.

Table 1: Land Use Percentage Distribution for the Potomac River LNB Watershed

General Land Use	**Detailed Land Use**	**Area** (Acres)	**Percent**	**Grouped Percent of Total**
Crop	Animal Feeding Operations	22.4	0.2	4.4
	Hay	2,818	0.3	
	High Till	143.2	0.0	
	Low Till	218.3	3.9	
	Nursery	0.0	0.0	
Extractive	Extractive	57.3	0.1	0.1
Forest	Forest	55,471.0	76.2	76.9
	Harvested Forest	560.3	0.8	
Pasture	Pasture	2,942.2	4.0	4.0
	Trampled Pasture	0.0	0.0	
Urban	Barren	14.9	0.0	14.6
	Impervious	1,689.1	2.3	
	Pervious	8,893.5	12.2	
Total		72,830.2	100.0	100.0

Point Sources

There are seventeen point source facilities with permits regulating their discharges in the Potomac River LNB watershed (Table 1). Of these, seven municipal and two industrial facilities have NPDES permits regulating the discharge of nutrients.

Table 1: Point Source Facilities in the Potomac River LNB Watershed

Facility	NPDES Number	MDE Number	Latitude (dec degree)	Longitude (dec degree)
Municipal				
BARTON BUSINESS PARK WWTP	MD0068896	02DP3402A	39.5586	-78.8617
BIERS LANE WWTP	MD0065749	04DP2883A	39.5417	-78.8761
CELANESE WWTP	MD0063878	03DP2625A	39.4608	-79.0056
CUMBERLAND WWTP	MD0021598	01DP0567	39.6294	-78.7586
OLDTOWN WWTP	MD0024759	07DP1004	39.5417	-78.6075
PINTO UTILITIES WWTP	MD0022748	00DP0713	39.5683	-78.8453
RAWLINGS WWTP	MD0023213	07DP0739	39.5333	-78.8750
Industrial				
LUKE PAPER COMPANY	MD0001422	95DP0300	39.4723	-79.0583
UPPER POTOMAC RIVER COMMISSION	MD0021687	95DP0230	39.4789	-79.0392

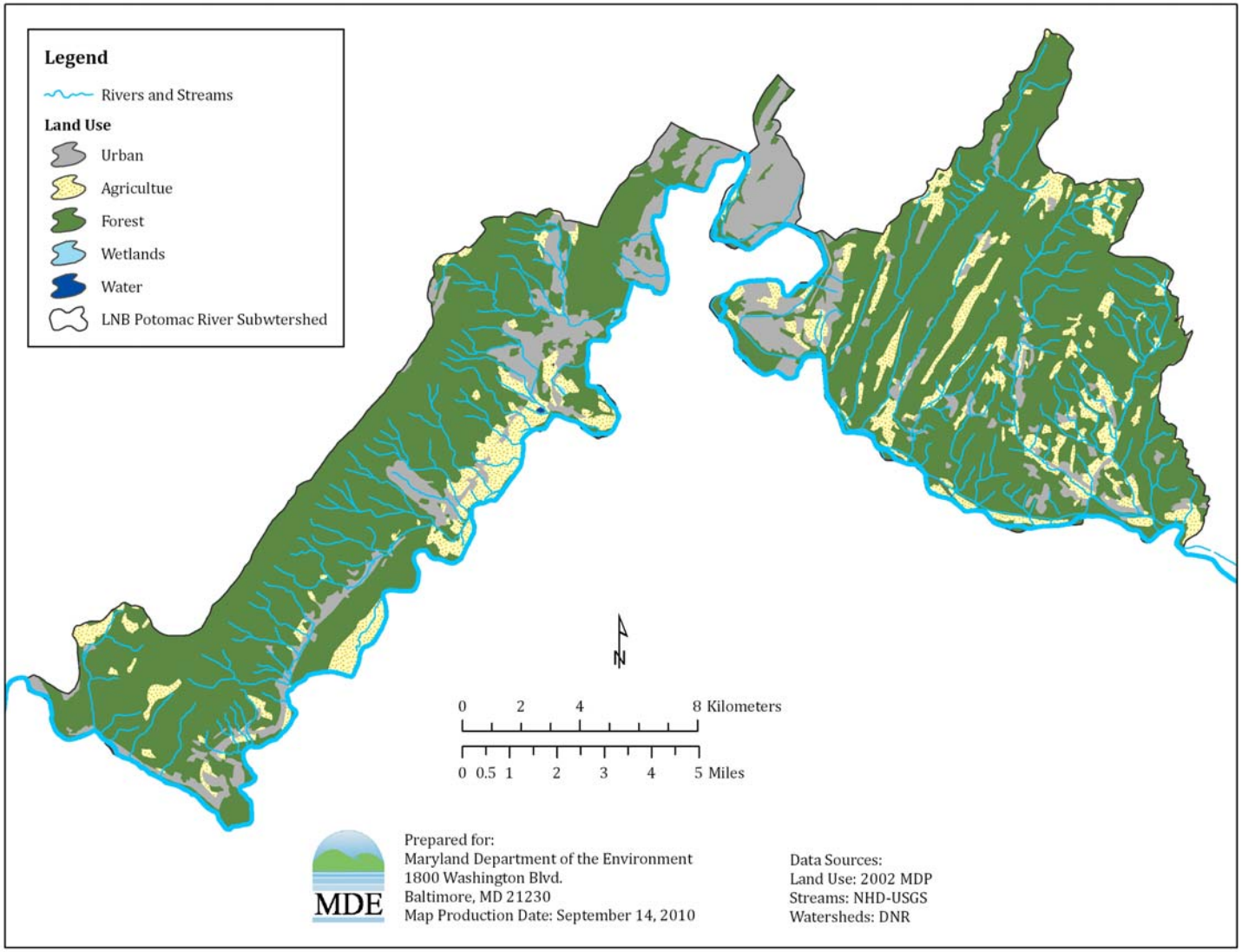

Figure 2. Land Use Map of the Potomac River LNB Watershed

3.0 WATER QUALITY CHARACTERIZATION

The Maryland Surface Water Use Designation in the Code of Maryland Regulations (COMAR) for the mainstem of the Potomac River LNB has been designated as Use I-P (*Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply*). Mill Run (near Rawlings) and its tributaries in Allegany County, and an unnamed tributary near Pinto also have this use designation. All other tributaries in the Potomac River LNB watershed are Use III-P (*Nontidal Cold Water and Public Water Supply*) (COMAR 2010a,b,c). Use III-P designates waters as suitable for the growth and propagation of trout and capable of supporting self-sustaining trout populations and their associated food organisms. Use III-P also includes all uses designated for Use I (*Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life*) (COMAR 2010a,c).

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 support of aquatic life, primary or secondary contact recreation, drinking water supply, and shellfish propagation and harvest. Water quality criteria consist of narrative statements and numeric values designed to protect the designated uses. The criteria developed to protect the designated use may differ and are dependent on the specific designated use(s) of a waterbody.

The 2008 Integrated Report specified that the designated use impaired by nutrients is the Aquatic Life Use. Currently, there are no specific numeric criteria for nutrients in Maryland's water quality standards for the protection of aquatic life in free-flowing non-tidal waters. MDE has developed a biological stressor identification (BSID) analysis to identify potential stressor of aquatic life, including nutrients, in 1st through 4th order streams assessed by the Maryland Biological Stream Survey (MBSS). The impact of eutrophication on smaller-order streams in the watershed will be evaluated on the basis of the BSID analysis, which provides necessary and sufficient conditions for determining whether phosphorus is a potential stressor of the biological community in smaller-order streams.

Low levels of dissolved oxygen are sometimes associated with the decay of excess primary production and therefore nutrient over-enrichment. The dissolved oxygen (DO) concentration to protect Use I-P waters "may not be less than 5 milligrams per liter (mg/l) at any time" and to protect Use III-P waters "may not be less than 5 mg/l at any time, with a minimum daily average of not less than 6 mg/l" (COMAR 2010d). The water quality analysis must demonstrate that either the water quality standards for dissolved oxygen are met or that nutrients are not the cause of the violation of the standards.

A data solicitation was conducted by MDE in 2009, and all readily available water quality data from the time period of 2000 through 2009 were considered for this analysis. DNR collected water quality data from four stations on the Potomac River LNB mainstem for its CORE/TREND network between January 2000 and December 2008, and from twenty stations located on tributaries to the LNB for its MBSS program in the spring and summer of 2001 through 2004. MDE also sampled at three CORE/TREND stations as well as three additional

stations on the mainstem between October 2000 and March 2004, and at nine stations sited in tributaries in 2009.

3.1 Potomac River LNB Watershed Monitoring Stations

Water quality data from a total of 40 sampling sites were used to characterize the Potomac River LNB watershed. Seven of the sites are on the mainstem LNB of the Potomac River, and 33 are in the 1st through 4th order streams in the watershed. The latter include 24 sampling stations used in Round 2 of the MBSS program and nine additional monitoring stations sampled by MDE. DNR collected water quality monitoring data at four stations in the mainstem LNB for the CORE/TREND program. MDE collected water quality monitoring data from six stations in the maintem. Three of these stations were at locations where DNR collected water quality data for the CORE/TREND program. The locations of the water quality monitoring stations are shown in Figure 3, and their geographical coordinates are listed in Table 1. Figures 4 through 7 provide graphical representation of the collected data for the parameters discussed below.

Biological and physical habitat data from 18 monitoring stations in Round 1 and 20 monitoring stations in Round 2 of MBSS program were used to assess the Potomac River LNB watershed in Maryland's 2008 Integrated Report and to characterize the watershed for the BSID analysis. Biological data were also collected at the four stations for the DNR CORE/TREND network on the mainstem Potomac River LNB (see Figure 3 and Table 1).

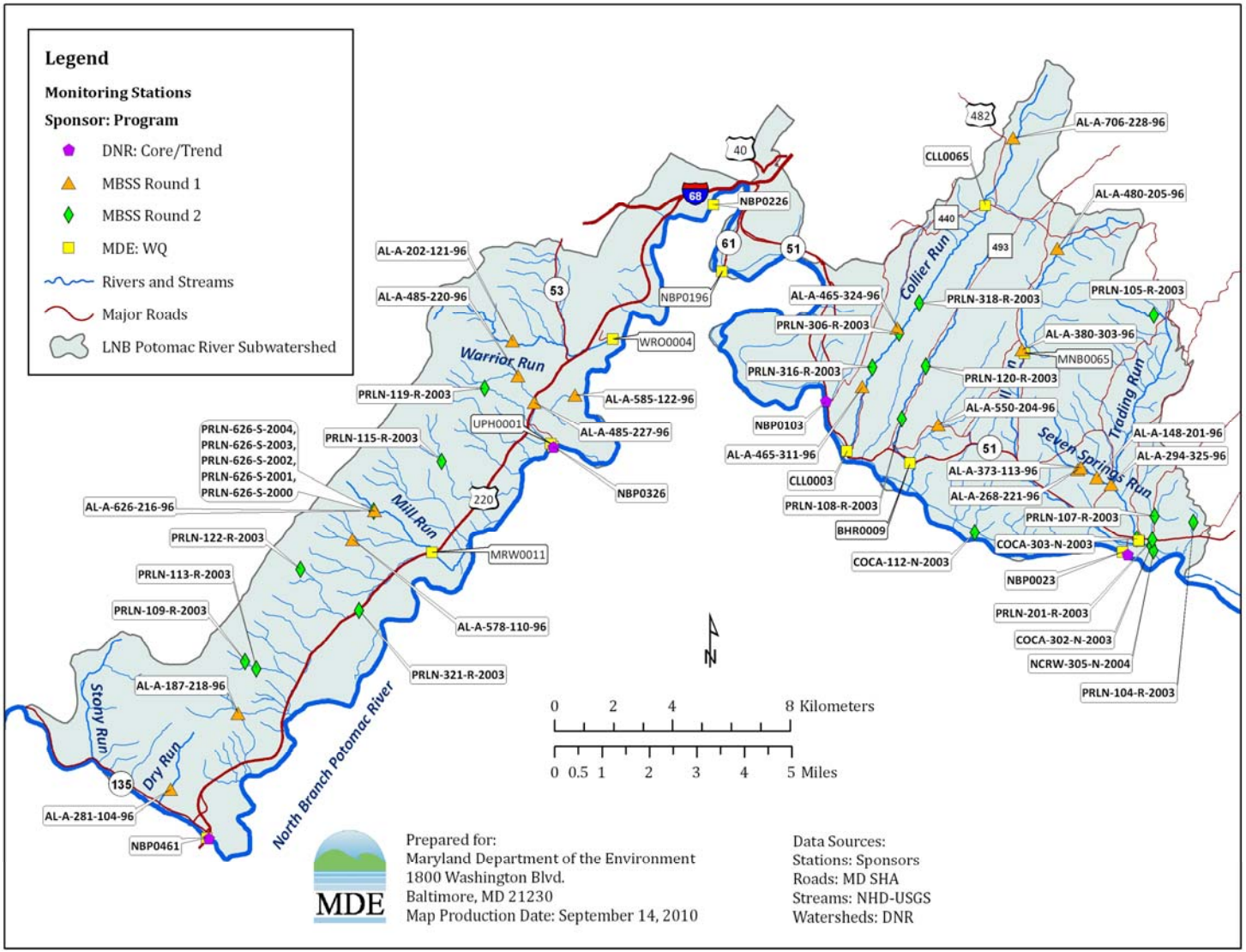

Figure 3. Water Quality Stations in Potomac River LNB Watershed Monitored During 2000-2009

Table 2: Water Quality Stations in the Potomac River LNB Watershed Monitored During 2000-2009

Station Number	Sponsor	Site Type	Location	Latitude (Decimal Degree)	Longitude (Decimal Degree)
NBP0023	DNR	TREND	Potomac River LNB	39.536944	-78.611389
NBP0103	DNR	CORE	Potomac River LNB	39.582500	-78.731667
NBP0326	DNR	CORE	Potomac River LNB	39.566667	-78.839167
NBP0461	DNR	TREND	Potomac River LNB	39.444722	-78.971944
AL-A-465-311-96	DNR	MBSS Round 1	Collier Run	39.587256	-78.717348
AL-A-706-228-96	DNR	MBSS Round 1	Collier Run	39.664164	-78.659591
AL-A-187-218-96	DNR	MBSS Round 1	Deep Hollow	39.483194	-78.961468
AL-A-281-104-96	DNR	MBSS Round 1	Dry Run	39.459422	-78.987413
AL-A-550-204-96	DNR	MBSS Round 1	Frog Hollow	39.575810	-78.687076
AL-A-380-303-96	DNR	MBSS Round 1	Mill Run	39.599288	-78.654526
AL-A-480-205-96	DNR	MBSS Round 1	Mill Run	39.630503	-78.641315
AL-A-626-216-96	DNR	MBSS Round 1	Mill Run	39.546176	-78.909292
AL-A-578-110-96	DNR	MBSS Round 1	Mill Run UT1	39.536967	-78.917716
AL-A-585-122-96	DNR	MBSS Round 1	North Branch Potomac River UT1	39.582941	-78.830975
AL-A-485-220-96	DNR	MBSS Round 1	North Branch Potomac River UT2	39.588515	-78.853633
AL-A-485-227-96	DNR	MBSS Round 1	North Branch Potomac River UT2	39.580388	-78.846923
AL-A-148-201-96	DNR	MBSS Round 1	Seven Springs Run	39.560566	-78.623965
AL-A-268-221-96	DNR	MBSS Round 1	Seven Springs Run	39.562759	-78.631547
AL-A-373-113-96	DNR	MBSS Round 1	Seven Springs Run UT1	39.563390	-78.630384
AL-A-294-325-96	DNR	MBSS Round 1	Trading Run	39.558637	-78.618284
AL-A-202-121-96	DNR	MBSS Round 1	Warrior Run	39.598941	-78.856080
AL-A-465-324-96	DNR	MBSS Round 1	Wildcat Hollow	39.605235	-78.704032
PRLN-108-R-2003	DNR	MBSS Round 2	Brice Hollow Run	39.577503	-78.701614
PRLN-120-R-2003	DNR	MBSS Round 2	Brice Hollow Run	39.593766	-78.692492
PRLN-306-R-2003	DNR	MBSS Round 2	Collier Run	39.603718	-78.703207
PRLN-316-R-2003	DNR	MBSS Round 2	Collier Run	39.593111	-78.713612
PRLN-318-R-2003	DNR	MBSS Round 2	Collier Run	39.613137	-78.695461
COCA-302-N-2003	DNR	MBSS Round 2	Mill Run	39.539944	-78.602109
NCRW-305-N-2004	DNR	MBSS Round 2	Mill Run	39.538333	-78.601116
PRLN-626-S-2000	DNR	MBSS Round 2	Mill Run	39.546084	-78.909545
PRLN-626-S-2001	DNR	MBSS Round 2	Mill Run	39.546086	-78.909545
PRLN-626-S-2002	DNR	MBSS Round 2	Mill Run	39.546086	-78.909545
PRLN-626-S-2003	DNR	MBSS Round 2	Mill Run	39.546086	-78.909545
PRLN-626-S-2004	DNR	MBSS Round 2	Mill Run	39.546086	-78.909545
PRLN-201-R-2003	DNR	MBSS Round 2	Mill Run UT1	39.541689	-78.601749
PRLN-107-R-2003	DNR	MBSS Round 2	Mill Run UT1 UT1	39.549110	-78.600977
PRLN-321-R-2003	DNR	MBSS Round 2	Mill Run UT2	39.515479	-78.914479
PRLN-122-R-2003	DNR	MBSS Round 2	Mill Run UT2 UT1	39.527571	-78.937974
COCA-303-N-2003	DNR	MBSS Round 2	Seven Springs Run	39.541888	-78.607797
PRLN-109-R-2003	DNR	MBSS Round 2	Toms Hollow	39.498929	-78.959161
PRLN-113-R-2003	DNR	MBSS Round 2	Toms Hollow	39.496777	-78.954656
PRLN-105-R-2003	DNR	MBSS Round 2	Trading Run UT1	39.610607	-78.602614
COCA-112-N-2003	DNR	MBSS Round 2	Potomac River LNB UT5	39.543031	-78.671895
PRLN-104-R-2003	DNR	MBSS Round 2	Potomac River LNB UT3	39.547377	-78.585551
PRLN-115-R-2003	DNR	MBSS Round 2	Potomac River LNB UT4	39.561490	-78.883116
PRLN-119-R-2003	DNR	MBSS Round 2	Potomac River LNB UT2 UT1	39.584485	-78.866657
BHR0009	MDE	WQ	Brice Hollow Run	39.563867	-78.697917
CLL0003	MDE	WQ	Collier Run	39.567167	-78.723033

Station Number	Sponsor	Site Type	Location	Latitude (Decimal Degree)	Longitude (Decimal Degree)
CLL0065	MDE	WQ	Collier Run	39.643467	-78.670117
MNB0006	MDE	WQ	Mill Run	39.541167	-78.606933
MNB0065	MDE	WQ	Mill Run	39.598183	-78.653500
MRW0011	MDE	WQ	Mill Run	39.533650	-78.886167
UPH0001	MDE	WQ	Potomac River LNB UT	39.567717	-78.840133
SSR0000	MDE	WQ	Seven Springs Run	39.541450	-78.607033
WRO0004	MDE	WQ	Warrior Run	39.600233	-78.816583
NBP0023	MDE	WQ	Potomac River LNB	39.537750	-78.613333
NBP0156	MDE	WQ	Potomac River LNB	39.605817	-78.748850
NBP0196	MDE	WQ	Potomac River LNB	39.621783	-78.773733
NBP0226	MDE	WQ	Potomac River LNB	39.642133	-78.777667
NBP0326	MDE	WQ	Potomac River LNB	39.566817	-78.839217
NBP0461	MDE	WQ	Potomac River LNB	39.445017	-78.972817

UT = Unnamed Tributary

The potential impact of eutrophication on water quality is best measured during the growing season, May through October. Water quality data for the mainstem of Potomac River and smaller-order streams will be analyzed separately. The impact of eutrophication on smaller-order streams in the watershed will be evaluated on the basis of the BSID analysis, which provides necessary and sufficient conditions for determining whether phosphorus is a potential stressor of the biological community in smaller-order streams.

3.2 Biological Stressor Identification Analysis

In the process of evaluating the existing biological impairments in 1st through 4th order streams, MDE developed a biological stressor identification (BSID) methodology (MDE 2009a). The BSID methodology uses data available from the statewide DNR MBSS. Data used in the development of the BSID report for the Potomac River LNB are presented in Appendix A.

The current MDE biological assessment methodology is a three-step process: (1) a data quality review, (2) a systematic vetting of the dataset, and (3) a watershed assessment that presents the results of this assignment in terms of currently used Integrated Report listing categories.

The BSID analysis for the Potomac River LNB watershed did not identify nutrients as potential stressors or indicate any significant association between current nutrient levels and the degraded biological conditions (MDE 2010). According to this report, there is no association between nutrient concentrations and any impairment to aquatic life or biological communities in the LNB watershed.

The BSID analysis did not implicate low DO concentrations as a potential stressor, which agrees with the data analysis in Section 3.3. Low DO concentrations are therefore not associated with biological impairments in the smaller order streams in the Potomac River LNB watershed.

The BSID analysis did not identify any probable stressors or sources associated with the impaired biological conditions in the Potomac River LNB watershed. The BSID report mentions two possible reasons why no stressors or sources were identified. First, the stressors or sources could be highly localized and site-specific. Second, the Potomac River LNB watershed is located east of the Appalachian Plateau where the elevation drops from over 2,000 feet to as low 600 feet near the Potomac River. Here the prevailing westerly wind creates a rain shadow and the watershed may experience drier conditions than other streams in the region. As a result, the streams in the Potomac River LNB watershed may be more sensitive to drought (MDE 2010).

3.3 Dissolved Oxygen

DNR collected samples for its CORE/TREND program in the mainstem Potomac River LNB from January 2000 through December 2008 and for its MBSS program in tributaries during the summers of 2000 - 2004. MDE collected samples in the mainstem from October 2000 through March 2004 and in tributaries during 2009.

Samples taken from the mainstem during the growing season (May through October) show DO concentrations ranging from 5.8 to 11.2 mg/l. Given that all samples have DO concentrations above the Use I criterion of 5 mg/l, MDE considers that the water quality standard for DO is being met in the mainstem Potomac River LNB.

MDE collected 53 samples during the growing season from tributaries to the Potomac River LNB. None of the samples have a DO concentration below 5 mg/l, and only two samples (i.e. 3.8%) have concentrations below 6 mg/l. The median concentration is 8.6 mg/l and the average concentration 8.7 mg/l. Twenty-three field DO samples were collected as part of the MBSS program. The minimum concentration is 6.8 mg/l and the median 8.3 mg/l. Given that none of the sample concentrations are below 5 mg/l and only two of a total of 76 samples are below 6 mg/l, MDE deems that the water quality standard for DO is being met in the 1st through 4th order streams in the Potomac River LNB watershed.

The DO data are presented graphically in Figure 4 and in tabular form in Appendix A.

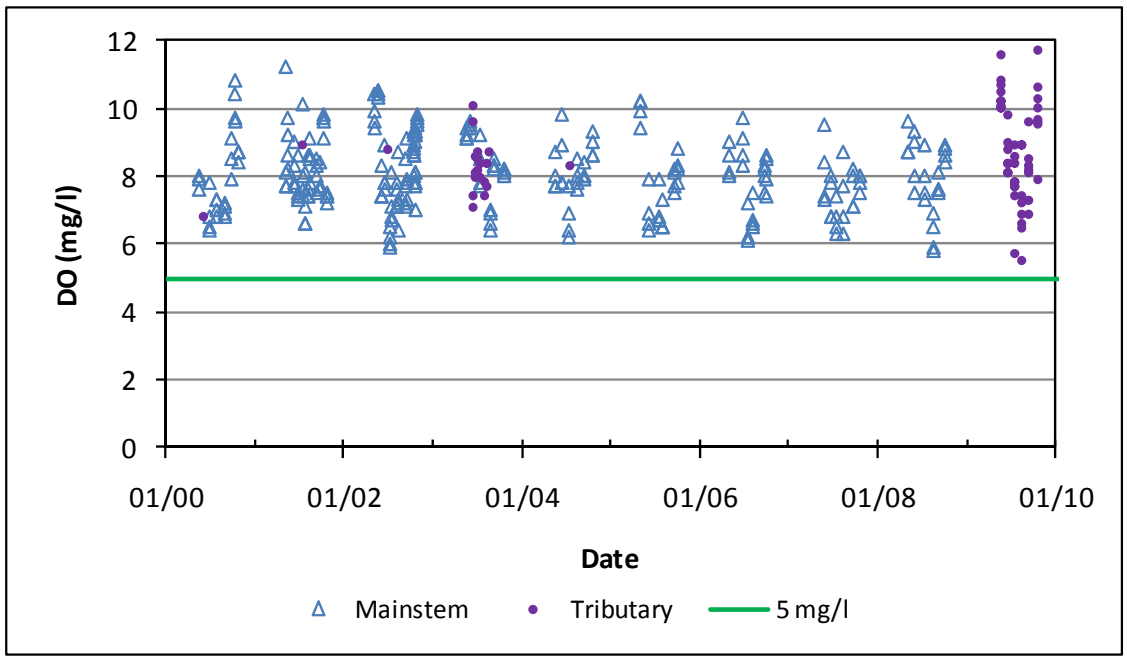

Figure 4: Potomac River LNB Dissolved Oxygen Data for Growing Season Periods May 2000 through October 2009

3.4 Nutrients

In the absence of State water quality standards with specific numeric limits for nutrients for the protection of aquatic life in non-tidal free-flowing waters, evaluation of potentially eutrophic conditions is based on the BSID analysis and analysis of dissolved oxygen levels. Consequently, the nutrients data presented in this section are for purposes of comparison only.

Total nitrogen (TN) and total phosphorus (TP) data for the Potomac River LNB watershed have been analyzed as part of this study. The results are presented here graphically in Figures 5 and 6, and in tabular form in Appendix A.

MDE sampled several tributaries during the 2009 growing season. The data show TN concentrations ranging from 0.10 mg/l to 1.10 mg/l and TP concentrations ranging from 0.02 to 0.07 mg/l.

DNR and MDE also sampled the mainstem of the Potomac River LNB. The data show TN concentrations during the growing season (May through October) ranging from 0.62 to 3.94 mg/l and TP concentrations ranging from 0.01 to 0.37 mg/l. Appendix B compares the level of nutrient concentrations observed in the LNB with the level of nutrient concentrations observed at other CORE/TREND stations.

A Nitrogen:Phosphorus (TN:TP) ratio in the range of 5:1 to 10:1 by mass is associated with plant growth being limited by neither phosphorus nor nitrogen. If the TN:TP ratio is greater than 10:1, phosphorus tends to be limiting; if the TN:TP ratio is less than 5:1, nitrogen tends to be limiting (Chiandani et al. 1974). In the mainstem samples across the two surveys, the average TN:TP ratio is 27.8 and the median 22.0. Ninety-two percent of the samples have TN:TP ratios greater than ten, and none less than five

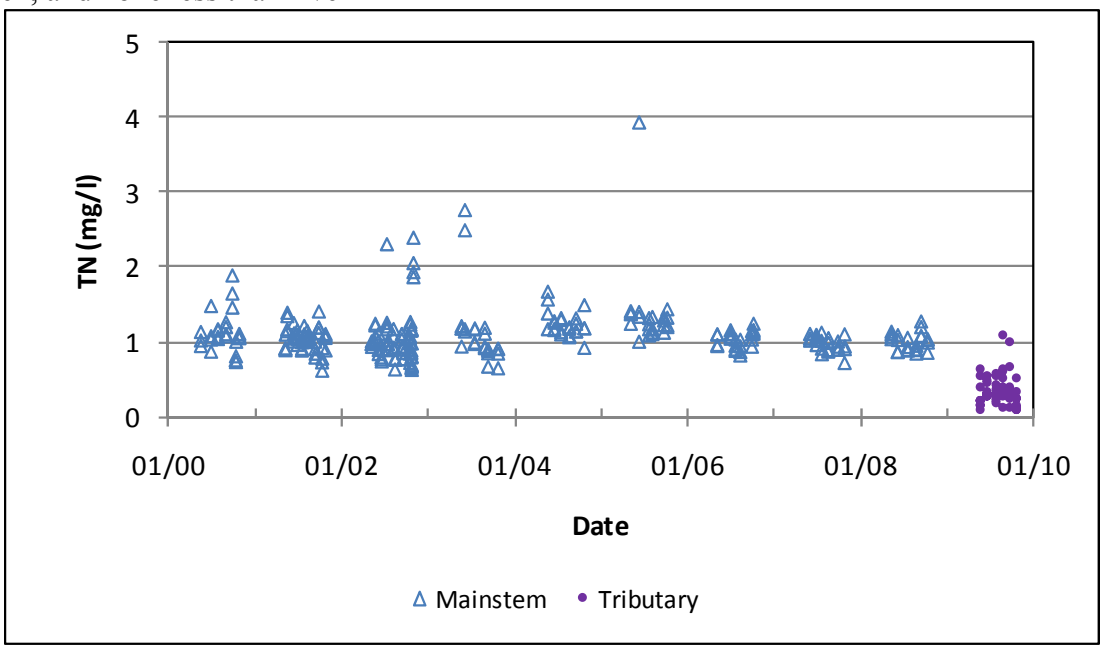

Figure 5: Potomac River LNB Total Nitrogen for Growing Season Periods May 2000 through October 2009

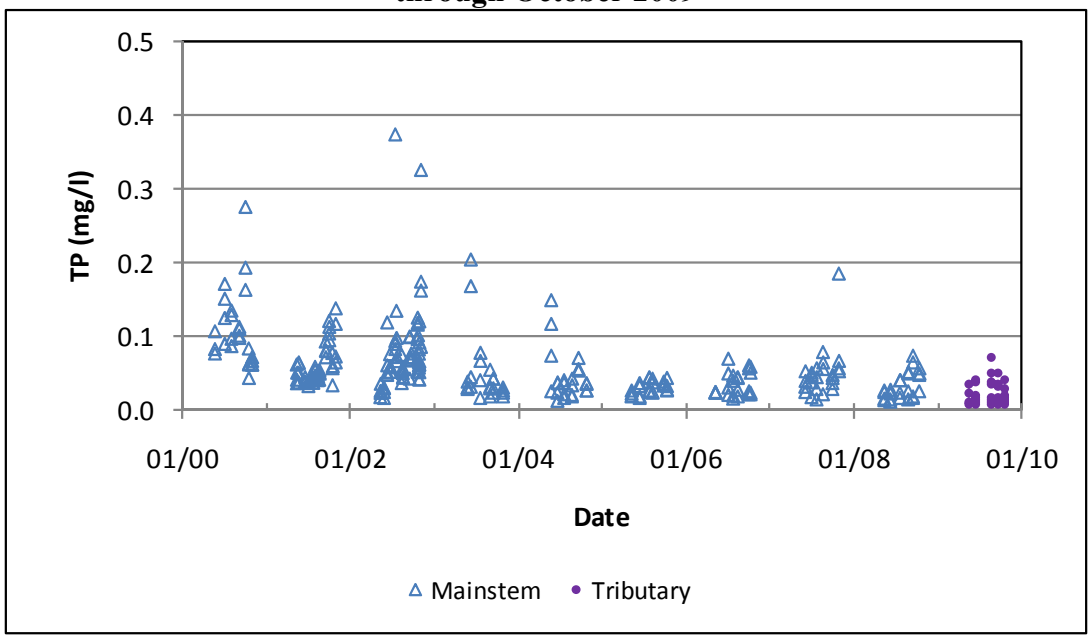

Figure 6: Potomac River LNB Total Phosphorus Data for Growing Season Periods May 2000 through October 2009

3.5 Potomac River Core/Trend Monitoring Stations

Additional biological data for the Potomac River LNB were obtained from the DNR CORE/TREND program. The program collected benthic macroinvertebrate data between 1976 and 2006. The data were used to calculate four benthic community measures: total number of taxa, Shannon-Weiner diversity index, modified Hilsenhoff biotic index, and percent *Ephemeroptera*, *Plecoptera*, and *Trichoptera* (EPT). DNR has extensive monitoring data for four stations on the mainstem of the Potomac River LNB through the CORE/TREND program. These stations have between 19 and 26 years of benthic macroinvertebrate data (DNR 2009). A summary of the results for each of the stations is presented in Table 3.

Table 3: Potomac River LNB CORE/TREND Data

Site Number	Current Water Quality Status	Trend Since 1970's
NBP0023	Fair/Good	Moderate Improvement
NBP0103	Fair/Good	Strong Improvement
NBP0326	Fair/Good	Slight Improvement
NBP0461	Fair	Slight Improvement

The CORE/TREND data for LNB stations show that water quality in the LNB mainstem has improved significantly over time, but because the water quality status of the LNB CORE/TREND stations is not consistently assessed as "Good," the CORE/TREND assessment does not provide sufficient evidence that the LNB mainstem is supporting its Aquatic Life Use. On the other hand, the current CORE/TREND assessment of the LNB is not sufficient by itself to maintain that the Aquatic Life Use is impaired in the LNB mainstem. Appendix B gives some additional background information on the water quality status and trends in the LNB mainstem.

Appendix B gives an analysis of the nutrient data collected at CORE/TREND stations in the LNB, and compares the distribution of concentrations observed in the LNB with the distribution of concentrations observed at CORE/TREND stations whose water quality status is at least "Good." The analysis shows that the concentrations observed in the LNB are consistently lower than those observed at stations assessed as having "Good" or better water quality. Thus the level of nutrient concentrations observed in the LNB mainstem is compatible with maintaining a water quality status of "Good" or better, and therefore nutrients are not potential stressors of aquatic life in the mainstem Potomac River LNB.

4.0 CONCLUSION

The BSID analysis of the Potomac River LNB watershed does not identify phosphorus or nitrogen as a potential stressor of aquatic life in the watershed. Excess nutrients, and consequently eutrophication, is therefore not a cause of the biological impairments in the 1st through 4th order streams in the watershed. In addition, the BSID analysis does not present significant evidence of low DO and therefore does not associate low DO with biological impairments in the watershed. An analysis of available DO data from the 1st through 4th order streams in Potomac River LNB watershed shows none of the observed DO data from smaller-order streams in the watershed have concentrations below 5 mg/l, and less than 4% of the samples have concentrations below 6 mg/l. Therefore, the DO criteria are met in the smaller-order streams draining to the mainstem Potomac River LNB.

An analysis of available DO data from the mainstem Potomac River LNB shows that the DO criterion is being met. A comparison of nitrogen and phosphorus concentrations at LNB CORE/TREND stations with concentrations at other CORE/TREND stations shows that nutrient concentrations in LNB mainstem are relatively low, strongly indicating that nutrients are not potential stressors of the biological community in the LNB mainstem. Ninety-two percent of the samples that were observed have TN:TP ratios greater than ten and none less than five; the average TN:TP ratio is 27.8 and the median 22.0. Therefore, it is concluded that nutrients in general and phosphorus in particular are not impairing the Aquatic Life Use in the Potomac River LNB mainstem.

MDE therefore concludes that currently the Potomac River LNB Aquatic Life Use is not being impaired by nutrients, based on the weight of evidence established above. Barring the receipt of contradictory data, this report will be used to support a revision of the phosphorus listing for the Potomac River LNB watershed, from Category 5 ("waterbody is impaired, does not attain the water quality standard, and a TMDL is required") to Category 2 ("waterbodies meeting some [in this case nutrients-related] water quality standards, but with insufficient data to assess all impairments"), when MDE proposes the revision of Maryland's Integrated Report.

Although the waters of the Potomac River LNB do not indicate likely eutrophication, the State reserves the right to require future controls if evidence suggests that nutrients from the basin are contributing to downstream water quality problems. For instance, reductions will be required to meet allocations assigned to the Potomac Tidal Fresh Bay Water Quality Segment by the Chesapeake Bay TMDL, established by EPA on December 29, 2010.

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Appendix A – Tabular Water Quality Data

Table A-1: DNR CORE/TREND Water Quality Data

Station	Sampling Date	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0023	01/26/00	11.90	1.91	0.10
NBP0023	02/24/00	11.30	1.63	0.04
NBP0023	03/22/00	11.10	1.38	0.06
NBP0023	04/18/00	8.80	1.09	0.07
NBP0023	05/16/00	7.90	1.02	0.08
NBP0023	06/28/00	6.50	1.04	0.09
NBP0023	07/27/00	6.80	1.07	0.09
NBP0023	08/30/00	6.90	1.20	0.11
NBP0023	09/26/00	7.90	1.65	0.19
NBP0023	10/25/00	8.70	1.11	0.06
NBP0023	11/29/00	11.00	1.20	0.05
NBP0023	12/20/00	11.50		
NBP0023	01/24/01	12.20	1.20	0.04
NBP0023	02/07/01	12.20	1.46	0.04
NBP0023	03/28/01	11.70	0.65	0.03
NBP0023	04/11/01	9.40	1.37	0.07
NBP0023	05/16/01	8.20	1.40	0.06
NBP0023	06/27/01	7.40	1.08	0.04
NBP0023	07/26/01	6.60	1.07	0.05
NBP0023	08/08/01	7.40	1.08	0.05
NBP0023	09/26/01	7.70	1.41	0.11
NBP0023	10/24/01	7.50	1.06	0.07
NBP0023	11/07/01	9.20	0.96	0.07
NBP0023	12/05/01	10.10	1.31	0.11
NBP0023	01/16/02	11.80	1.57	0.09
NBP0023	02/06/02	12.30	1.20	0.05
NBP0023	03/06/02	12.40	1.48	0.05
NBP0023	04/17/02	9.40	1.79	0.07
NBP0023	05/22/02	10.30	1.23	0.03
NBP0023	06/05/02	7.40	0.84	0.05
NBP0023	07/10/02	6.00	1.17	0.09
NBP0023	08/07/02	7.10	1.18	0.05
NBP0023	09/11/02	7.10	1.11	0.10
NBP0023	10/30/02	9.70	1.87	0.16
NBP0023	11/20/02	10.80	1.31	0.05
NBP0023	12/04/02	12.90	1.00	0.04
NBP0023	01/07/03	12.10	1.62	0.04
NBP0023	02/05/03	12.50	1.07	0.04
NBP0023	03/05/03	12.20	1.20	0.03
NBP0023	04/16/03	10.00	1.83	0.03
NBP0023	05/21/03	9.10	1.18	0.04
NBP0023	06/04/03	9.50	2.77	0.20
NBP0023	07/16/03	7.70	1.17	0.07
NBP0023	08/27/03	6.60	0.92	0.03
NBP0023	09/10/03	8.30	0.89	0.04

Station	Sampling Date	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0023	10/22/03	8.10	0.65	0.03
NBP0023	11/05/03	8.60	0.89	0.04
NBP0023	12/10/03	11.90	1.11	0.03
NBP0023	01/07/04	13.00	1.27	0.02
NBP0023	02/11/04	12.90	1.51	0.04
NBP0023	03/10/04	12.10	1.49	0.01
NBP0023	04/21/04	8.90	1.38	0.02
NBP0023	05/19/04	7.70	1.57	0.12
NBP0023	06/16/04	7.80	1.18	0.04
NBP0023	07/14/04	6.20	1.30	0.04
NBP0023	08/18/04	7.80	1.08	0.03
NBP0023	09/15/04	7.90	1.14	0.05
NBP0023	10/20/04	9.00	0.93	0.03
NBP0023	11/17/04	10.70	1.12	0.02
NBP0023	12/15/04	12.10	1.35	0.03
NBP0023	01/19/05	13.30	1.06	0.02
NBP0023	02/09/05	10.80	1.18	0.04
NBP0023	03/09/05	11.70	1.49	0.04
NBP0023	04/06/05	10.70	1.48	0.03
NBP0023	05/04/05	9.40	1.25	0.02
NBP0023	06/08/05	6.40	3.94	0.04
NBP0023	07/20/05	6.70	1.09	0.04
NBP0023	08/03/05	6.50	1.11	0.04
NBP0023	09/21/05	7.50	1.23	0.04
NBP0023	10/05/05	8.20	1.33	0.03
NBP0023	11/02/05	9.40	1.28	0.05
NBP0023	12/07/05	12.30	1.59	0.04
NBP0023	01/24/06	12.30	1.44	0.03
NBP0023	02/15/06	12.20	1.17	0.03
NBP0023	03/15/06	9.90	1.13	0.20
NBP0023	04/12/06	10.10	0.92	0.03
NBP0023	05/04/06	8.10	0.96	0.02
NBP0023	06/29/06	8.30	1.16	0.05
NBP0023	07/20/06	6.10	0.88	0.04
NBP0023	08/09/06	6.60	0.87	0.04
NBP0023	09/27/06	8.30	1.04	0.06
NBP0023	10/04/06	8.50	1.25	0.05
NBP0023	11/02/06	8.90	0.95	0.05
NBP0023	12/06/06	11.60	0.90	0.04
NBP0023	01/18/07	12.60	1.28	0.04
NBP0023	02/07/07	12.80	1.21	0.04
NBP0023	03/06/07	11.50	1.44	0.04
NBP0023	04/05/07	9.40	1.04	0.02
NBP0023	05/31/07	7.40	1.02	0.04
NBP0023	06/27/07	6.80	1.07	0.05
NBP0023	07/19/07	6.50	0.92	0.06
NBP0023	08/16/07	6.30	0.99	0.05
NBP0023	09/26/07	7.10	0.90	0.05
NBP0023	10/24/07	7.80	0.94	0.05
NBP0023	11/28/07	10.90	1.03	0.05

Station	Sampling Date	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0023	12/05/07	12.00	1.18	0.05
NBP0023	01/09/08	10.60	1.06	0.04
NBP0023	02/06/08	11.60	1.36	0.08
NBP0023	04/02/08	10.10	1.04	0.03
NBP0023	05/08/08	8.70	1.04	0.03
NBP0023	06/04/08	8.00	1.03	0.02
NBP0023	07/16/08	7.30	0.89	0.04
NBP0023	08/21/08	5.80	0.85	0.05
NBP0023	09/10/08	7.50	1.28	0.07
NBP0023	10/08/08	8.60	1.04	0.05
NBP0023	11/06/08	8.60	0.87	0.06
NBP0023	12/03/08	12.00	1.91	0.05
NBP0103	01/26/00	12.70	1.89	0.10
NBP0103	02/24/00	11.20	1.36	0.04
NBP0103	03/22/00	11.20	1.32	0.06
NBP0103	04/18/00	8.80	1.01	0.05
NBP0103	05/16/00	8.00	1.14	0.08
NBP0103	06/28/00	6.40	1.49	0.12
NBP0103	07/27/00	7.30	1.16	0.10
NBP0103	08/30/00	6.80	1.27	0.10
NBP0103	09/26/00	8.50	1.46	0.16
NBP0103	10/25/00	8.70	1.08	0.07
NBP0103	11/29/00	10.80	1.35	0.06
NBP0103	12/20/00	12.50		
NBP0103	01/24/01	12.50	1.31	0.05
NBP0103	02/07/01	11.70	1.64	0.04
NBP0103	03/28/01	11.80	1.30	0.03
NBP0103	04/11/01	9.60	1.33	0.06
NBP0103	05/16/01	9.20	1.35	0.06
NBP0103	06/27/01	7.50	1.16	0.04
NBP0103	07/26/01	6.60	1.22	0.05
NBP0103	08/08/01	7.40	1.15	0.04
NBP0103	09/26/01	7.70	1.20	0.09
NBP0103	10/24/01	7.40	1.09	0.06
NBP0103	11/07/01	8.80	1.17	0.07
NBP0103	12/05/01	9.70	1.23	0.10
NBP0103	01/16/02	11.50	1.49	0.09
NBP0103	02/06/02	12.70	1.22	0.07
NBP0103	03/06/02	12.30	1.51	0.06
NBP0103	04/17/02	9.70	1.44	0.04
NBP0103	05/22/02	10.40	1.25	0.03
NBP0103	06/05/02	7.40	1.02	0.06
NBP0103	07/10/02	6.20	1.26	0.09
NBP0103	08/07/02	7.10	0.92	0.05
NBP0103	09/11/02	7.20	1.11	0.10
NBP0103	10/30/02	9.60	2.06	0.17
NBP0103	11/20/02	10.80	1.17	0.03
NBP0103	12/04/02	12.40	1.13	0.05
NBP0103	01/07/03	12.10	1.57	0.03
NBP0103	02/05/03	12.30	1.21	0.04

Station	Sampling Date	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0103	03/05/03	12.40	1.09	0.01
NBP0103	04/16/03	10.00	1.07	0.02
NBP0103	05/21/03	9.10	1.22	0.03
NBP0103	06/04/03	9.50	2.50	0.17
NBP0103	07/16/03	7.80	1.19	0.08
NBP0103	08/27/03	6.40	1.19	0.05
NBP0103	09/10/03	8.20	0.91	0.04
NBP0103	10/22/03	8.20	0.92	0.03
NBP0103	11/05/03	8.70	0.91	0.04
NBP0103	12/10/03	11.70	1.07	0.03
NBP0103	01/07/04	13.10	1.32	0.03
NBP0103	02/11/04	12.90	1.59	0.06
NBP0103	03/10/04	12.10	1.50	0.03
NBP0103	04/21/04	9.20	1.48	0.02
NBP0103	05/19/04	7.70	1.68	0.15
NBP0103	06/16/04	7.80	1.26	0.04
NBP0103	07/14/04	6.40	1.14	0.04
NBP0103	08/18/04	8.00	1.20	0.04
NBP0103	09/15/04	8.00	1.32	0.07
NBP0103	10/20/04	9.30	1.50	0.04
NBP0103	11/17/04	10.70	1.17	0.01
NBP0103	12/15/04	11.80	1.49	0.02
NBP0103	01/19/05	13.20	1.23	0.02
NBP0103	02/09/05	10.60	1.43	0.04
NBP0103	03/09/05	12.00	1.62	0.04
NBP0103	04/06/05	10.70	1.36	0.03
NBP0103	05/04/05	10.20	1.42	0.03
NBP0103	06/08/05	6.60	1.34	0.02
NBP0103	07/20/05	6.80	1.24	0.04
NBP0103	08/03/05	6.50	1.13	0.04
NBP0103	09/21/05	8.10	1.13	0.03
NBP0103	10/05/05	8.80	1.44	0.04
NBP0103	11/02/05	9.80	1.30	0.05
NBP0103	12/07/05	12.00	1.08	0.04
NBP0103	01/24/06	12.40	1.52	0.03
NBP0103	02/15/06	12.30	1.24	0.03
NBP0103	03/15/06	10.10	1.20	0.03
NBP0103	04/12/06	10.20	1.00	0.03
NBP0103	05/04/06	8.60	1.11	0.02
NBP0103	06/29/06	8.60	1.05	0.07
NBP0103	07/20/06	6.20	0.90	0.05
NBP0103	08/09/06	6.70	0.82	0.04
NBP0103	09/27/06	8.20	0.94	0.06
NBP0103	10/04/06	8.60	1.16	0.06
NBP0103	11/02/06	8.60	1.20	0.08
NBP0103	12/06/06	11.80	0.98	0.04
NBP0103	01/18/07	12.50	1.38	0.06
NBP0103	02/07/07	13.60	1.24	0.05
NBP0103	03/06/07	11.90	1.54	0.03
NBP0103	04/05/07	9.30	1.13	0.03

Station	Sampling Date	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0103	05/31/07	7.30	1.02	0.05
NBP0103	06/27/07	6.80	0.96	0.05
NBP0103	07/19/07	6.30	0.84	0.04
NBP0103	08/16/07	6.80	1.06	0.06
NBP0103	09/26/07	7.10	0.94	0.04
NBP0103	10/24/07	8.00	0.91	0.07
NBP0103	11/28/07	10.20	0.99	0.04
NBP0103	12/05/07	11.80	1.28	0.05
NBP0103	01/09/08	10.60	1.20	0.05
NBP0103	02/06/08	11.60	1.30	0.07
NBP0103	04/02/08	10.30	1.10	0.03
NBP0103	05/08/08	8.70	1.08	0.02
NBP0103	06/04/08	7.50	1.10	0.03
NBP0103	07/16/08	7.50	0.90	0.04
NBP0103	08/21/08	5.90	0.95	0.05
NBP0103	09/10/08	7.60	1.20	0.06
NBP0103	10/08/08	8.40	1.00	0.06
NBP0103	11/06/08	7.40	0.88	0.08
NBP0103	12/03/08	11.30	1.03	0.04
NBP0326	01/26/00	11.80	0.91	0.02
NBP0326	02/24/00	11.60	1.15	0.04
NBP0326	03/22/00	11.00	1.32	0.04
NBP0326	04/18/00	9.80	1.08	0.05
NBP0326	05/16/00	7.60	0.95	0.11
NBP0326	06/28/00	6.80	1.08	0.17
NBP0326	07/27/00	7.00	1.17	0.13
NBP0326	08/30/00	7.10	1.11	0.11
NBP0326	09/26/00	9.10	1.89	0.27
NBP0326	10/25/00	8.40	1.05	0.06
NBP0326	11/29/00	10.30	1.21	0.05
NBP0326	12/20/00	12.00	0.88	0.02
NBP0326	01/23/01	13.20	1.14	0.03
NBP0326	02/07/01	11.30	1.31	0.07
NBP0326	03/28/01	11.20	1.09	0.03
NBP0326	04/11/01	10.60	1.27	0.04
NBP0326	05/15/01	8.60	1.17	0.04
NBP0326	06/27/01	7.30	1.04	0.03
NBP0326	07/26/01	7.10	1.09	0.06
NBP0326	08/08/01	7.60	1.02	0.04
NBP0326	09/25/01	7.60	1.13	0.10
NBP0326	10/24/01	7.20	0.89	0.12
NBP0326	11/06/01	9.30	0.92	0.09
NBP0326	12/05/01	9.20	1.16	0.07
NBP0326	01/16/02	10.30	1.18	0.09
NBP0326	02/05/02	11.80	1.17	0.04
NBP0326	03/06/02	11.10	1.04	0.05
NBP0326	04/16/02	10.90	1.44	0.03
NBP0326	05/22/02	10.50	1.08	0.02
NBP0326	06/05/02	7.40	0.90	0.05
NBP0326	07/10/02	5.90	1.21	0.08

Station	Sampling Date	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0326	08/07/02	7.60	1.08	0.04
NBP0326	09/11/02	7.70	1.04	0.07
NBP0326	10/30/02	9.50	2.40	0.32
NBP0326	11/20/02	10.30	1.06	0.03
NBP0326	12/04/02	11.80	0.91	0.03
NBP0326	01/07/03	12.10	1.42	0.02
NBP0326	02/05/03	12.10	1.13	0.02
NBP0326	03/05/03	12.00	1.38	0.02
NBP0326	04/16/03	10.10	1.05	0.02
NBP0326	05/21/03	9.20	1.19	0.03
NBP0326	06/04/03	9.60	1.18	0.04
NBP0326	07/15/03	8.50	1.00	0.04
NBP0326	08/27/03	6.90	0.94	0.02
NBP0326	09/10/03	8.30	0.68	0.03
NBP0326	10/22/03	8.00	0.85	0.02
NBP0326	11/05/03	8.50	0.98	0.03
NBP0326	12/10/03	11.20	1.00	0.03
NBP0326	01/07/04	13.00	1.07	0.02
NBP0326	02/11/04	13.10	1.34	0.03
NBP0326	03/10/04	12.30	1.38	0.01
NBP0326	04/21/04	9.30	1.29	0.02
NBP0326	05/19/04	8.00	1.18	0.02
NBP0326	06/15/04	8.90	1.28	0.02
NBP0326	07/14/04	6.90	1.11	0.02
NBP0326	08/17/04	7.60	1.07	0.02
NBP0326	09/15/04	8.00	1.15	0.05
NBP0326	10/20/04	8.60	1.19	0.03
NBP0326	11/17/04	10.00	1.13	0.02
NBP0326	12/15/04	11.60	1.27	0.02
NBP0326	01/19/05	12.80	1.01	0.01
NBP0326	02/08/05	11.00	1.21	0.02
NBP0326	03/08/05	11.40	1.80	0.04
NBP0326	04/06/05	11.40	1.50	0.02
NBP0326	05/04/05	9.90	1.39	0.02
NBP0326	06/08/05	6.90	1.41	0.02
NBP0326	07/20/05	6.70	1.17	0.03
NBP0326	08/03/05	6.50	1.18	0.02
NBP0326	09/21/05	7.70	1.29	0.03
NBP0326	10/05/05	7.80	1.20	0.03
NBP0326	11/02/05	9.00	1.19	0.06
NBP0326	12/07/05	11.80	1.31	0.04
NBP0326	01/24/06	12.20	1.41	0.03
NBP0326	02/15/06	11.30	1.10	0.02
NBP0326	03/15/06	10.30	1.20	0.02
NBP0326	04/12/06	8.70	1.00	0.03
NBP0326	05/04/06	8.00	0.95	0.02
NBP0326	06/29/06	9.10	1.08	0.03
NBP0326	07/20/06	6.20	0.95	0.01
NBP0326	08/09/06	6.50	0.95	0.02
NBP0326	09/27/06	7.50	1.11	0.02

Station	Sampling Date	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0326	10/04/06	7.40	1.12	0.02
NBP0326	11/01/06	7.80	0.92	0.02
NBP0326	12/05/06	11.30	0.82	0.02
NBP0326	01/17/07	12.60	1.05	0.03
NBP0326	02/07/07	12.00	1.11	0.02
NBP0326	03/06/07	11.50	1.35	0.02
NBP0326	04/04/07	9.30	1.08	0.02
NBP0326	05/30/07	8.40	1.05	0.02
NBP0326	06/26/07	8.00	1.03	0.02
NBP0326	07/18/07	6.80	1.02	0.01
NBP0326	08/15/07	7.70	0.88	0.02
NBP0326	09/25/07	8.00	0.90	0.04
NBP0326	10/23/07	8.00	0.72	0.06
NBP0326	11/27/07	9.20	1.06	0.04
NBP0326	12/04/07	11.80	1.33	0.05
NBP0326	01/08/08	11.20	1.09	0.03
NBP0326	02/06/08	11.70	1.32	0.05
NBP0326	03/04/08	11.20	1.18	0.02
NBP0326	04/02/08	9.70	1.12	0.03
NBP0326	05/08/08	8.70	1.11	0.01
NBP0326	06/03/08	9.00	0.87	0.01
NBP0326	07/15/08	8.00	0.94	0.02
NBP0326	08/20/08	6.50	0.90	0.01
NBP0326	09/10/08	7.60	1.08	0.02
NBP0326	10/07/08	8.80	0.86	0.02
NBP0326	11/05/08	8.60	1.00	0.02
NBP0326	12/02/08	11.00	1.05	0.03
NBP0461	01/26/00	11.70	0.99	0.02
NBP0461	02/24/00	11.70	1.19	0.03
NBP0461	03/22/00	11.40	1.24	0.03
NBP0461	06/28/00	7.80	0.87	0.15
NBP0461	07/27/00	7.30	1.04	0.13
NBP0461	08/30/00	7.20	1.08	0.10
NBP0461	10/25/00	8.70	1.06	0.07
NBP0461	11/29/00	10.40	0.91	0.06
NBP0461	12/20/00	12.10	0.86	0.13
NBP0461	01/23/01	13.50	1.03	0.03
NBP0461	02/07/01	11.60	1.32	0.03
NBP0461	03/27/01	12.60	1.23	0.03
NBP0461	04/11/01	10.90	1.21	0.02
NBP0461	05/15/01	9.70	1.15	0.05
NBP0461	06/27/01	8.60	0.97	0.04
NBP0461	07/26/01	8.10	1.11	0.04
NBP0461	08/08/01	8.60	1.00	0.04
NBP0461	09/25/01	8.40	1.20	0.12
NBP0461	10/24/01	7.40	1.11	0.14
NBP0461	11/06/01	9.70	0.98	0.09
NBP0461	12/05/01	9.10	1.03	0.09
NBP0461	01/16/02	10.20	1.32	0.07
NBP0461	02/05/02	12.20	1.15	0.05

Station	Sampling Date	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0461	03/06/02	11.20	1.03	0.05
NBP0461	04/16/02	11.10	1.30	0.02
NBP0461	05/22/02	10.50	0.99	0.02
NBP0461	06/05/02	8.30	1.11	0.12
NBP0461	07/10/02	6.50	2.31	0.37
NBP0461	08/07/02	7.80	0.93	0.07
NBP0461	09/11/02	8.50	0.94	0.04
NBP0461	10/30/02	9.80	1.94	0.08
NBP0461	11/20/02	10.40	0.93	0.02
NBP0461	01/07/03	12.30	1.30	0.02
NBP0461	02/05/03	12.70	1.62	0.03
NBP0461	03/05/03	12.30	1.13	0.01
NBP0461	04/16/03	10.60	1.05	0.02
NBP0461	05/21/03	9.40	0.94	0.03
NBP0461	06/04/03	9.40	1.14	0.03
NBP0461	07/15/03	9.20	0.98	0.02
NBP0461	08/27/03	7.00	1.12	0.03
NBP0461	09/10/03	8.50	0.85	0.02
NBP0461	10/22/03	8.20	0.91	0.02
NBP0461	11/05/03	9.20	0.84	0.03
NBP0461	12/10/03	11.40	0.92	0.02
NBP0461	01/07/04	12.70	1.06	0.03
NBP0461	02/11/04	13.30	1.17	0.03
NBP0461	03/10/04	12.40	1.45	0.01
NBP0461	04/21/04	10.00	1.41	0.01
NBP0461	05/19/04	8.70	1.39	0.07
NBP0461	06/15/04	9.80	1.16	0.01
NBP0461	07/14/04	7.70	1.32	0.02
NBP0461	08/17/04	8.50	1.18	0.02
NBP0461	09/15/04	8.40	1.25	0.05
NBP0461	10/20/04	8.60	1.19	0.03
NBP0461	11/17/04	10.10	1.14	0.01
NBP0461	12/15/04	11.40	1.20	0.01
NBP0461	01/19/05	12.60	1.06	0.01
NBP0461	02/08/05	11.30	1.28	0.01
NBP0461	03/08/05	12.00	1.77	0.02
NBP0461	04/06/05	11.40	1.52	0.01
NBP0461	05/04/05	10.17	1.38	0.02
NBP0461	06/08/05	7.90	1.01	0.03
NBP0461	07/20/05	7.90	1.32	0.02
NBP0461	08/03/05	7.30	1.34	0.02
NBP0461	09/21/05	8.20	1.34	0.03
NBP0461	10/05/05	8.30	1.23	0.03
NBP0461	11/02/05	8.50	1.26	0.06
NBP0461	12/07/05	11.80	1.24	0.05
NBP0461	01/24/06	12.40	1.49	0.02
NBP0461	02/15/06	12.10	1.15	0.01
NBP0461	03/15/06	11.00	1.22	0.03
NBP0461	04/12/06	9.50	1.18	0.03
NBP0461	05/04/06	9.00	1.10	0.02

Station	Sampling Date	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0461	06/29/06	9.70	1.11	0.02
NBP0461	07/20/06	7.20	1.04	0.02
NBP0461	08/09/06	7.50	1.03	0.03
NBP0461	09/27/06	8.00	1.15	0.02
NBP0461	10/04/06	7.90	1.14	0.02
NBP0461	11/01/06	7.70	1.03	0.03
NBP0461	12/05/06	10.90	0.99	0.03
NBP0461	01/17/07	12.40	1.08	0.03
NBP0461	02/07/07	12.90	1.05	0.02
NBP0461	03/06/07	11.30	1.37	0.02
NBP0461	04/04/07	10.20	1.17	0.02
NBP0461	05/30/07	9.50	1.11	0.03
NBP0461	06/26/07	7.80	1.10	0.04
NBP0461	07/18/07	7.40	1.13	0.03
NBP0461	08/15/07	8.70	0.90	0.08
NBP0461	09/25/07	8.20	1.01	0.03
NBP0461	10/23/07	7.50	1.11	0.18
NBP0461	11/27/07	9.70	1.01	0.04
NBP0461	12/04/07	11.30	1.53	0.09
NBP0461	01/08/08	11.60	1.12	0.02
NBP0461	02/06/08	12.00	1.33	0.03
NBP0461	03/04/08	11.30	1.09	0.01
NBP0461	04/02/08	10.90	1.22	0.02
NBP0461	05/08/08	9.60	1.14	0.01
NBP0461	06/03/08	9.30	0.87	0.01
NBP0461	07/15/08	8.90	1.06	0.02
NBP0461	08/20/08	6.90	0.90	0.02
NBP0461	09/10/08	8.10	1.09	0.02
NBP0461	10/07/08	8.90	1.03	0.05
NBP0461	11/05/08	7.90	1.12	0.03
NBP0461	12/02/08	10.60	0.92	0.08

Table A-2: MBSS Water Quality Data

Station	Sampling Date	DO (mg/l)	TN (mg/l)	TP (mg/l)
COCA-112-N-2003	07/30/03	7.40		
COCA-302-N-2003	07/30/03	7.80		
COCA-303-N-2003	07/03/03	8.20		
NCRW-305-N-2004	04/01/04	7.10		
PRLN-104-R-2003	06/12/03	7.40		
PRLN-105-R-2003	06/12/03	7.10		
PRLN-107-R-2003	06/26/03	8.60		
PRLN-108-R-2003	07/07/03	8.50		
PRLN-109-R-2003	06/18/03	10.10		
PRLN-113-R-2003	06/18/03	10.10		
PRLN-115-R-2003	08/07/03	7.70		
PRLN-119-R-2003	06/18/03	9.60		
PRLN-120-R-2003	06/26/03	8.00		
PRLN-122-R-2003	08/07/03	8.40		
PRLN-201-R-2003	06/26/03	8.10		
PRLN-306-R-2003	07/07/03	8.70		
PRLN-316-R-2003	07/07/03	8.20		
PRLN-318-R-2003	08/20/03	8.70		
PRLN-321-R-2003	07/17/03	8.00		
PRLN-626-S-2000	06/01/00	6.80		
PRLN-626-S-2001	07/18/01	8.90		
PRLN-626-S-2002	07/01/02	8.80		
PRLN-626-S-2003	07/17/03	8.40		
PRLN-626-S-2004	07/13/04	8.30		
COCA-112-N-2003	04/15/03		0.24	0.01
COCA-302-N-2003	04/15/03		0.20	0.01
COCA-303-N-2003	04/15/03		0.19	0.02
NCRW-305-N-2004	04/29/04		0.35	0.01
PRLN-104-R-2003	03/25/03		0.21	0.01
PRLN-105-R-2003	03/25/03		0.34	0.00
PRLN-107-R-2003	03/25/03		0.20	0.00
PRLN-108-R-2003	03/25/03		0.56	0.01
PRLN-109-R-2003	03/26/03		1.68	0.02
PRLN-113-R-2003	03/26/03		1.66	0.02
PRLN-115-R-2003	03/26/03		1.55	0.01
PRLN-119-R-2003	03/27/03		1.33	0.03
PRLN-120-R-2003	03/25/03		0.67	0.01
PRLN-122-R-2003	03/27/03		1.05	0.01
PRLN-201-R-2003	03/25/03		0.22	0.01
PRLN-306-R-2003	03/27/03		0.45	0.01
PRLN-316-R-2003	03/27/03		0.42	0.01
PRLN-318-R-2003	03/31/03		0.39	0.01
PRLN-321-R-2003	03/26/03		0.85	0.01
PRLN-626-S-2000	04/11/00		0.58	0.01
PRLN-626-S-2001	04/06/01		0.97	0.02
PRLN-626-S-2002	03/27/02		2.05	0.02
PRLN-626-S-2003	03/26/03		1.25	0.02
PRLN-626-S-2004	03/25/04		2.25	0.02

Table A-3: MDE Water Quality Data

Station	Sampling Date	Chlorophyll *a* (µg/l)	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0023	10/12/00	0.45	9.60	1.01	0.06
NBP0023	11/13/00	0.75	9.70	0.85	0.07
NBP0023	12/12/00	2.24	11.20	1.02	0.05
NBP0023	01/18/01	2.24	11.90	0.86	0.05
NBP0023	02/14/01	22.13	11.40	1.35	0.10
NBP0023	03/15/01	12.41	10.80	1.95	0.05
NBP0023	04/09/01	5.08	10.40	1.01	0.03
NBP0023	05/09/01	2.69	7.70	1.10	0.05
NBP0023	06/13/01	1.79	7.70	1.12	0.04
NBP0023	07/18/01	2.24	7.40	1.03	0.04
NBP0023	08/15/01	2.14	7.80	1.07	0.05
NBP0023	09/12/01	1.12	7.50	0.85	0.08
NBP0023	10/11/01		9.60	0.92	0.06
NBP0023	11/15/01	1.79	10.20	0.78	0.08
NBP0023	12/12/01	1.94	10.50	1.00	0.09
NBP0023	01/16/02	1.94	10.20	1.20	0.07
NBP0023	02/13/02	2.39	11.40	0.99	0.05
NBP0023	03/13/02	6.28	10.90	0.87	0.06
NBP0023	04/10/02	2.54	9.70	1.11	0.04
NBP0023	05/08/02	2.69	9.40	0.94	0.04
NBP0023	06/19/02	1.64	7.60	0.91	0.05
NBP0023	07/17/02	1.50	6.70	0.90	0.07
NBP0023	08/14/02	1.05	6.40	0.77	0.05
NBP0023	09/18/02	0.75	7.30	0.94	0.08
NBP0023	10/15/02	0.15	8.90	0.91	0.07
NBP0023	10/17/02	1.64	8.60	1.27	0.10
NBP0023	10/21/02	0.15	9.20	1.15	0.06
NBP0023	10/23/02	0.30	9.30	0.99	0.07
NBP0023	11/12/02	1.50	9.30	1.13	0.04
NBP0023	11/13/02	4.19	9.60	1.40	0.10
NBP0023	11/15/02		10.10		
NBP0023	11/18/02	2.54	10.20	1.23	0.06
NBP0023	12/09/02	1.05	12.80	1.04	0.03
NBP0023	12/08/03	0.60	12.40	0.93	0.02
NBP0023	02/09/04	2.99	13.40	1.59	0.05
NBP0023	02/10/04	2.49	11.90	1.48	0.05
NBP0023	02/12/04	2.39	12.60	1.53	0.04
NBP0023	03/29/04	1.94	10.00	1.28	0.02
NBP0156	10/15/02	1.05	8.70	1.06	0.10
NBP0156	10/17/02	1.35	8.60	1.24	0.07
NBP0156	10/21/02	0.15	9.00	1.18	0.08
NBP0156	10/23/02	1.79	9.20	1.17	0.12
NBP0156	11/12/02	2.24	9.50	1.10	0.04
NBP0156	11/13/02	6.73	9.80	1.50	0.13
NBP0156	11/15/02		10.00		

Station	Sampling Date	Chlorophyll *a* (µg/l)	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0156	11/18/02	3.44	12.40	1.28	0.05
NBP0156	12/09/02	2.69	12.50	1.01	0.03
NBP0156	12/08/03	0.60	12.50	0.94	0.02
NBP0156	02/09/04	2.84	13.30	1.46	0.03
NBP0156	02/10/04	2.24	12.40	1.35	0.04
NBP0156	02/12/04	2.09	12.80	1.27	0.03
NBP0156	03/29/04	2.69	10.30	1.32	0.02
NBP0196	10/11/00	1.35	10.80	0.81	0.04
NBP0196	11/02/00	1.94	10.10	0.70	0.02
NBP0196	12/11/00	2.84	11.90	0.93	0.05
NBP0196	01/17/01	11.96	12.20	0.90	0.03
NBP0196	02/13/01	36.13	11.90	1.91	0.19
NBP0196	03/13/01	11.51	10.90	1.20	0.04
NBP0196	04/11/01	16.90	10.70	1.21	0.06
NBP0196	05/08/01	4.19	8.10	0.91	0.04
NBP0196	06/12/01	2.39	8.30	1.26	0.04
NBP0196	07/17/01	4.78	8.00	1.00	0.04
NBP0196	08/14/01	4.11	8.50	1.10	0.05
NBP0196	09/11/01	2.74	8.00	0.80	0.07
NBP0196	10/10/01	0.68	9.80	0.78	0.03
NBP0196	11/14/01	2.99	10.70	0.61	0.07
NBP0196	12/11/01	1.94	10.60	0.88	0.08
NBP0196	01/15/02	1.94	11.80	0.91	0.05
NBP0196	02/12/02	3.20	11.20	0.83	0.26
NBP0196	03/12/02	4.49	11.10	0.67	0.04
NBP0196	04/09/02	2.99	10.20	0.94	0.03
NBP0196	05/07/02	2.54	9.90	0.98	0.03
NBP0196	06/18/02	2.69	7.80	0.77	0.06
NBP0196	07/16/02	2.84	7.10	0.90	0.07
NBP0196	08/13/02	9.72	7.20	0.64	0.04
NBP0196	09/17/02	1.94	7.90	0.86	0.07
NBP0196	10/15/02	1.05	9.30	0.85	0.05
NBP0196	10/17/02	4.04	9.20	0.99	0.05
NBP0196	10/21/02	1.05	9.40	0.86	0.04
NBP0196	10/23/02	1.05	9.30	0.68	0.04
NBP0196	11/12/02	2.39	9.90	1.14	0.05
NBP0196	11/13/02	1.87	9.80	1.63	0.14
NBP0196	11/15/02		10.50		
NBP0196	11/18/02	2.84	8.60	1.15	0.04
NBP0196	12/09/02	2.09	13.10	0.93	0.02
NBP0196	12/08/03	0.45	12.90	0.92	0.01
NBP0196	02/09/04	3.89	13.50	1.38	0.03
NBP0196	02/10/04	2.62	12.80	1.32	0.03
NBP0196	02/12/04	2.54	13.90	1.31	0.03
NBP0196	03/29/04	2.24	10.70	1.27	0.01
NBP0226	10/16/02	2.69	8.80	1.07	0.11

Station	Sampling Date	Chlorophyll *a* (µg/l)	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0226	10/21/02	0.75	7.70	0.89	0.06
NBP0226	10/23/02	0.75	7.80	0.70	0.06
NBP0226	11/13/02	2.99	8.90	1.09	0.05
NBP0226	11/15/02		9.10		
NBP0226	11/18/02	3.44	8.90	1.07	0.04
NBP0226	12/09/03	1.05	10.50	0.85	0.01
NBP0226	02/09/04	2.39	12.50	1.34	0.03
NBP0226	02/10/04	1.79	12.20	1.44	0.03
NBP0226	02/12/04	1.94	12.10	1.33	0.02
NBP0226	03/29/04	2.24	9.50	1.35	0.02
NBP0326	10/11/00	2.39	9.70	0.74	0.06
NBP0326	11/02/00	2.84	10.20	0.74	0.04
NBP0326	12/11/00	5.08	10.50	0.93	0.07
NBP0326	01/17/01	30.20	11.40	0.88	0.03
NBP0326	02/13/01	16.30	12.10	1.49	0.09
NBP0326	03/13/01	20.04	9.90	1.17	0.04
NBP0326	04/11/01	8.82	11.80	1.14	0.03
NBP0326	05/08/01	8.07	7.70	0.89	0.04
NBP0326	06/12/01	1.50	7.80	1.06	0.04
NBP0326	07/17/01	7.48	7.60	0.91	0.04
NBP0326	08/14/01	4.49	8.60	1.06	0.05
NBP0326	09/11/01	5.23	8.30	0.91	0.08
NBP0326	10/10/01	1.92	9.10	0.62	0.06
NBP0326	11/14/01	3.49	9.70	0.83	0.10
NBP0326	12/11/01	4.04	10.20	0.88	0.09
NBP0326	01/15/02	6.73	9.70	0.84	0.08
NBP0326	02/12/02	6.23	10.60	0.90	0.05
NBP0326	03/12/02	11.81	10.30	0.74	0.04
NBP0326	04/09/02	3.74	9.40	0.91	0.03
NBP0326	05/07/02	1.79	9.60	1.01	0.02
NBP0326	06/18/02	2.54	7.80	0.74	0.06
NBP0326	07/16/02	1.99	6.80	1.03	0.10
NBP0326	08/13/02	6.43	7.30	0.78	0.04
NBP0326	09/17/02	2.69	7.80	0.78	0.07
NBP0326	10/16/02	3.44	8.00	0.90	0.12
NBP0326	10/21/02	1.79	7.80	0.80	0.08
NBP0326	10/23/02	1.64	8.10	0.63	0.05
NBP0326	11/13/02	4.67	8.80	1.31	0.07
NBP0326	11/15/02		8.20		
NBP0326	11/18/02	2.39	10.10	1.09	0.03
NBP0326	12/10/02	4.19	12.30	0.92	0.02
NBP0326	12/09/03	1.05	11.50	0.87	0.01
NBP0326	02/09/04	2.09	14.10	1.24	0.02
NBP0326	02/10/04	1.99	12.50	1.25	0.02
NBP0326	02/12/04	1.64	12.50	1.14	0.03
NBP0326	03/29/04	2.09	10.50	1.39	0.02

Station	Sampling Date	Chlorophyll *a* (µg/l)	DO (mg/l)	TN (mg/l)	TP (mg/l)
NBP0461	10/10/00	1.79	10.40	0.76	0.08
NBP0461	11/01/00	2.09	10.30	0.83	0.05
NBP0461	12/04/00	1.94	11.80	0.91	0.07
NBP0461	01/16/01	19.44	11.50	0.86	0.06
NBP0461	02/12/01	25.67	11.80	1.90	0.20
NBP0461	03/12/01	5.08	12.60	1.06	0.04
NBP0461	04/10/01	2.99	12.30	1.03	0.02
NBP0461	05/07/01	10.32	11.20	0.92	0.06
NBP0461	06/11/01	1.05	9.00	1.01	0.04
NBP0461	07/16/01	4.04	10.10	0.89	0.04
NBP0461	08/13/01	1.94	9.10	1.05	0.04
NBP0461	09/10/01	3.63	8.50	1.01	0.09
NBP0461	10/09/01	1.25	9.70	0.73	0.08
NBP0461	11/13/01	2.14	10.10	0.92	0.13
NBP0461	12/10/01	1.64	10.60	0.76	0.10
NBP0461	01/14/02	2.24	10.20	0.81	0.08
NBP0461	02/11/02	2.84	11.70	0.82	0.05
NBP0461	03/11/02	7.33	13.80	0.78	0.05
NBP0461	04/08/02	1.20	11.70	1.00	0.03
NBP0461	05/06/02	1.20	10.40	0.98	0.02
NBP0461	06/17/02	2.74	8.90	0.80	0.08
NBP0461	07/15/02	2.49	8.10	0.98	0.13
NBP0461	08/12/02	4.24	8.70	0.91	0.05
NBP0461	09/16/02	2.69	9.10	0.77	0.07
NBP0461	10/16/02	6.35	7.80	0.73	0.12
NBP0461	10/21/02	2.24	8.10	0.66	0.06
NBP0461	10/23/02	2.54	7.00	0.81	0.09
NBP0461	11/13/02	2.54	9.50	1.13	0.03
NBP0461	11/15/02		9.90		
NBP0461	11/18/02	1.05	10.20	1.05	0.01
NBP0461	12/10/02	2.99	12.00	0.88	0.02
NBP0461	12/09/03	1.35	11.60	0.85	0.02
NBP0461	02/09/04	1.20	13.10	1.17	0.02
NBP0461	02/10/04	0.90	12.70	1.15	0.02
NBP0461	02/12/04	0.90	12.60	1.20	0.02
NBP0461	03/29/04	0.60	11.40	1.31	0.01
BHR0009	01/14/09	0.30	12.60	0.38	0.03
BHR0009	02/18/09	2.09	12.30	0.22	0.02
BHR0009	03/17/09	5.13	10.40	0.22	0.03
BHR0009	04/21/09		10.40	0.54	0.03
BHR0009	05/19/09	1.05	10.10	0.20	0.02
BHR0009	06/16/09	0.75	9.00	0.32	0.04
BHR0009	07/21/09	0.37	8.90	0.30	
BHR0009	08/18/09		8.90	0.29	0.05
BHR0009	09/15/09		9.60	0.25	0.05
BHR0009	10/20/09		9.50	0.15	0.04

Station	Sampling Date	Chlorophyll *a* (µg/l)	DO (mg/l)	TN (mg/l)	TP (mg/l)
BHR0009	11/09/09		11.20	0.14	0.03
BHR0009	12/15/09		11.60	0.78	0.02
CLL0003	01/14/09		13.30	0.48	0.01
CLL0003	02/18/09		13.00	0.30	0.00
CLL0003	03/17/09	0.43	11.10	0.17	0.01
CLL0003	04/21/09		10.20	0.53	0.02
CLL0003	05/19/09		10.20	0.21	0.01
CLL0003	06/16/09		8.10	0.45	0.01
CLL0003	07/21/09	0.25	7.70	0.41	
CLL0003	08/18/09		7.20	0.40	0.01
CLL0003	09/15/09		8.10	0.31	0.01
CLL0003	10/20/09		9.70	0.12	0.01
CLL0003	11/09/09		10.80	0.12	0.01
CLL0003	12/15/09		12.20	0.69	0.01
CLL0065	01/14/09		13.40	0.53	0.01
CLL0065	02/18/09		13.90	0.36	0.00
CLL0065	03/17/09		11.70	0.24	0.01
CLL0065	04/21/09		10.70	0.46	0.02
CLL0065	05/19/09		10.00	0.21	0.01
CLL0065	06/16/09	0.45	8.80	0.30	0.01
CLL0065	07/21/09	2.12	5.70	0.21	
CLL0065	08/18/09		5.50	0.53	0.01
CLL0065	09/15/09	1.35	7.30	0.39	0.01
CLL0065	10/20/09		7.90	0.53	0.01
CLL0065	11/09/09		10.50	0.29	0.00
CLL0065	12/15/09		11.90	0.66	0.01
MNB0006	01/14/09		13.40	0.33	0.01
MNB0006	02/18/09	2.99	13.10	0.33	0.02
MNB0006	03/17/09	2.14	10.50	0.19	0.02
MNB0006	04/21/09	1.50	10.20	0.71	0.05
MNB0006	05/19/09	1.50	10.50	0.10	0.01
MNB0006	06/16/09	1.05	8.10	0.26	0.02
MNB0006	07/21/09		7.70	0.18	
MNB0006	08/18/09	0.45	7.40	0.13	0.04
MNB0006	09/15/09	0.45	8.30	0.12	0.03
MNB0006	10/20/09		10.00	0.10	0.03
MNB0006	11/09/09	0.90	11.10	0.07	0.02
MNB0006	12/15/09		11.80	0.52	0.02
MNB0065	01/14/09		13.40	0.21	0.01
MNB0065	02/18/09		13.30	0.15	0.00
MNB0065	03/17/09		11.60	0.14	0.01
MNB0065	04/21/09		10.40	0.46	0.02
MNB0065	05/19/09		10.20	0.15	0.01
MNB0065	06/16/09	0.90	8.40	0.29	0.01
MNB0065	07/21/09		7.80	0.23	
MNB0065	08/18/09		6.50	0.36	0.01

Station	Sampling Date	Chlorophyll *a* (µg/l)	DO (mg/l)	TN (mg/l)	TP (mg/l)
MNB0065	10/20/09		9.60	0.11	0.02
MNB0065	11/09/09		10.60	0.11	0.00
MNB0065	12/15/09		11.80	0.32	0.01
MRW0011	01/14/09		13.50	0.53	0.00
MRW0011	02/18/09		12.90	0.56	0.00
MRW0011	03/17/09	1.50	11.90	0.39	0.01
MRW0011	04/21/09	1.12	11.60	0.58	0.01
MRW0011	05/19/09		10.80	0.40	0.01
MRW0011	06/16/09	0.75	9.80	0.34	0.01
MRW0011	07/21/09		8.40	0.37	
MRW0011	08/18/09	1.35	8.90	0.65	0.02
MRW0011	09/15/09		8.50	0.99	0.02
MRW0011	10/20/09		10.60	0.23	0.01
MRW0011	11/09/09		12.10	0.20	0.01
MRW0011	12/15/09		11.20	0.58	0.01
SSR0000	01/14/09		13.60	0.34	0.01
SSR0000	02/18/09	0.60	13.50	0.19	0.01
SSR0000	03/17/09	1.50	10.70	0.14	0.01
SSR0000	04/21/09		10.20	0.58	0.03
SSR0000	05/19/09	0.90	10.00	0.15	0.01
SSR0000	06/16/09	1.50	8.10	0.32	0.02
SSR0000	07/21/09	1.25	7.40	0.42	
SSR0000	08/18/09	1.20	6.60	0.62	0.04
SSR0000	09/15/09	1.05	8.20	0.34	0.02
SSR0000	10/20/09	0.43	10.60	0.10	0.01
SSR0000	11/09/09	0.45	11.40	0.24	0.01
SSR0000	12/15/09		12.10	0.53	0.01
UPH0001	01/14/09		14.00	0.82	0.02
UPH0001	02/18/09	2.19	12.90	0.68	0.00
UPH0001	03/17/09	2.99	11.60	0.46	0.01
UPH0001	04/21/09	5.98	10.70	0.98	0.03
UPH0001	05/19/09	3.29	10.70	0.55	0.03
UPH0001	06/16/09	2.39	8.40	0.49	0.04
UPH0001	07/21/09	0.60	7.80	0.54	
UPH0001	08/18/09	1.05	6.90	1.10	0.07
UPH0001	09/15/09	2.49	6.90	0.67	0.03
UPH0001	10/20/09		10.30	0.32	0.02
UPH0001	11/09/09		11.20	0.23	0.01
UPH0001	12/15/09		10.60	0.81	0.01
WRO0004	01/14/09		15.30	0.90	0.02
WRO0004	02/18/09	1.79	13.00	0.79	0.00
WRO0004	03/17/09	2.09	11.80	0.64	0.01
WRO0004	04/21/09		10.60	1.04	0.02
WRO0004	05/19/09	1.35	11.60	0.64	0.01
WRO0004	06/16/09	2.09	9.80	0.56	0.01
WRO0004	07/21/09	1.50	8.60	0.58	

Station	Sampling Date	Chlorophyll *a* (µg/l)	DO (mg/l)	TN (mg/l)	TP (mg/l)
WRO0004	08/18/09	1.50	8.90	0.31	0.01
WRO0004	09/15/09		7.30	0.32	0.01
WRO0004	10/20/09		11.70	0.24	0.02
WRO0004	11/09/09		12.30	0.22	0.00
WRO0004	12/15/09		11.60	1.00	0.01

APPENDIX B

Comparison of Nutrient Data from Potomac River Lower North Branch Stations with Other CORE/TREND Monitoring Stations

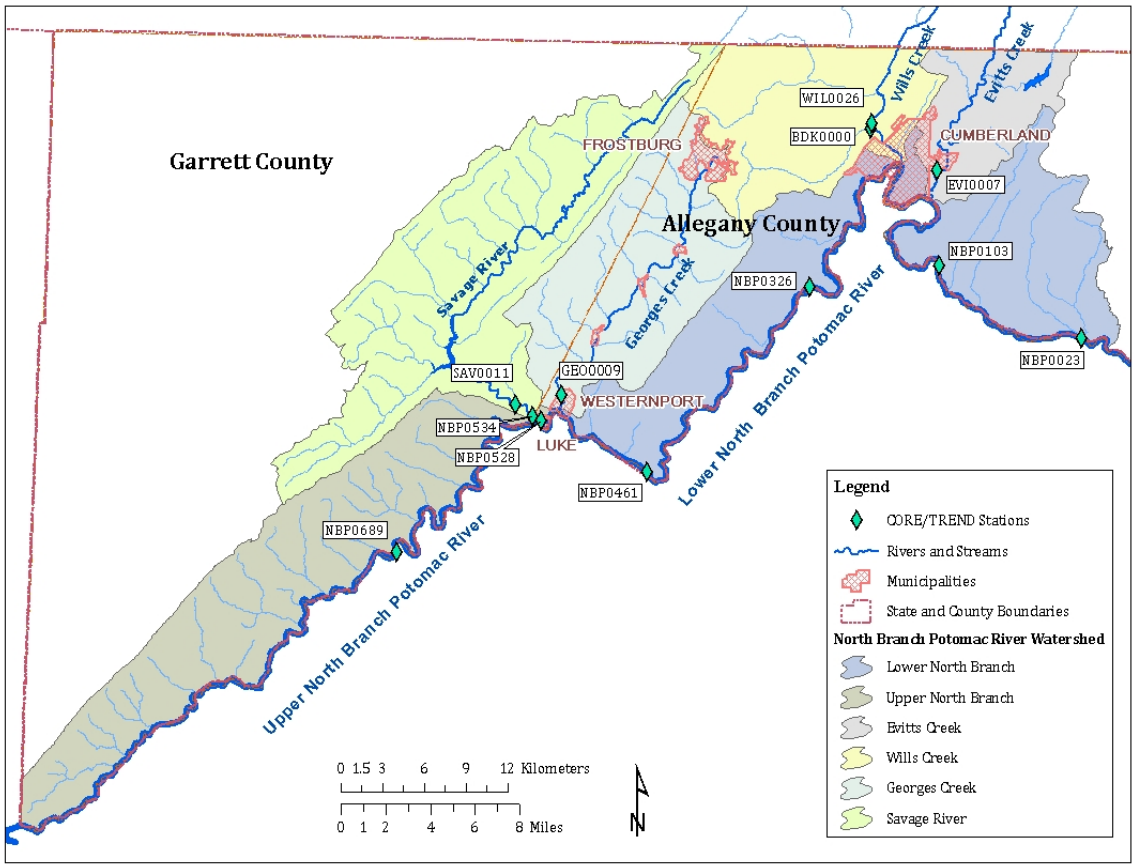

Figure B-1: Location of CORE/TREND Stations on the North Branch of the Potomac River

Nutrient Concentrations vs. Water Quality Status

To test whether nutrients are stressors of the aquatic community in LNBP, the median, 75th percentile, and 90th percentile of nutrient concentrations (TN, TP, NO_3, and PO_4) at LNBP CORE/TREND stations were compared with other CORE/TREND stations in the Piedmont and Highland Ecoregions of Maryland. Concentrations were classified according to the water quality status of the stations. The results are shown in Figures B-3 through B-18.

Generally, the nutrient concentrations in LNBP are lower (on average, by 33%) than those found at CORE/TREND stations with GOOD or better water quality. This strongly suggests that the concentrations of nutrients in the LNBP are compatible with supporting aquatic life use, and therefore nutrients are not the cause of any stress to aquatic life in the LNBP.

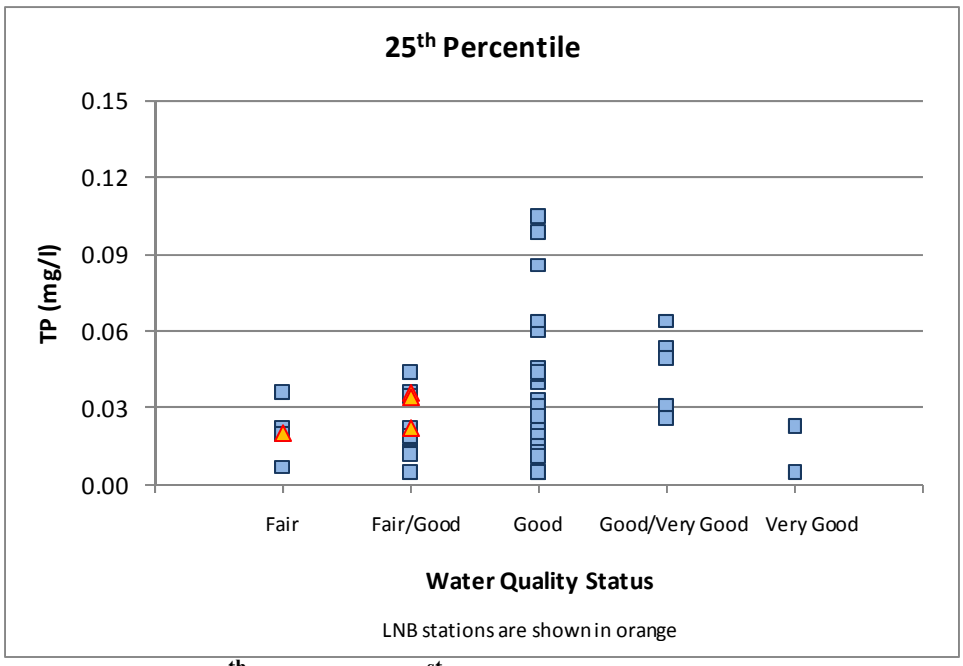

Figure B-2: 25th Percentile (1st Quartile) TP Concentrations (mg/l)

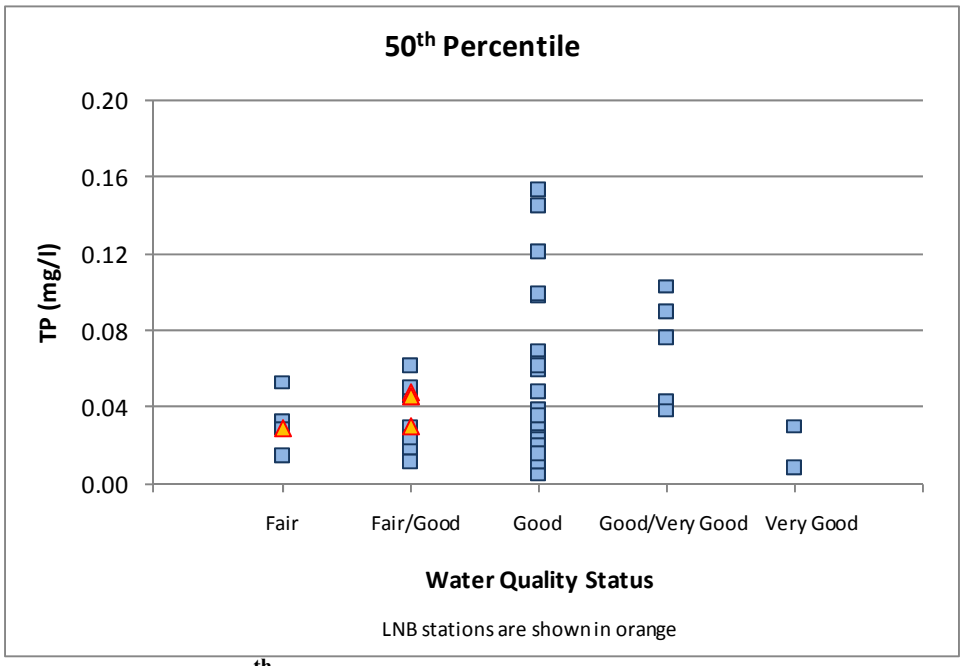

Figure B-3: 50th Percentile (Median) TP Concentrations (mg/l)

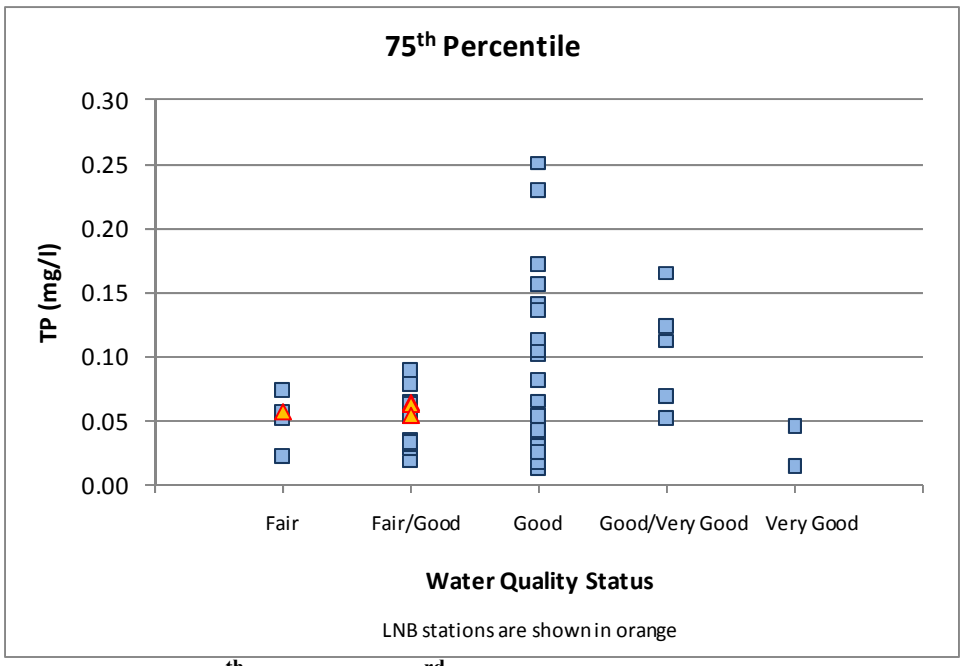

Figure B-4: 75th Percentile (3rd Quartile) TP Concentrations (mg/l)

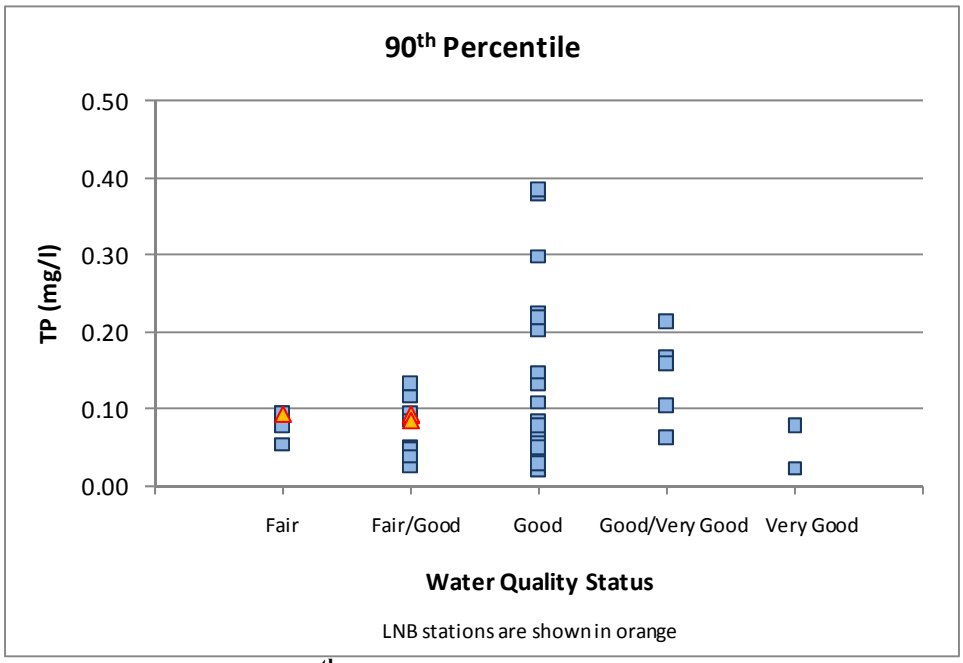

Figure B-5: 90th Percentile TP Concentrations (mg/l)

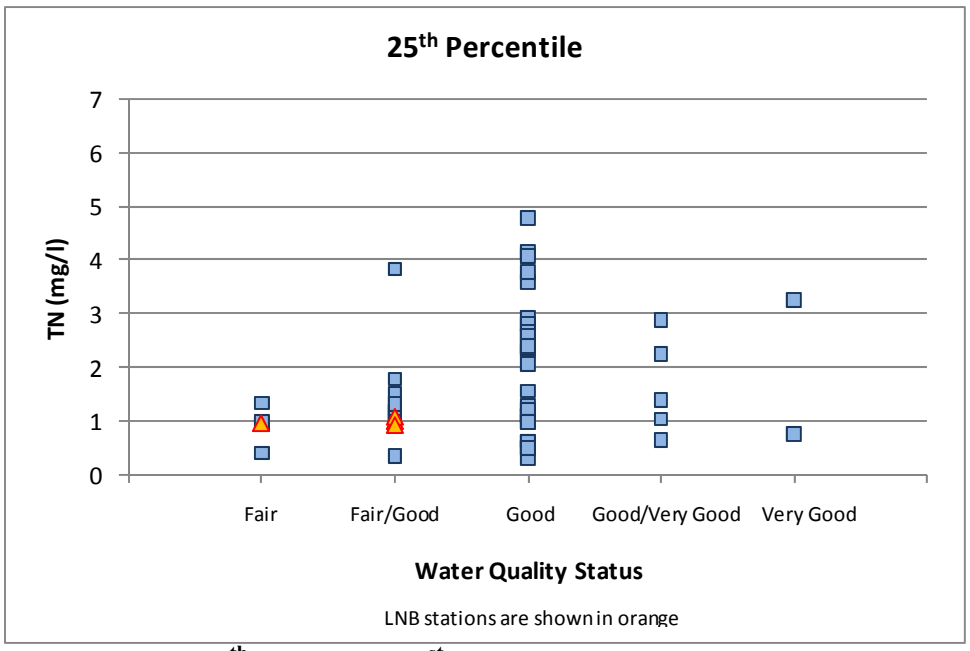

Figure B-6: 25th Percentile (1st Quartile) TN Concentrations (mg/l)

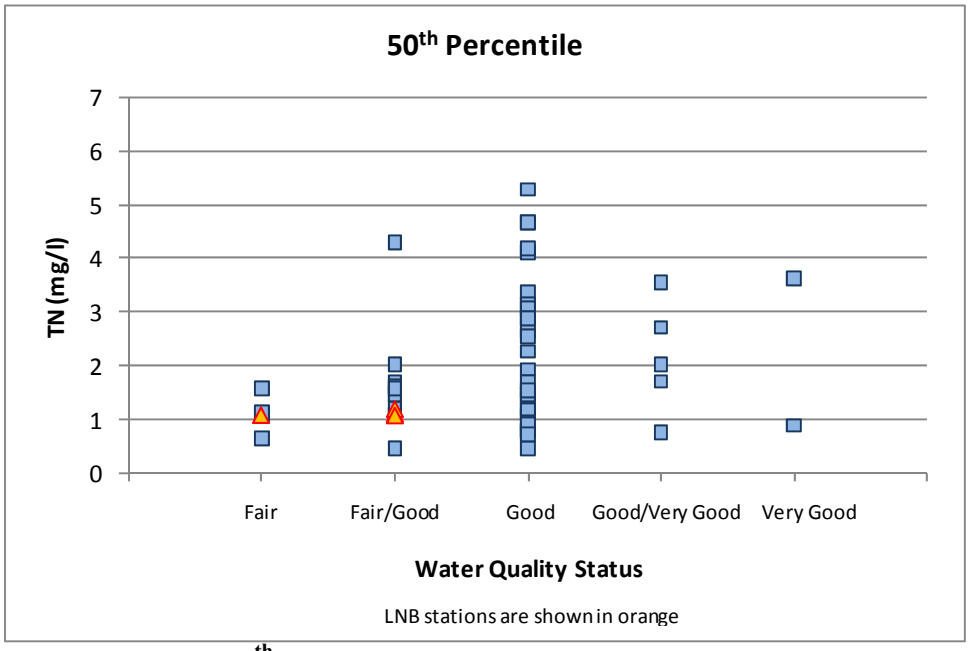

Figure B-7: 50th Percentile (Median) TN Concentrations (mg/l)

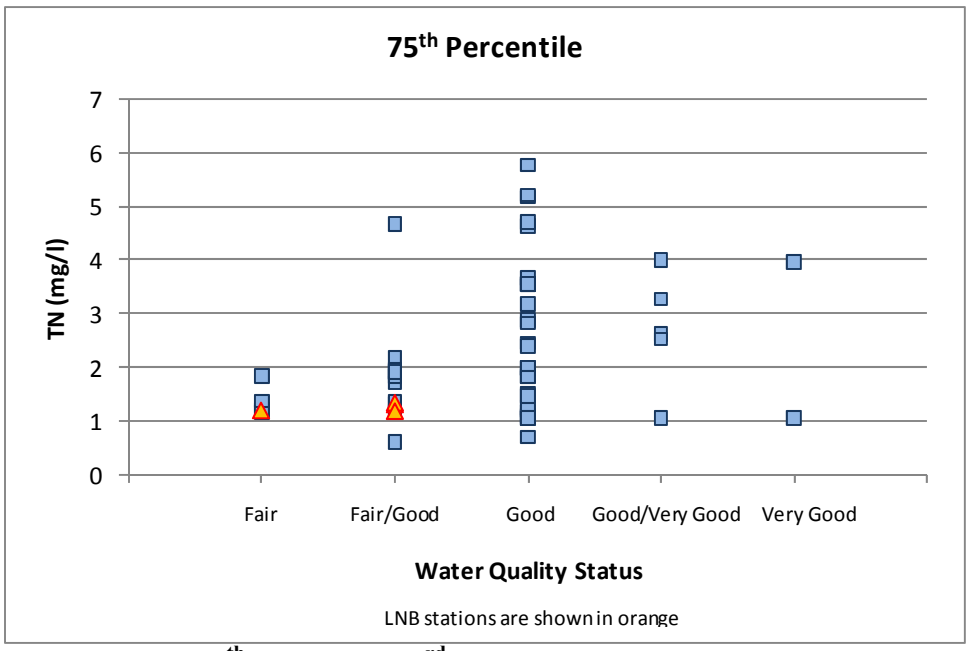

Figure B-8: 75th Percentile (3rd Quartile) TN Concentrations (mg/l)

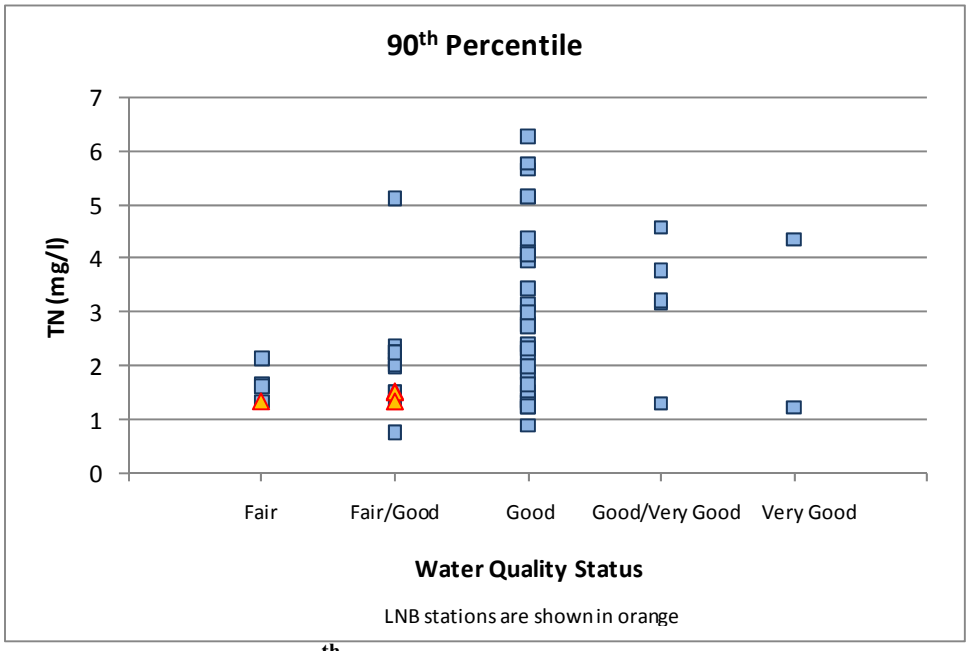

Figure B-9: 90th Percentile TN Concentrations (mg/l)

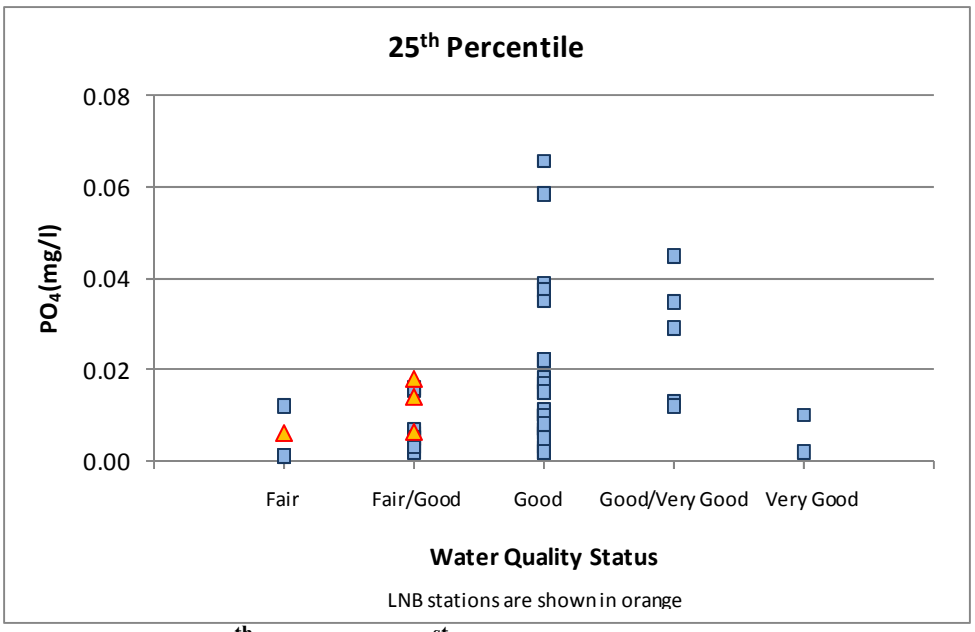

Figure B-10: 25th Percentile (1st Quartile) PO_4 Concentrations (mg/l)

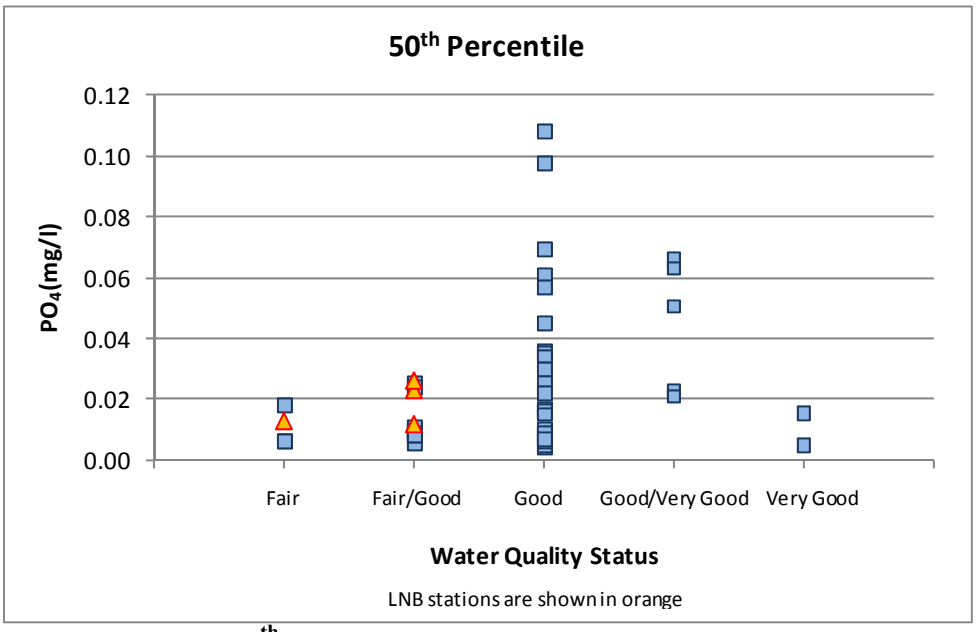

Figure B-11: 50th Percentile (Median) PO_4 Concentrations (mg/l)

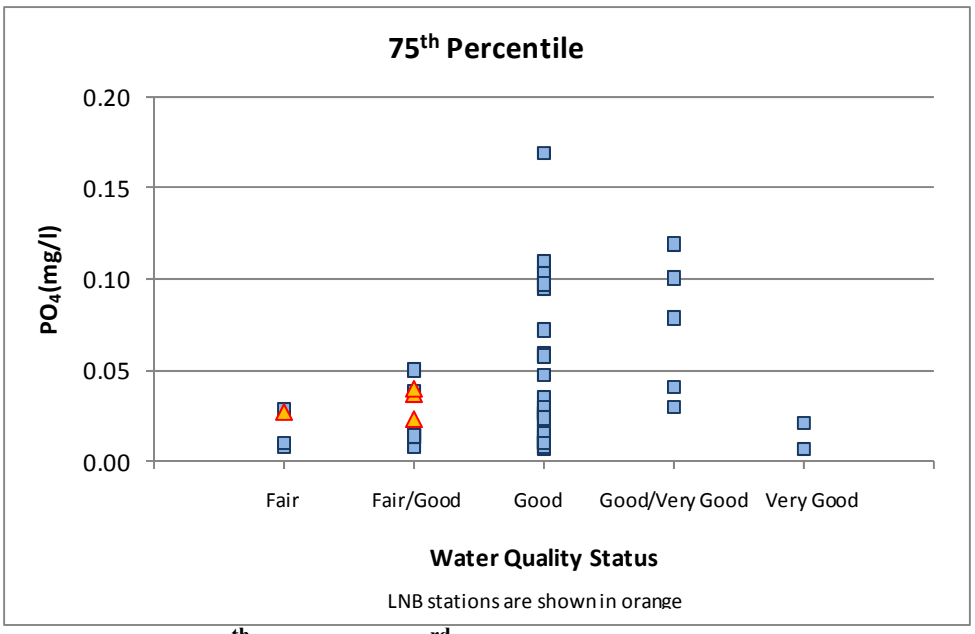

Figure B-12: 75th Percentile (3rd Quartile) PO_4 Concentrations (mg/l)

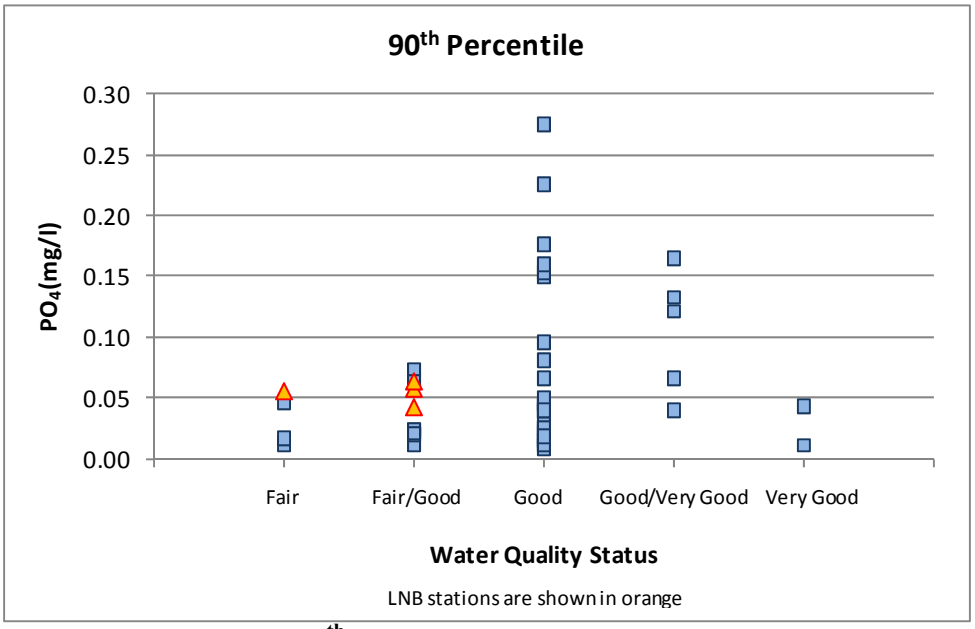

Figure B-13: 90th Percentile PO_4 Concentrations (mg/l)

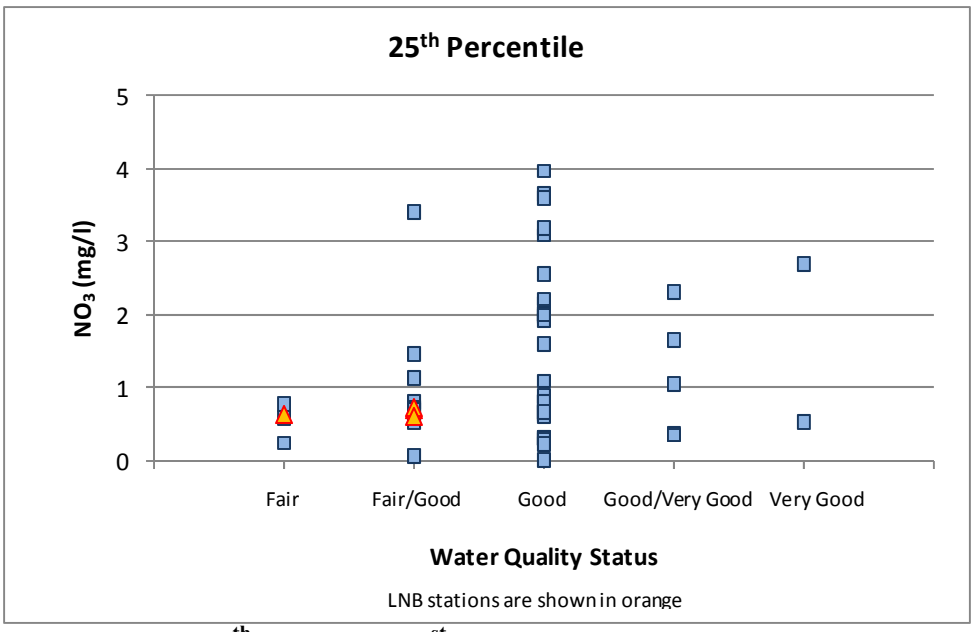

Figure B-14: 25th Percentile (1st Quartile) NO_3 Concentrations (mg/l)

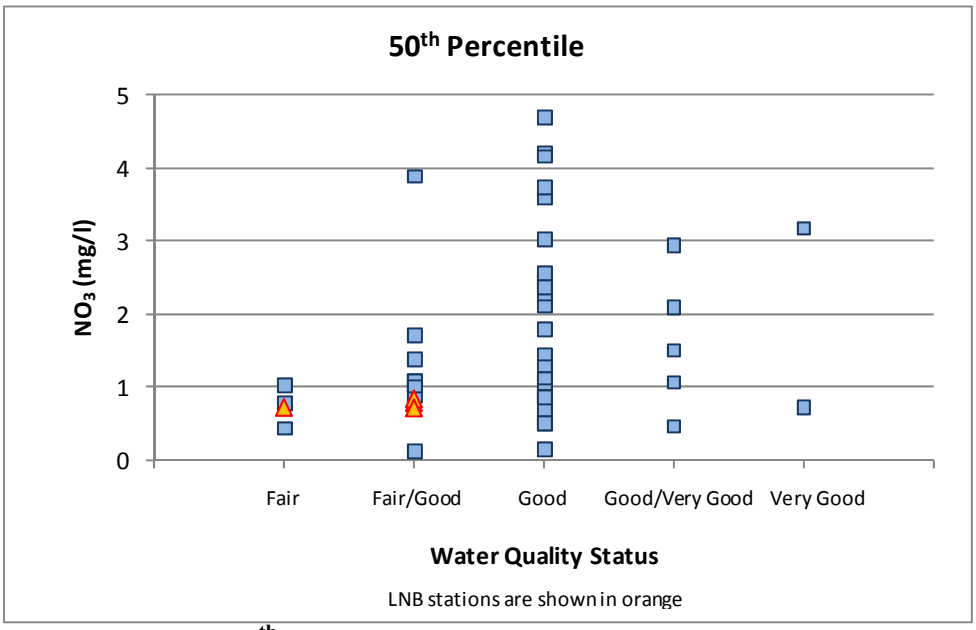

Figure B-15: 50th Percentile (Median) NO_3 Concentrations (mg/l)

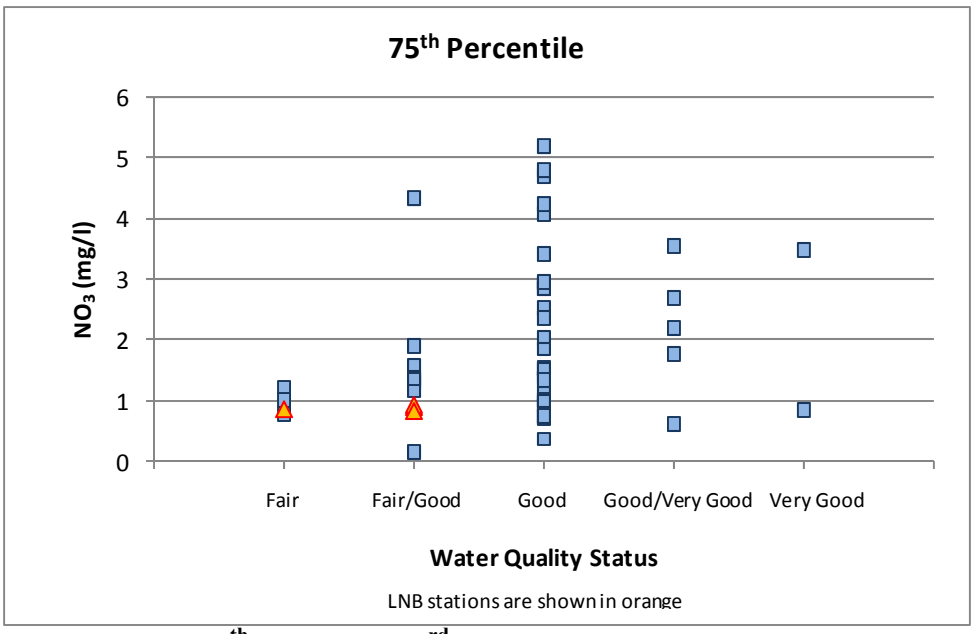

Figure B-16: 75th Percentile (3rd Quartile) NO_3 Concentrations (mg/l)

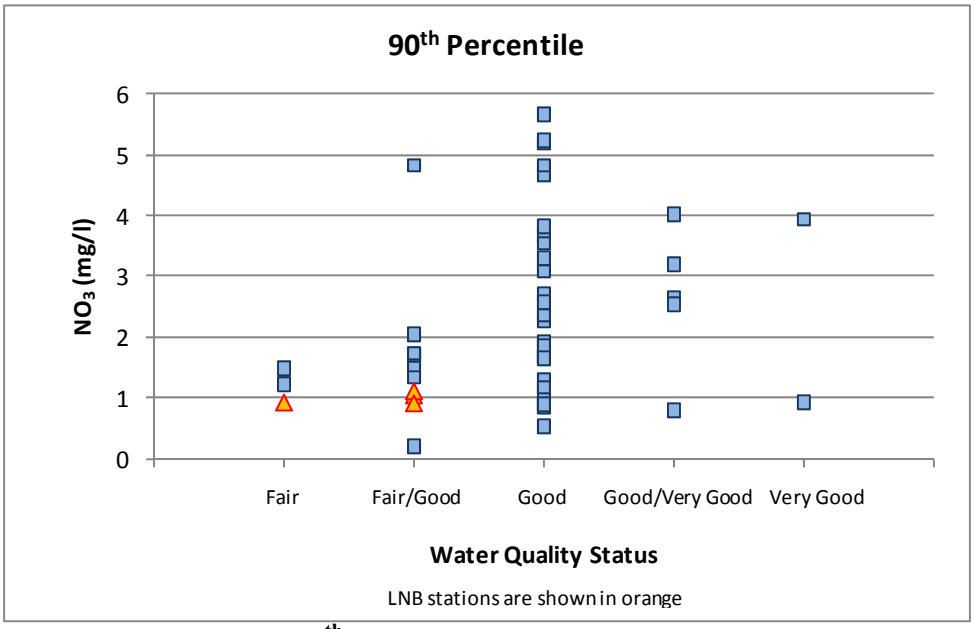

Figure B-17: 90th Percentile NO_3 Concentrations (mg/l)

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