Water Quality Analysis of Sediment in Potomac River Lower North Branch, Allegany County, Maryland

FINAL

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Submitted to:

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1650 Arch Street
Philadelphia, PA 19103-2029

Partially Funded by the American Recovery and Reinvestment Act of 2009

September 2011

EPA Submittal: Sept. 28, 2011
EPA Concurrence: May 18, 2012

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List of Abbreviations

BIBI	Benthic Index of Biotic Integrity
BSID	Biological Stressor Identification Methodology
CBP P5.2	Chesapeake Bay Program Phase 5.2
CWA	Clean Water Act
DI	Shannon-Weiner Diversity Index
DNR	Department of Natural Resources
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, and Trichoptera
FIBI	Fish Index of Biologic Integrity
HBI	Hilsenhoff Biotic Index
LNB	Lower North Branch (Potomac River)
m	Meter
MD 8-Digit	Maryland 8-Digit Watershed
MDE	Maryland Department of the Environment
MBSS	Maryland Biological Stream Survey
Mg/l	Milligrams per Liter
PSU	Primary Sampling Unit
SCS	Soil Conservation Service
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WQA	Water Quality Analysis
WQLS	Water Quality Limited Segment

EXECUTIVE SUMMARY

This document, upon approval by the U.S. Environmental Protection Agency (EPA), presents a Water Quality Analysis (WQA) of sediment in the Potomac River Lower North Branch (LNB) watershed (basin number 02141001) (2010 *Integrated Report of Surface Water Quality in Maryland* Assessment Unit ID: MD-02141001). Section 303(d) of the federal Clean Water Act (CWA) and the 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. 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 (CFR 2010).

The Maryland Department of the Environment (MDE) has identified the waters of the Potomac River LNB watershed on the State's 2010 Integrated Report as impaired by sediments (1996), nutrients – phosphorus (1996), methylmercury (2002), metals – cadmium (1996), low pH (1996), and impacts to biological communities (2002) (MDE 2010a). The designated use of the Potomac River LNB mainstem, Mill Run and its tributaries, and an unnamed tributary to the Potomac River LNB mainstem near Pinto, Maryland and its tributaries is Use I-P (Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply). All other tributaries in the Potomac River LNB watershed are designated as use III-P (Nontidal Cold Water and Public Water Supply) (COMAR 2010a,b,c,d,e).

The WQA presented herein by MDE will address the 1996 sediments listing, for which a data solicitation was conducted, and all readily available data from the past five years have been considered. A WQA for low pH was approved by the EPA in 2005, and a WQA for cadmium was approved by EPA in 2006. The watershed was also delisted for methylmercury in the 2010 Integrated Report. A WQA for eutrophication to address the nutrients/phosphorus listing is scheduled to be submitted to the EPA in 2011. In the 2012 Integrated Report, the listing for impacts to biological communities will include the results of a stressor identification analysis.

Currently in Maryland, there are no specific numeric criteria that quantify the impact of sediment on the aquatic life of nontidal stream systems. Therefore, to determine whether aquatic life is impacted by elevated sediment loads, MDE's *Biological Stressor Identification* (BSID) methodology was applied. The BSID identifies the most probable cause(s) for observed biological impairments throughout Maryland's 8-digit (MD 8-digit) watersheds (1st though 4th order streams only) by ranking the likely stressors affecting a watershed using a suite of physical, chemical, and land use data. The ranking of stressors was conducted via a risk-based, systematic, weight-of-evidence approach. The risk-based approach estimates the strength of association between various stressors and an impaired biological community. The BSID analysis then identifies individual stressors (pollutants) as probable or unlikely causes of the poor biological conditions within a given MD 8-digit watershed and subsequently concludes whether or not these individual stressors or groups of stressors are contributing to the impairment (MDE 2009). The BSID analysis for the Potomac River LNB watershed did not identify any stressors to be significantly associated with the impaired biological communities. Rather, the BSID

concludes that the biological impairment in the watershed is due to natural conditions caused by a rainshadow effect, making the Potomac River LNB watershed more drought sensitive than surrounding highland watersheds (MDE 2011). It is therefore concluded that sediment is not a cause of the biological impairment in the 1st through 4th order streams in the watershed.

Since the BSID analysis is only applicable to 1st thru 4th order streams in the watershed, an additional assessment was necessary to determine whether sediment loads are impacting aquatic life in the mainstem of the Potomac River LNB. The Maryland Department of Natural Resources (DNR) conducts benthic macroinvertebrate monitoring at four sites in the Potomac River LNB mainstem and subsequently provides a water quality assessment on the basis of the monitoring results as part of its CORE/TREND program. Three of the four CORE/TREND sites were rated as having "Fair/Good" water quality and the fourth site was rated "Fair". Therefore, the overall water quality status of these stations does not provide sufficient evidence as to whether or not the Potomac River LNB mainstem is supporting aquatic life. Despite this analysis regarding attainment of the aquatic life designated use being inconclusive, it can still be determined whether or not sediment is a stressor to aquatic life in the mainstem. Further analysis comparing sediment concentrations at the Potomac River LNB CORE/TREND stations with CORE/TREND stations assessed as having "Good" or better water quality in the Piedmont and Highland Ecoregions of Maryland. This analysis shows that observed sediment concentrations at Potomac River LNB stations are well within the range of concentrations observed at CORE/TREND stations with "Good" or better water quality. Therefore, it is concluded that sediment is not impacting aquatic life in the Potomac River LNB mainstem.

As stated above, the analysis presented in this report supports the conclusion that a TMDL for sediments is not necessary to achieve water quality standards in the Potomac River LNB watershed. Although the waters of the Potomac River LNB watershed do not display signs of a sediment impairment, the State reserves the right to require future controls in the watershed if evidence suggests that sediments from the basin are contributing to downstream water quality problems. For example, reductions will be required to meet allocations assigned to the Potomac River Tidal Fresh Chesapeake Bay Water Quality Segment, as specified by the Chesapeake Bay Nutrient and Sediment TMDLs, established by EPA on December 29, 2010.

Barring the receipt of contradictory data, this report will be used to support a revision of the 2010 Integrated Report sediment 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 ("waterbody is meeting some [in this case sediments-related] water quality standards, but with insufficient data to assess all impairments"), when MDE proposes the revision of the Integrated Report.

1.0 INTRODUCTION

This document, upon approval by the U.S. Environmental Protection Agency (EPA), presents a Water Quality Analysis (WQA) of sediment in the Potomac River Lower North Branch (LNB) watershed (basin number 02141001) (2010 *Integrated Report of Surface Water Quality in Maryland* Assessment Unit ID: MD-02141001). Section 303(d) of the federal Clean Water Act (CWA) and the 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. 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 (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 likely scenarios obviating 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 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 Maryland Department of the Environment (MDE) has identified the waters of the Potomac River LNB watershed on the State's 2010 Integrated Report as impaired by sediments (1996), nutrients – phosphorus (1996), methylmercury (2002), metals – cadmium (1996), low pH (1996), and impacts to biological communities (2002) (MDE 2010a). The designated use of the Potomac River LNB mainstem, Mill Run and its tributaries, and an unnamed tributary to the Potomac River LNB mainstem near Pinto, Maryland and its tributaries is Use I-P (Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply). All other tributaries in the Potomac River LNB watershed are designated as use III-P (Nontidal Cold Water and Public Water Supply) (COMAR 2010a,b,c,d,e).

The WQA presented herein by MDE will address the 1996 sediments listing, for which a data solicitation was conducted, and all readily available data from the past five years have been considered. A WQA for low pH was approved by the EPA in 2005, and a WQA for cadmium was approved by EPA in 2006. The watershed was also delisted for methylmercury in the 2010 Integrated Report. A WQA for eutrophication to address the nutrients/phosphorus listing is scheduled to be submitted to the EPA in 2011. In the 2012 Integrated Report, the listing for impacts to biological communities will include the results of a stressor identification analysis.

The remainder of this report lays out the general setting of the Potomac River LNB watershed and presents a discussion of the water quality characteristics in the basin in terms of the existing water quality standards relating to sediments. Currently in Maryland, however, there are no specific numeric criteria that quantify the impact of sediment on the aquatic life of nontidal stream systems. Therefore, to determine whether aquatic life is impacted by elevated sediment

loads, MDE's *Biological Stressor Identification* (BSID) methodology was applied for the 1st through 4th order tributary streams in the watershed, and a comparison of observed sediment concentrations at Potomac River LNB Maryland Department of Natural Resources (DNR) CORE/TREND monitoring stations to CORE/TREND monitoring station observed concentrations in the Piedmont and Highland Ecoregions of Maryland was conducted for the watershed mainstem. These analyses support the conclusion that current watershed sediment loads are at a level to support the Use I-P/III-P designations for the watershed stream system, and more specifically, at a level to support aquatic life. Thus, a TMDL is not required.

2.0 GENERAL SETTING

Location

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 Potomac River LNB is defined as the portion of the North Branch Potomac River extending 53 miles from the river's confluence with the Savage River to its confluence with the South Branch Potomac River. The Potomac River LNB watershed is located in the North Branch Potomac River sub-basin of the Chesapeake Bay watershed within Allegany County, Maryland and covers approximately 114 square miles (see Figure 1). There are no "high quality," or Tier II, stream segments (Benthic Index of Biotic Integrity (BIBI) and Fish Index of Biotic Integrity (FIBI) aquatic life assessment scores > 4 (scale 1-5)) located within the watershed requiring the implementation of Maryland's anti-degradation policy (COMAR 2010f; MDE 2010b). Also, approximately 0.4% of the watershed is covered by water (i.e., streams, ponds, etc.). The total population in the Potomac River LNB watershed is approximately 50,420 (US Census Bureau 2000).

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 surficial geology of the Ridge and Valley Province is characterized by strongly folded and faulted sedimentary rock, producing a rugged surface terrain. Folding has produced elongated arches across the region, which exposes Devonian rock at the surface. The topography in the watershed is often steep and deeply carved by winding streams.

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 Allegany Ridge, which is particular portion of the Ridge and Valley Province where the Potomac LNB watershed is located. 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 consists 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 2010; Vokes and Ewards 1974; DNR 2010).

The Potomac River LNB watershed is comprised of several different soil series associations, which include the Elliber-Dekalb-Opequon association, Weikert-Gilpin association, Gilpin-Dekalb-Cookport association, and the Weikert-Calvin-Lehew association. 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 stony Dekalb soils are moderately deep and are found over sandstone. The Opequon soils generally occur on the sides of the limestone ridges and contain stones or flagstones. Weikert soils are mostly shallow and are found 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 (USDA 1977).

Soil type for the Potomac River LNB watershed is also categorized by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS) into four hydrologic soil groups: Group A soils have high infiltration rates and are typically deep well-drained to excessively drained sands or gravels; Group B soils have moderate infiltration rates and consist of moderately deep to deep and moderately well to well drained soils, with moderately fine to moderately coarse textures; Group C soils have slow infiltration rates and a layer that impedes downward water movement and consist of moderately fine to fine textured soils; Group D soils have very slow infiltration rates and consist of clay soils with a permanently high water table that are shallow and often over nearly impervious material.. The Potomac River LNB watershed is comprised of primarily C type soils (56%) with smaller amounts of and B (24%) and B/D soils (20%) (USDA 2006).

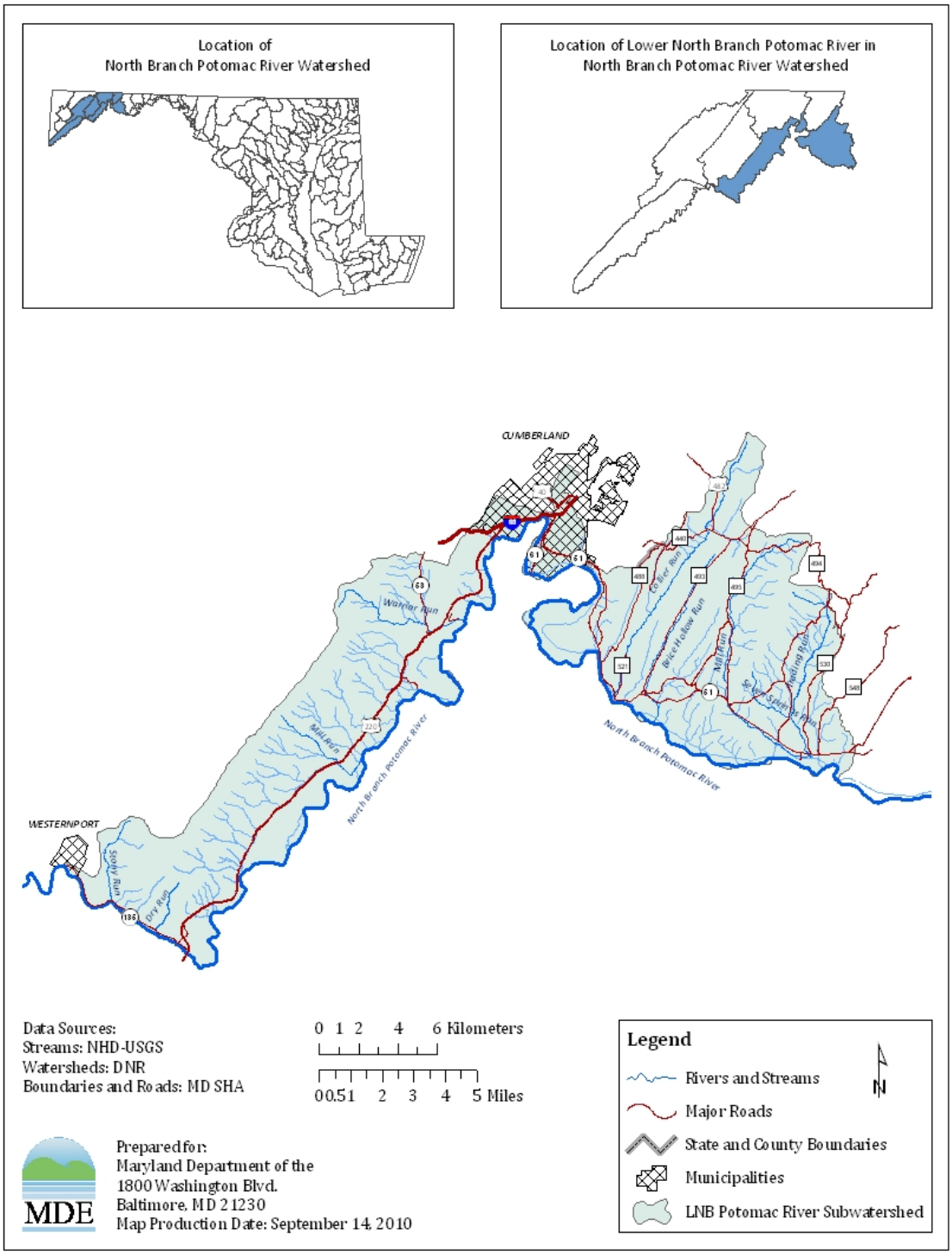

Figure 1: Location Map of the Potomac River LNB Watershed in Allegany County, Maryland

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

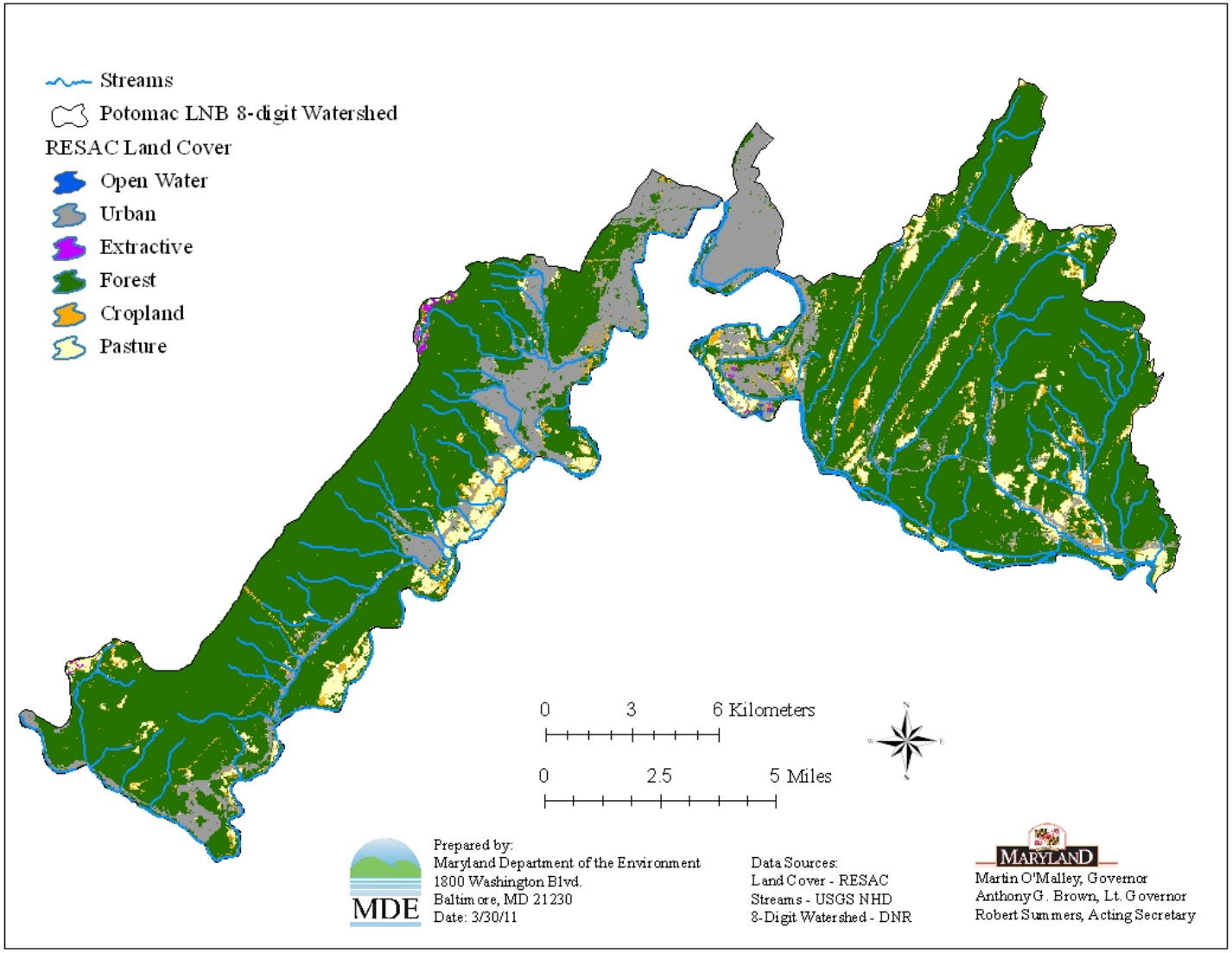

Figure 2: Land Use of the Potomac River LNB Watershed

3.0 WATER QUALITY CHARACTERIZATION

The Maryland water quality standards surface water use designation for the Potomac River LNB mainstem, Mill Run and its tributaries, and an unnamed tributary to the Potomac River LNB mainstem near Pinto, Maryland and its tributaries is Use I-P (Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply). All other tributaries in the Potomac River LNB watershed are designated as use III-P (Nontidal Cold Water and Public Water Supply) (COMAR 2010a,b,c,d,e). A water quality standard is the combination of a designated use for a particular body of water and the water quality criteria designed to protect that use. Designated uses include activities such as fishing, swimming, drinking water supply, protection of aquatic life, and shellfish propagation and harvest. Water quality criteria consist of narrative statements and numeric values designed to protect the designated uses. Criteria may differ among waters with different designated uses.

The Potomac River LNB watershed was originally listed on Maryland's 1996 303(d) List as impaired by elevated sediments from nonpoint sources, with supporting evidence cited in Maryland's 1996 305(b) report. The 1996 305(b) report did not directly state that elevated sediments were a concern, and it has been determined that the sediment listing was based on best professional judgment (MDE 2004; DNR 1996).

Currently in Maryland, there are no specific numeric criteria for suspended sediments. Therefore, to determine whether aquatic life is impacted by elevated sediment loads, MDE's BSID analysis was applied for the 1st through 4th order tributary streams in the watershed, and a comparison of observed sediment concentrations at Potomac River LNB CORE/TREND monitoring stations to CORE/TREND monitoring station observed concentrations in the Piedmont and Highland Ecoregions of Maryland was conducted for the watershed mainstem. MDE's BSID methodology is applied for watersheds that are identified on Maryland's 2010 Integrated Report as impaired for impacts to biological communities. The primary goal of the BSID analysis is to identify the most probable cause(s) for observed biological impairments throughout Maryland's 8-digit (MD 8-Digit) watersheds (MDE 2009). However, the BSID methodology is only applicable to 1st thru 4th order tributaries. Therefore, additional assessment was necessary to determine whether sediment loads are impacting aquatic life in the mainstem of the Potomac River LNB.

3.1 Potomac River LNB Tributary Assessment

The Potomac River LNB watershed (1st through 4th order tributary streams only) is identified in Maryland's 2010 Integrated Report as impaired for impacts to biological communities. The biological assessment is based on the combined results of Maryland Biological Stream Survey (MBSS) round one (1995-1997) and round two (2000-2004) data, which includes 38 stations. Eight of the 38 stations, or 21% of the stream miles in the watershed, are assessed as having BIBI and/or FIBI scores significantly lower than 3.0 (on a scale of 1 to 5), which is significantly different from the MBSS reference sites (MDE 2010a). Thus, since the watershed was identified as not supporting aquatic life, a BSID analysis was conducted. See Figure 3 and Table 2 for MBSS station locations and information.

Table 2: Monitoring Stations in the Potomac River LNB Tributaries

Station Number	Sponsor	Station Type	Station Name[1]	Latitude (dec. degrees)	Longitude (dec. degrees)
AL-A-148-201-96	DNR	MBSS Round 1	Seven Springs Run	39.56057	-78.62397
AL-A-187-218-96	DNR	MBSS Round 1	Deep Hollow	39.48319	-78.96147
AL-A-202-121-96	DNR	MBSS Round 1	Warrior Run	39.59894	-78.85608
AL-A-268-221-96	DNR	MBSS Round 1	Seven Springs Run	39.56276	-78.63155
AL-A-281-104-96	DNR	MBSS Round 1	Dry Run	39.45942	-78.98741
AL-A-294-325-96	DNR	MBSS Round 1	Trading Run	39.55864	-78.61828
AL-A-373-113-96	DNR	MBSS Round 1	Seven Springs Run UT1	39.56339	-78.63038
AL-A-380-303-96	DNR	MBSS Round 1	Mill Run	39.59929	-78.65453
AL-A-465-311-96	DNR	MBSS Round 1	Collier Run	39.58726	-78.71735
AL-A-465-324-96	DNR	MBSS Round 1	Wildcat Hollow	39.60524	-78.70403
AL-A-480-205-96	DNR	MBSS Round 1	Mill Run	39.63050	-78.64132
AL-A-485-220-96	DNR	MBSS Round 1	North Branch Potomac River UT2	39.58852	-78.85363
AL-A-485-227-96	DNR	MBSS Round 1	North Branch Potomac River UT2	39.58039	-78.84692
AL-A-550-204-96	DNR	MBSS Round 1	Frog Hollow	39.57581	-78.68708
AL-A-578-110-96	DNR	MBSS Round 1	Mill Run UT1	39.53697	-78.91772
AL-A-585-122-96	DNR	MBSS Round 1	North Branch Potomac River UT3	39.58294	-78.83098
AL-A-626-216-96	DNR	MBSS Round 1	Mill Run	39.54618	-78.90929
AL-A-706-228-96	DNR	MBSS Round 1	Collier Run	39.66416	-78.65959
COCA-112-N-2003	DNR	MBSS Round 2	Potomac River LNB UT5	39.54303	-78.67190
COCA-302-N-2003	DNR	MBSS Round 2	Mill Run	39.53994	-78.60211
COCA-303-N-2003	DNR	MBSS Round 2	Seven Springs Run	39.54189	-78.60780
NCRW-305-N-2004	DNR	MBSS Round 2	Mill Run	39.53833	-78.60112
PRLN-104-R-2003	DNR	MBSS Round 2	Potomac River LNB UT3	39.54738	-78.58555
PRLN-105-R-2003	DNR	MBSS Round 2	Trading Run UT1	39.61061	-78.60261
PRLN-107-R-2003	DNR	MBSS Round 2	Mill Run UT1 UT1	39.54911	-78.60098
PRLN-108-R-2003	DNR	MBSS Round 2	Brice Hollow Run	39.57750	-78.70161
PRLN-109-R-2003	DNR	MBSS Round 2	Toms Hollow	39.49893	-78.95916
PRLN-113-R-2003	DNR	MBSS Round 2	Toms Hollow	39.49678	-78.95466
PRLN-115-R-2003	DNR	MBSS Round 2	Potomac River LNB UT4	39.56149	-78.88312
PRLN-119-R-2003	DNR	MBSS Round 2	Potomac River LNB UT2 UT1	39.58449	-78.86666
PRLN-120-R-2003	DNR	MBSS Round 2	Brice Hollow Run	39.59377	-78.69249
PRLN-122-R-2003	DNR	MBSS Round 2	Mill Run UT2 UT1	39.52757	-78.93797
PRLN-201-R-2003	DNR	MBSS Round 2	Mill Run UT1	39.54169	-78.60175
PRLN-306-R-2003	DNR	MBSS Round 2	Collier Run	39.60372	-78.70321
PRLN-316-R-2003	DNR	MBSS Round 2	Collier Run	39.59311	-78.71361
PRLN-318-R-2003	DNR	MBSS Round 2	Collier Run	39.61314	-78.69546
PRLN-321-R-2003	DNR	MBSS Round 2	Mill Run UT2	39.51548	-78.91448
PRLN-626-S-2000	DNR	MBSS Round 2	Mill Run	39.54608	-78.90955

Note: [1]UT = Unnamed Tributary

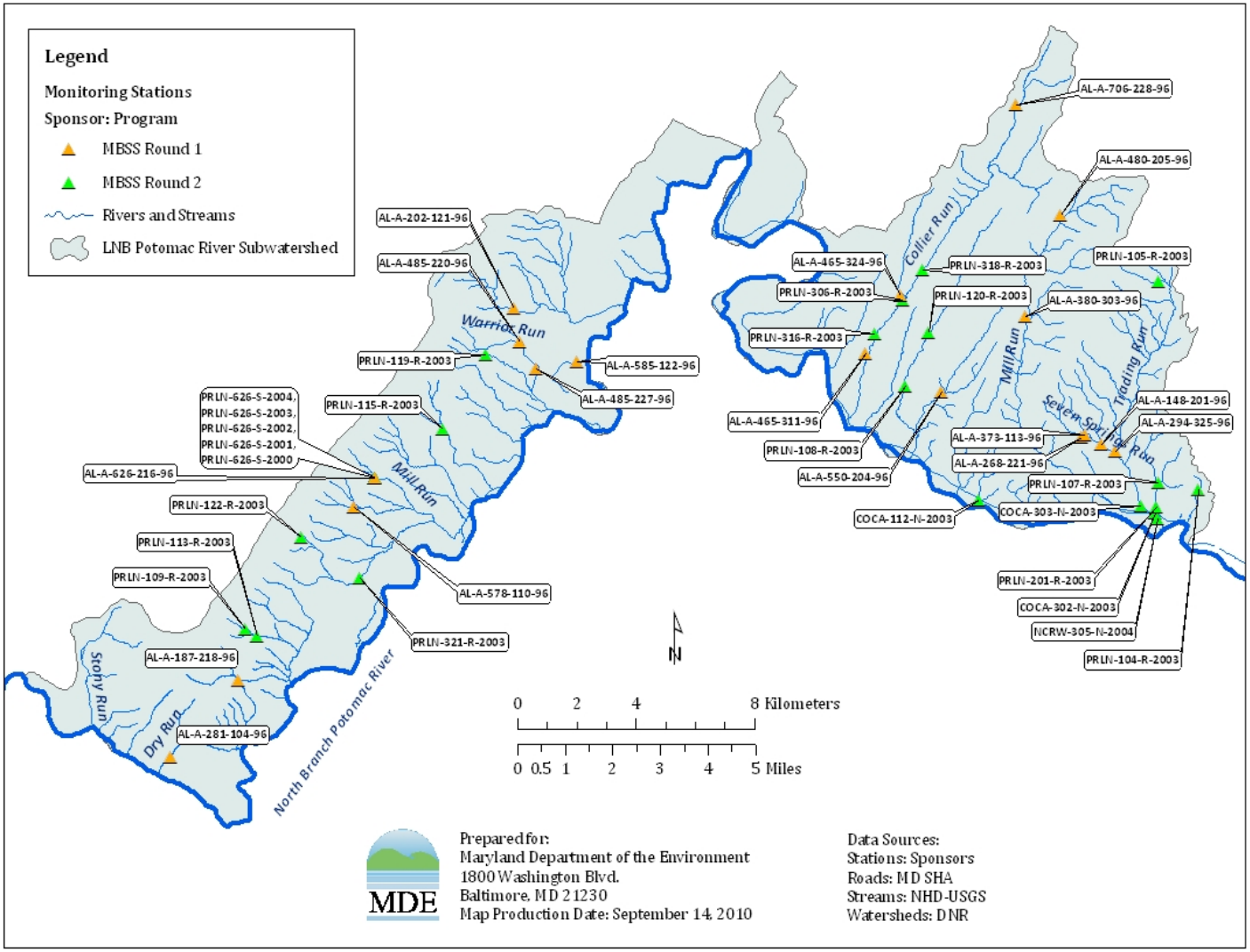

Figure 3: Monitoring Stations in the Potomac River LNB Tributaries

The primary goal of the BSID analysis is to identify the most probable cause(s) for observed biological impairments throughout MD's 8-digit watersheds (1st though 4th order streams only). The BSID analysis applies a case-control, risk-based, weight-of-evidence approach to identify potential causes of biological impairment. The risk-based approach estimates the strength of association between various stressors and an impaired biological community. The BSID analysis then identifies individual stressors as probable or unlikely causes of the poor biological conditions within a given MD 8-digit watershed, and subsequently reviews ecological plausibility. Finally, the analysis concludes whether or not these individual stressors or groups of stressors are contributing to the impairment (MDE 2009).

The primary dataset for BSID analysis is Maryland DNR MBSS round two data (collected between 2000-2004) because it provides a broad spectrum of paired data variables, which allow for a more comprehensive stressor analysis. The MBSS is a robust statewide probability-based sampling survey for assessing the biological conditions of 1st through 4th order, non-tidal streams (Klauda et al. 1998; Roth et al. 2005). It uses a fixed length (75 meter (m)) randomly selected stream segment for collecting site level information within a primary sampling unit (PSU), also defined as a watershed. The randomly selected stream segments, from which field data are collected, are selected using either stratified random sampling with proportional allocation, or simple random sampling (Cochran 1977). The random sample design allows for unbiased estimates of overall watershed conditions. Thus, the dataset facilitated case-control analyses because: 1) in-stream biological data are paired with chemical, physical, and land use data variables that could be identified as possible stressors; and 2) it uses a probabilistic statewide monitoring design.

The BSID analysis combines the individual stressors (physical and chemical variables) into three generalized parameter groups in order to assess how the resulting impacts of these stressors can alter the biological community and structure. The three generalized parameter groups include: sediment, habitat, and water chemistry. Identification of a sediment/flow stressor as contributing to the biological impairment is based on the results of the individual stressor associations within both the sediment and habitat parameter groups that reveal the effects of sediment related impacts or an altered hydrologic regime (MDE 2009).

The BSID analysis for the Potomac River LNB watershed did not identify sediment as a potential stressor to aquatic life, nor did it indicate any significant association between current sediment stressors and impaired biological communities within the watershed (MDE 2011). Moreover, the BSID analysis did not identify any other probable stressors or sources as being significantly associated with the impaired biological communities in the watershed. Rather, the BSID concludes that the biological impairment in the watershed is due to natural conditions. The Potomac River LNB watershed is located just 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 effect, and as a result, the watershed experiences drier conditions than other streams in the region, making it more sensitive to drought (MDE 2011). Based on the BSID analysis, it is concluded that sediment is not a cause of the biological impairment in the 1st through 4th order streams in the watershed.

3.2 Potomac River LNB Mainstem Assessment

As noted in Sections 3.0 and 3.1, the BSID analysis only applies to 1st thru 4th order tributary streams due to the nature of the MBSS data used. Therefore, an additional assessment was necessary to determine whether sediment loads are impacting aquatic life in the mainstem of the Potomac River LNB.

Total Suspended Solids (TSS) and biological monitoring data for the Potomac River LNB mainstem were obtained from the DNR CORE/TREND program. Data were collected at four stations on the mainstem Potomac River LNB as part of the DNR CORE/TREND monitoring network. Additionally, MDE collected TSS and water quality monitoring data from three stations in the mainstem, which correspond to the locations of three of the DNR CORE/TREND program stations. Table 3 and Figure 4 provide the DNR CORE/TREND and MDE monitoring station locations and information.

Table 3: Monitoring Stations in the Potomac River LNB Mainstem

Station Number	Sponsor	Station Type	Station Name	Latitude (dec. degrees)	Longitude (dec. degrees)
NBP0103	DNR	CORE	Potomac River LNB	39.58250	-78.73167
NBP0023	DNR	TREND	Potomac River LNB	39.53694	-78.61139
NBP0326	DNR	CORE	Potomac River LNB	39.56667	-78.83917
NBP0461	DNR	TREND	Potomac River LNB	39.44472	-78.97194
NBP0023	MDE	Water Quality	Potomac River LNB	39.537750	-78.613333
NBP0326	MDE	Water Quality	Potomac River LNB	39.566817	-78.839217
NBP0461	MDE	Water Quality	Potomac River LNB	39.445017	-78.972817

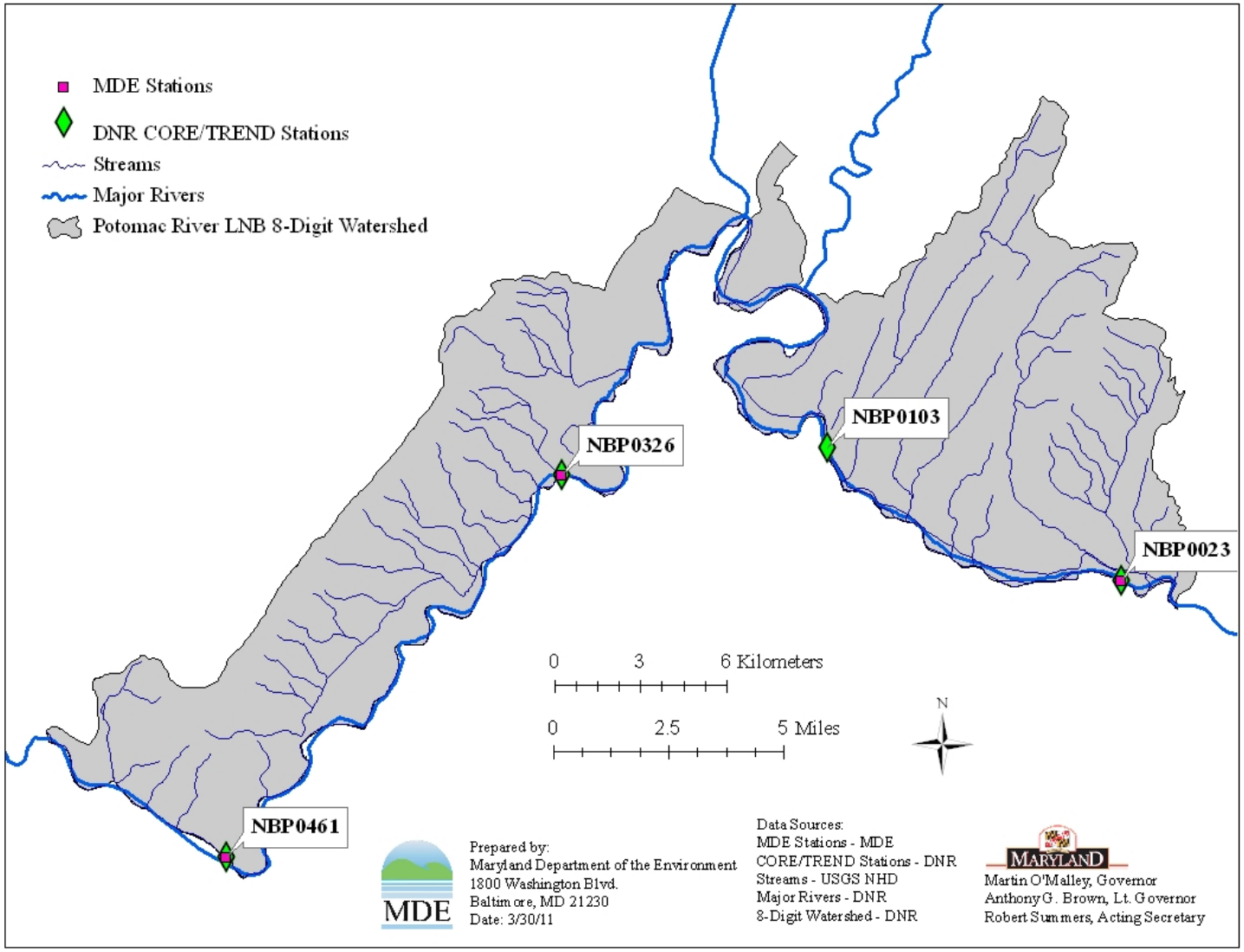

Figure 4: Monitoring Stations in the Potomac River LNB Mainstem

The DNR CORE/TREND monitoring program collected benthic macroinvertebrate data between 1976 and 2006. This data was used to calculate four benthic community measures: total number of taxa, Shannon-Weiner Diversity Index (DI), modified Hilsenhoff Biotic Index (HBI), 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).

The CORE/TREND data for Potomac River LNB stations show that water quality in the mainstem has improved over time, but because the water quality status of the stations is not consistently assessed as "Good," the CORE/TREND assessment does not provide sufficient evidence as to whether or not the mainstem is supporting aquatic life. A summary of the results for each of the stations is presented in Table 4, and Appendix A provides additional background information on the water quality status and trends in the Potomac River LNB mainstem.

Table 4: Potomac River LNB Mainstem CORE/TREND Data

Station 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

Although the water quality status of the Potomac River LNB CORE/TREND stations is inconclusive, it can still be determined whether or not sediment is a stressor to aquatic life in the mainstem. Appendix A provides an analysis of the TSS data that was collected, in addition to the benthic macroinvertebrate data, at the CORE/TREND stations in the Potomac River LNB mainstem. The analysis compares the distribution of concentrations observed in the watershed with the distribution of concentrations observed at CORE/TREND stations in the Piedmont and Highland Ecoregions of Maryland with a water quality status of "Good" or better. The analysis shows that the concentrations observed in the Potomac River LNB are well within the range of observed concentrations at stations assessed as having "Good" or better water quality. Thus, the sediment concentrations observed in the Potomac River LNB mainstem are compatible with CORE/TREND stations maintaining a water quality status of "Good" or better, and therefore sediment is not a potential stressor to aquatic life in the Potomac River LNB mainstem.

4.0 CONCLUSION

Based on the analyses presented in the preceding section of this report, it is concluded that the Potomac River LNB watershed is not impaired by sediment. The BSID analysis does not identify sediment as a potential stressor to aquatic life in the 1st through 4th order tributary streams in the watershed. Excess sedimentation is therefore not a cause of the biological impairments in these tributary streams in. Additionally, a comparison of observed sediment concentrations at Potomac River LNB CORE/TREND stations with observed concentrations at CORE/TREND stations in the Piedmont and Highland Ecoregions of Maryland shows that concentrations in the watershed mainstem are well within the range of concentrations observed at stations assessed as having "Good" or better water quality. This comparison indicates that sediments are not a potential stressor to the biological communities in the Potomac River LNB mainstem. Therefore, this analysis supports the conclusion that current watershed sediment loads are at a level to support the Use I-P/III-P designations for the Potomac River LNB watershed, and more specifically, at a level to support aquatic life.

Barring the receipt of contradictory data, this report will be used to support a revision of the 2010 Integrated Report sediment 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 ("waterbody is meeting some [in this case sediments-related] water quality standards, but with insufficient data to assess all impairments"), when MDE proposes the revision of the Integrated Report. Although the waters of the Potomac River LNB watershed do not display signs of a sediment impairment, the State reserves the right to require future controls in the watershed if evidence suggests that sediments from the basin are contributing to downstream water quality problems. For instance, reductions will be required to meet allocations assigned to the Potomac River Tidal Fresh Chesapeake Bay Water Quality Segment, as specified by the Chesapeake Bay Nutrient and Sediment TMDLs, established by EPA on December 29, 2010.

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APPENDIX A – Comparison of Sediment Data from the Potomac River Lower North Branch CORE/TREND Stations with CORE/TREND Monitoring Data From Other Stations in the Piedmont and Highland Ecoregions of Maryland

TSS Concentration vs. Water Quality Status

Although the water quality status of the Potomac River LNB CORE/TREND stations is inconclusive, it can still be determined whether or not sediment is a stressor to aquatic life in the mainstem. In order to evaluate whether elevated sediment loads are impacting aquatic life in the mainstem, a comparison of observed sediment concentrations at Potomac River LNB CORE/TREND monitoring stations to CORE/TREND monitoring station observed concentrations in the Piedmont and Highland Ecoregions of Maryland was conducted. Specifically, the 25th percentile, 50^{th} percentile, 75^{th} percentile, and 90^{th} percentile of TSS concentrations were compared. Concentrations were classified according to the water quality status of the stations. The results are shown in Figures A-2 through A-5. The 25th percentile, concentrations at all stations tend to occupy a narrow range between 2 and 6 milligrams per liter (mg/l). This indicates a limited correlation between TSS concentration and water quality status. At higher percentiles, the correlation between low TSS concentration and a "Good" or better water quality status is stronger but still explains only a limited amount of the variability in TSS concentrations. At these higher percentiles, however, summary statistics for TSS concentrations from Potomac River LNB mainstem stations are within the range observed not just for stations with "Good" water quality status, but also for stations with "Good/Very Good" water quality status. This demonstrates that the sediment concentrations observed in the Potomac River LNB mainstem are compatible with supporting aquatic life.

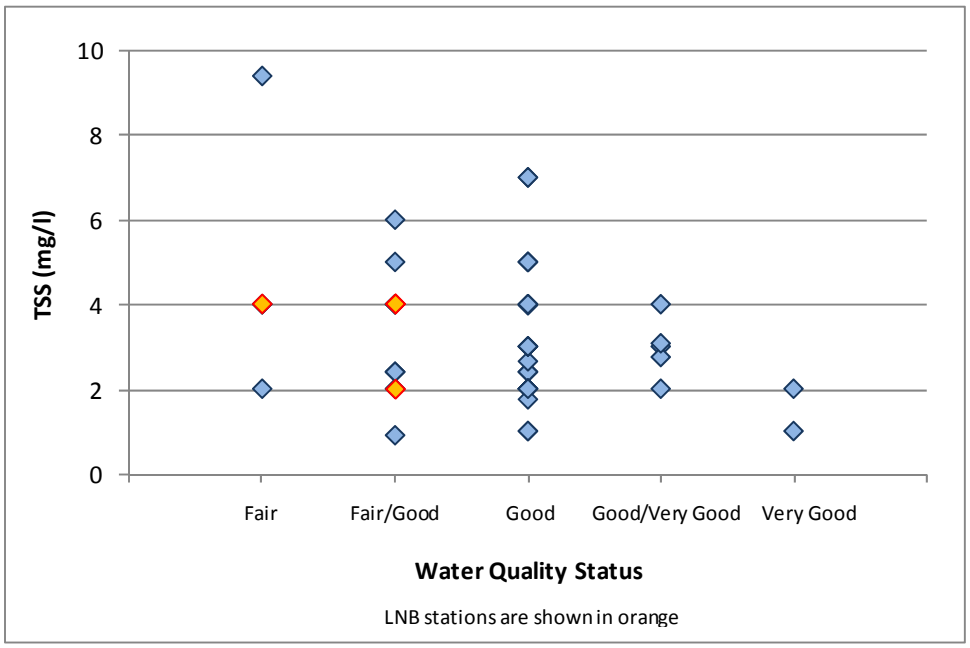

Figure A-1: 25th percentile TSS Concentrations

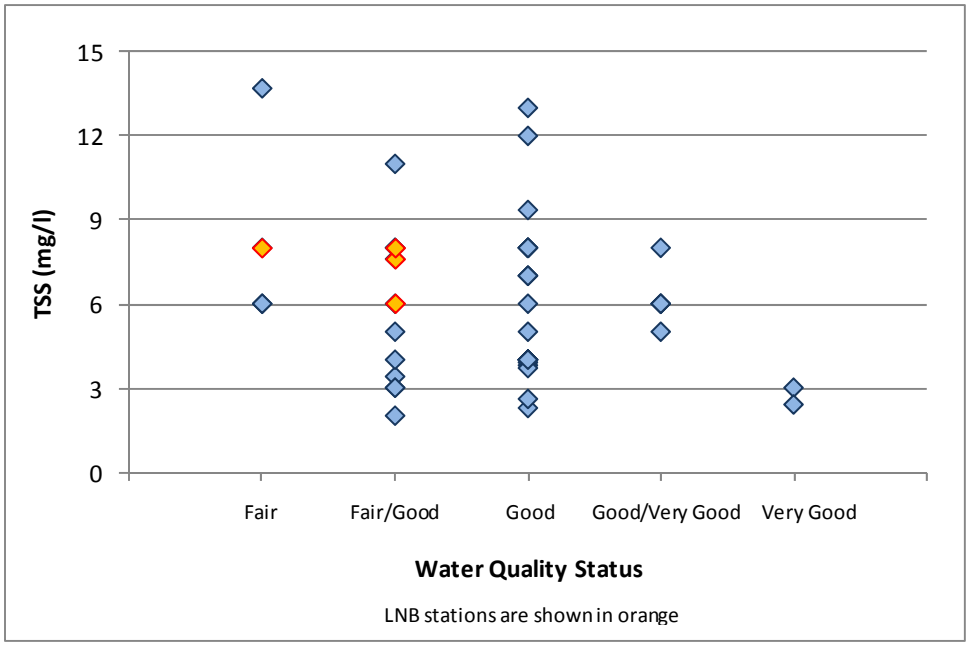

Figure A-2: 50th percentile TSS Concentrations

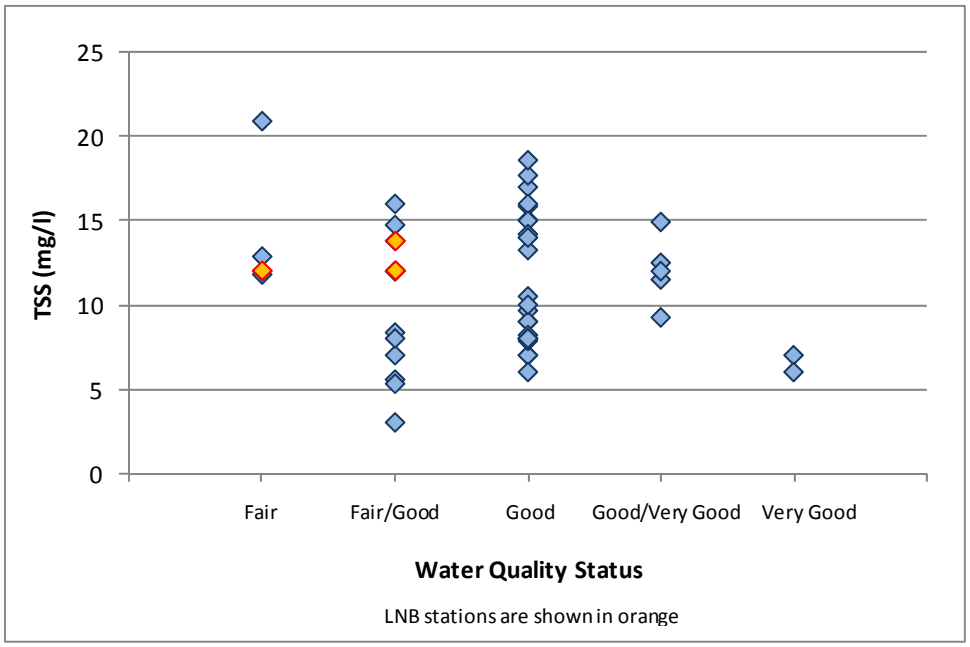

Figure A-3: 75th percentile TSS Concentrations

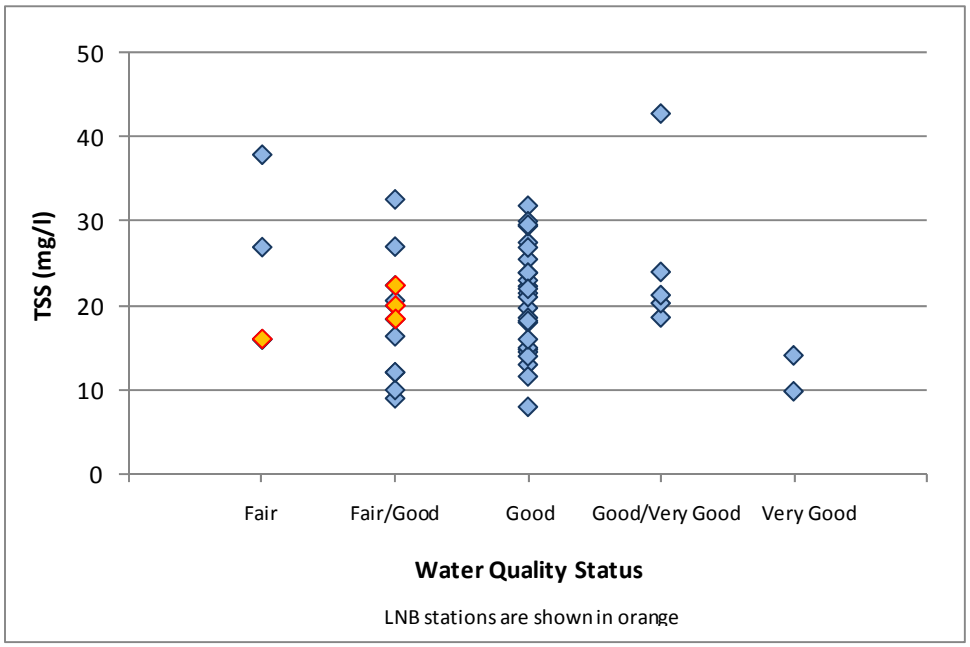

Figure A-4: 90th Percentile TSS Concentrations

TSS Concentration vs. Flow

Many studies have documented the correlation between high flows and increased TSS concentrations (Schueler 1994; Arnold and Gibbons 1996), indicating that the majority of sediment is transported during high flows. To examine this relationship in the Potomac River LNB mainstem, CORE/TREND stations were paired with the nearest U. S. Geological Survey (USGS) stream gage, and the flow percentile at the corresponding gage was calculated for each sediment observation during the time period of 2000-2008. Sediment data from the CORE/TREND program was supplemented with data collected by MDE at the CORE/TREND station locations when available. The average observed TSS concentration in the highest quintile of flows was calculated for both the Potomac River LNB stations and other CORE/TREND stations in the Highland and Piedmont Ecoregions of Maryland with a water quality status rated "Good" or better. Table A-2 provides the CORE/TREND stations in the Piedmont and Highland Ecoregions of Maryland with a "Good" or better water quality status, the USGS gage that was used to calculate flow percentiles for the TSS observations at the station, and the average observed TSS concentration in the top quintile of flows. The same information is provided for Potomac River LNB stations in Table A-3. Figure A-6 compares the average observed TSS concentrations in the top quintile of flows at Potomac River LNB stations with the average concentrations at CORE/TREND stations with a "Good" or better water quality status. Average observed TSS concentrations at Potomac River LNB stations under high flow conditions are lower than the median value of average observed high flow concentrations at "Good" or better sites.

This analysis shows that sediment concentrations under high flows at Potomac River LNB stations are low compared to concentrations during high flow conditions at CORE/TREND stations with a water quality status rated "Good" or better. Since flow is proportional to watershed area, the relatively low sediment concentrations at Potomac River LNB stations during high flow conditions strongly suggests that the sediment yield, or load per area, is also correspondingly lower in the watershed. Thus, it is the conclusion of this analysis that the sediment concentrations observed in the Potomac River LNB mainstem are well within the range of observed concentrations at stations with a water quality status rated "Good" or better by the CORE/TREND program. Therefore, sediment is not a potential stressor to aquatic life in the Potomac River LNB mainstem.

Table A-1: Average Observed TSS Concentrations During Fifth Quintile Flows at CORE/TREND Stations with Associated USGS Gages

Mainstem River/Stream	USGS Gage	CORE/TREND Station	CORE/TREND Status	Average TSS Concentration (mg/l)
Antietam Creek	1619500	ANT0044	GOOD	71.7
Antietam Creek	1619500	ANT0203	GOOD	29.3
Big Pipe Creek	1639500	BPC0035	GOOD/VERY GOOD	112.3
Catoctin Creek	1637500	CAC0031	GOOD/VERY GOOD	11.4
Catoctin Creek	1637500	CAC0148	GOOD	37.2
Casselman River	3078000	CAS0479	GOOD	30.9
Conococheague Creek	1614500	CON0005	GOOD	39.7
Conococheague Creek	1614500	CON0180	GOOD	39.2
Deer Creek	1580000	DER0015	VERY GOOD	42.0
Deer Creek	1580000	DER0231	VERY GOOD	138.2
Gunpowder River	1582500	GUN0125	GOOD	8.1
Gunpowder River	1582500	GUN0258	GOOD	29.4
Gunpowder River	1581810	GUN0476	GOOD	20.3
Little Patuxent River	1594000	LXT0173	GOOD	22.5
Monocacy River	1643000	MON0020	GOOD	15.6
Monocacy River	1643000	MON0155	GOOD	18.0
Monocacy River	1643000	MON0269	GOOD/VERY GOOD	38.5
Monocacy River	1639000	MON0528	GOOD/VERY GOOD	17.2
Middle Patuxent River	1594000	MXT0021	GOOD	33.7
North Branch Potomac River	1598500	NBP0534	GOOD	5.3
North Branch Potomac River	1595500	NBP0689	GOOD	11.2
Potomac River	1646500	POT1471	GOOD	26.7
Potomac River	1638500	POT1595	GOOD	29.5
Potomac River	1618000	POT1830	GOOD	22.3
Potomac River	1613000	POT2386	GOOD	24.2
Potomac River	1610000	POT2766	GOOD/VERY GOOD	48.9
Patuxent River	1591000	PXT0972	GOOD	37.0
Savage River	1597500	SAV0011	VERY GOOD	10.9
Seneca Creek	1645000	SEN0005	GOOD	31.9
Sideling Hill Creek	1610155	SID0015	GOOD/VERY GOOD	25.6
Tonoloway Creek	1610155	TOC0004	GOOD	43.7
Town Creek	1609000	TOW0013	GOOD	71.6
Western Run	1583500	WGP0050	GOOD	20.5
Wills Creek	1601500	WIL0026	GOOD	51.4
Youghiogheny River	3076500	YOU0925	GOOD	19.3

Mainstem River/Stream	USGS Gage	CORE/TREND Station	CORE/TREND Status	Average TSS Concentration (mg/l)
Youghiogheny River	3075500	YOU1069	GOOD	22.4
Youghiogheny River	3075500	YOU1139	GOOD	44.0
Median				**29.4**
Average				**35.2**

Table A-2: Average Observed TSS Concentrations During Fifth Quintile Flows at Potomac River LNB CORE/TREND Stations with Associated USGS Gages

Mainstem River/Stream	USGS Gage	CORE/TREND Station	CORE/TREND Status	Average TSS Concentration (mg/l)
North Branch Potomac River	1603000	NBP0023	Fair/Good	24.5
North Branch Potomac River	1603000	NBP0103	Fair/Good	21.4
North Branch Potomac River	1598500	NBP0326	Fair/Good	13.6
North Branch Potomac River	1598500	NBP0461	Fair	14.7

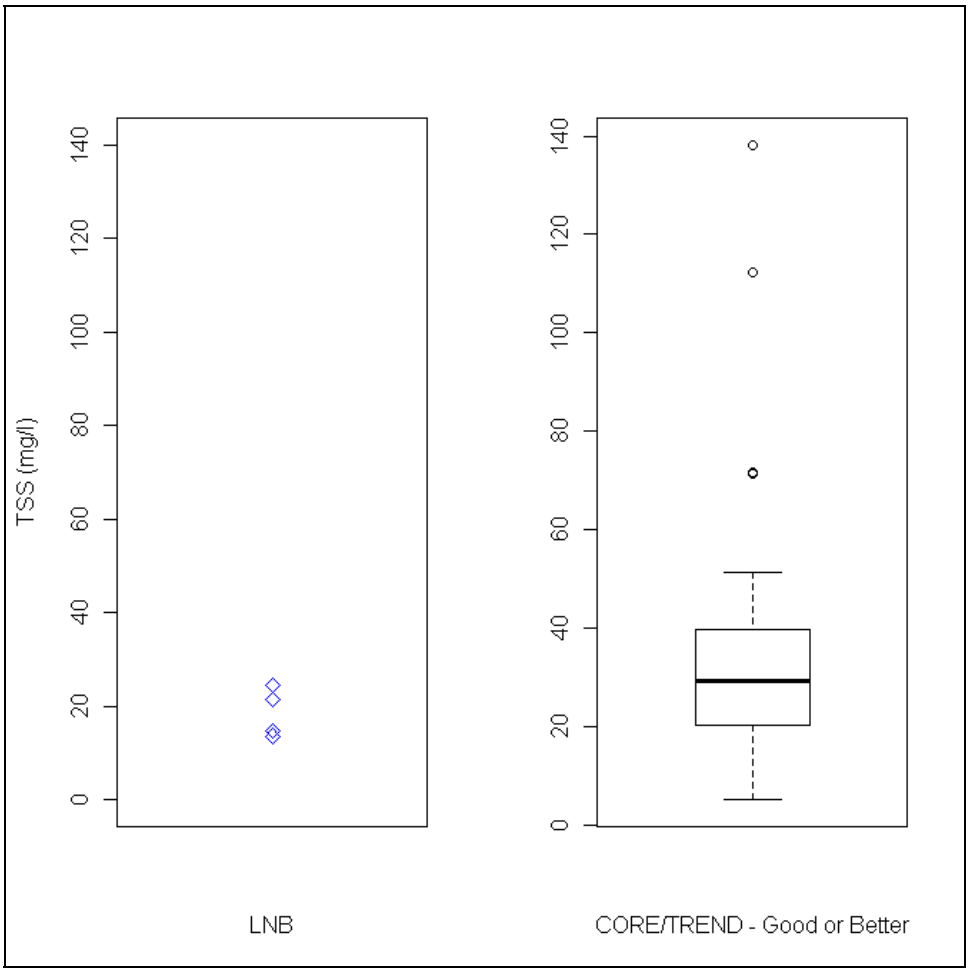

Figure A-5: Comparison of Average Observed TSS Concentrations During Fifth Quintile Flows at Potomac River LNB Stations to CORE/TREND Stations with a Water Quality Staus Rated "Good" or Better