Appendix C: Sinepuxent Bay

1.0 Introduction

As described in the main TMDL report, the Coastal Bays are a shallow coastal lagoon system comprised of several individual and distinct waterbodies. The MD 8-Digit Sinepuxent Bay (basin code: 02130104) is situated between the Ocean City Inlet and Chincoteague Bay on the Atlantic Coast of the Delmarva (Delaware-Maryland-Virginia) Peninsula in Worcester County, Maryland. A major area of interest in the MD 8-Digit Sinepuxent Bay watershed includes Assateague Island National Seashore. The MD 8-Digit Sinepuxent Bay connects to the Atlantic Ocean through the Ocean City Inlet. Figure C1 shows the location of Isle of Wight Bay and its watershed.

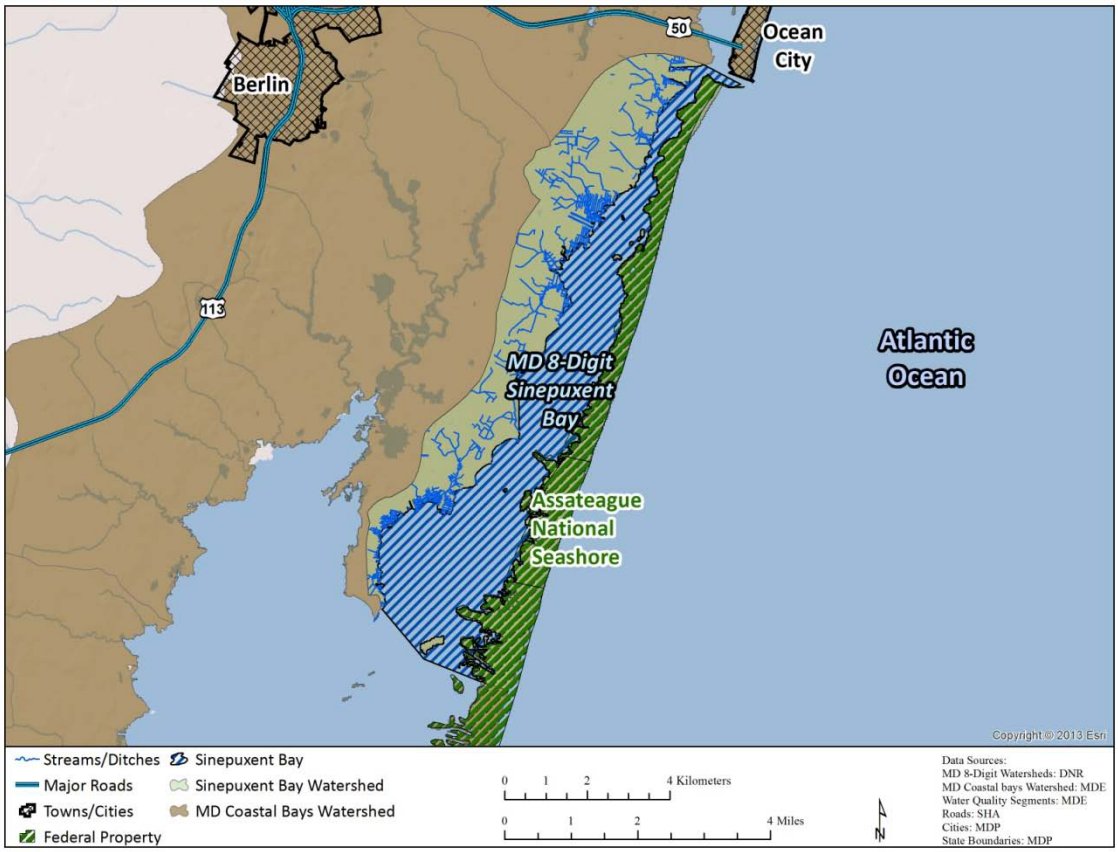

Figure C1: Location map of the MD 8-Digit Sinepuxent Bay Watershed.

TMDLs have been developed for the MD 8-Digit Sinepuxent Bay, referred to MD 8-Digit Sinepuxent Bay. Specific WLAs and LAs are provided. In the sections below, more detailed information regarding watershed characteristics, water quality, baseline nutrient loadings, and the specific TMDLs developed for the MD 8-Digit Sinepuxent Bay are provided.

2.0 Land Use

Sinepuxent Bay

The MD 8-Digit Sinepuxent Bay watershed has a drainage area of 7,442 acres. The average depth is 2 ft (1 m). The land uses in the watershed consist of forest and other herbaceous (2,340 acres, or 41% of the total watershed area); mixed agriculture (499 acres, 7%); urban (1,838 acres, 25%); water/wetlands (1,882 acres, 25%); and barren (884 acres, 12%). Figure C2 shows the relative amounts of the different land uses in the MD 8-Digit Sinepuxent Bay watershed.

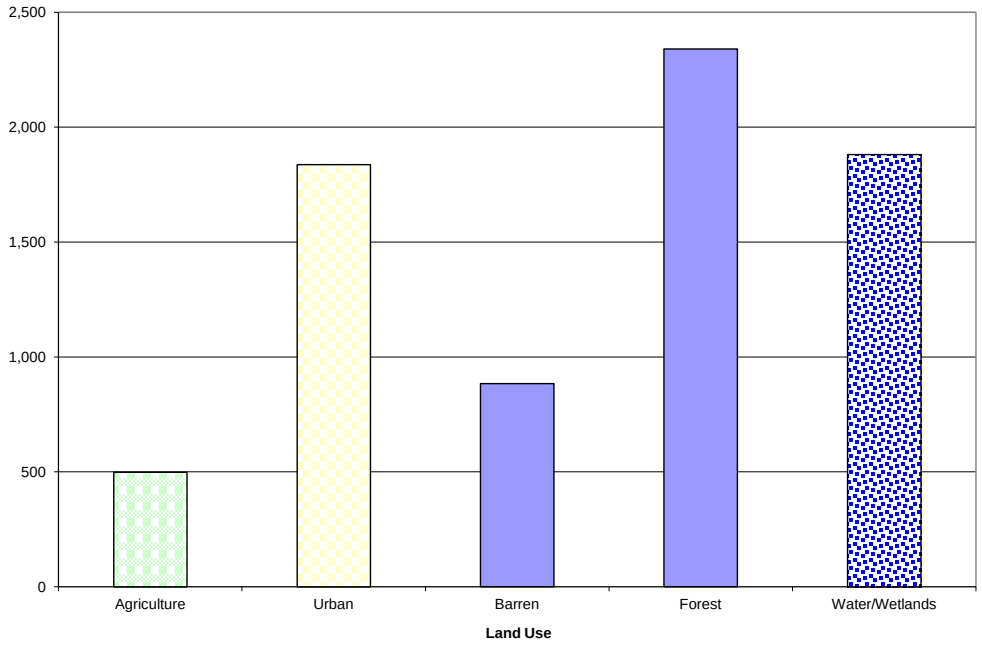

Figure C2: Proportions of land use draining the MD 8-Digit Sinepuxent Bay watershed.

3.0 Watershed Model Information

The applicable MD 8-Digit Sinepuxent Bay watershed model segments and water quality monitoring stations are presented in Tables C1 and C2 below.

Table C1: MD 8-Digit Sinepuxent Bay Watershed model segments

Watershed Name	Watershed Model Segments
Sinepuxent Bay	58,59,60,61,62,63,64,65,66,67,68,69,70, 71,72,169,170,171,172,173,174,235

Table C2: MD 8-Digit Sinepuxent Bay water quality monitoring stations

Watershed	Stations
Sinepuxent Bay	ASSA 2
	ASSA16
	ASSA1
	ASSA17
	ASSA18

4.0 Point Sources: National Pollutant Discharge Elimination System (NPDES) Loads

Table C3 below provides information on process water point source facilities with permits regulating the discharge nutrients within the MD 8-Digit Sinepuxent Bay watershed. As described in the main TMDL report, there are no NPDES-regulated stormwater facilities in the entire Maryland Coastal Bays watershed.

Table C3: Average daily flows and estimated TN and TP loads for process water point sources to the MD 8-Digit Sinepuxent Bay, 2001 – 2004.

Watershed Model Segment	Facility	Type	Average Flow (MGD)	Estimated Delivered TN Load (lbs/yr)	Estimated Delivered TP Load (lbs/yr)
174	Assateague Island National Seashore	Municipal	0.004	662	191
64	Assateague Pointe WWTP	Spray Irrigation	0.042	367	0
59	The Mystic Harbour	Injection Well	0.103	853	0
64	The Landings	Injection Well	0.00	0.00	0

5.0 Nonpoint Source Loads

Urban Stormwater, Agricultural, Atmospheric Deposition and Shoreline Erosion Loads

Nonpoint source loads and urban stormwater loads were estimated using the HSPF watershed model. Urban stormwater regulated by an NPDES stormwater permit, such as a Municipal Separate Storm Sewer System (MS4) permit, industrial stormwater permit, etc., is considered a point source by USEPA. However, since there are no NPDES stormwater permits within the watershed, urban stormwater loads are presented here as nonpoint sources. Atmospheric deposition loads were estimated using data from the National Atmospheric Deposition Program, which collects data at Assateague Island National Seashore. Shoreline erosion loads were estimated based on the work of Wells, Hennessee, and Hill (2002 and 2003), and *Wells et al*. (2008). Methods are described in the main report, with full details available in Wang *et al*. (2013) and VIMS (2013).

On-Site Wastewater Disposal (Septic Systems) Loads

Septic system loading estimates were calculated using 2000 U.S. Census data, the USEPA-CBP sewer service area GIS coverage, the USEPA-CBP land river segment GIS coverage, 1997 DNREC septic system GIS coverage, the MDE-WMA septic system GIS coverage, and the Maryland Coastal Bays TMDL HSPF watershed model GIS segmentation created by MDE. The assumptions used in the analysis are presented in Table C4. These loads were calculated based on a methodology used by the USEPA-CBP. Table C5 presents the calculated septic system loads for all segments.

Table C4. Assumptions used in the septic load analysis.

Assumption	Within 1,000ft of surface water	Greater than 1,000ft from surface water
Average # persons/septic	3.2	
Nitrogen loading per Person (lbs/year)	9.5	
Nitrogen loading per septic (lbs/year)	30.4	
Nitrogen attenuation rate	0.2	0.7
Surface water delivered nitrogen load per septic with attenuation (lbs/year)	24.32	9.12

Table C5: Delivered septic loads and values used in the Coastal Bays Model for the MD 8-Digit Sinepuxent Bay.

SEGMENT	*MD# Septics (within 1,000 ft)*	*MD # Septics (outside 1,000 ft)*	*Upstream # Septics (within 1,000 ft)*	*Upstream # Septics (outside 1,000 ft)*	*Total # Septics (within 1,000 ft)*	*Total # Septics (outside 1,000 ft)*	*Total Surface Water Delivered Nitrogen Load with Loss (Within 1,000 ft) (lbs/year)*	*Total Surface Water Delivered Nitrogen Load with Loss (Outside 1,000 ft) (lbs/year)*	*Total Surface Water Delivered Nitrogen Load with Loss (Within 1,000 ft) (lbs/day)*	*Total Surface Water Delivered Nitrogen Load with Loss (Outside 1,000 ft) (lbs/day)*	*Total Surface Water Delivered Nitrogen Load with Loss (lbs/day)*
59	0	2	0	0	0	2	0	18	0.00	0.05	0.05
60	0	4	0	0	0	4	0	36	0.00	0.10	0.10
61	2	9	0	0	2	9	49	82	0.13	0.22	0.36
62	40	5	0	0	40	5	973	46	2.67	0.12	2.79
63	3	0	0	0	3	0	73	0	0.20	0.00	0.20
64	73	8	0	0	73	8	1775	73	4.86	0.20	5.06
65	1	0	0	0	1	0	24	0	0.07	0.00	0.07
66	1	6	0	0	1	6	24	55	0.07	0.15	0.22
67	2	5	0	0	2	5	49	46	0.13	0.12	0.26
69	4	0	0	0	4	0	97	0	0.27	0.00	0.27
70	3	0	0	0	3	0	73	0	0.20	0.00	0.20
71	28	48	0	0	28	48	681	438	1.87	1.20	3.06
72	82	8	0	0	82	8	1994	73	5.46	0.20	5.66
172	2	0	0	0	2	0	49	0	0.13	0.00	0.13
174	8	0	0	0	8	0	195	0	0.53	0.00	0.53
235	2	0	0	0	2	0	49	0	0.13	0.00	0.13
Totals	251	95	0	0	251	95	6105	867	16.72	2.36	19.09

6.0 Baseline Load Summary

The baseline average annual total nitrogen load to the MD 8-Digit Sinepuxent Bay is 90,037 lbs/yr. Direct atmospheric deposition to the water's surface accounts for approximately 48% of the baseline nitrogen load. Shoreline erosion comprises 10%. Mixed agricultural (7%), urban (24%), septics (8%) and forest/barren (2%) account for the remaining nitrogen baseline load. The estimated average annual total phosphorus load is 6,229 lbs/yr. Direct atmospheric deposition to the water's surface accounts for approximately 35% of the baseline phosphorus load. Shoreline erosion comprises 24%. Mixed agricultural (6%), urban (33%) and forest/barren (2%) account for the remaining phosphorus baseline load. There are four process water point source facilities with permits regulating the discharge of nutrients in the MD 8-Digit Sinepuxent Bay watershed; however, the nonpoint source load comprises the majority of the total load to the waterbody. Figure C3 shows the relative contributions of nitrogen and phosphorus from the various sources to the MD 8-Digit Sinepuxent Bay. Details can be found in Wang *et al*. (2013) and VIMS (2013).

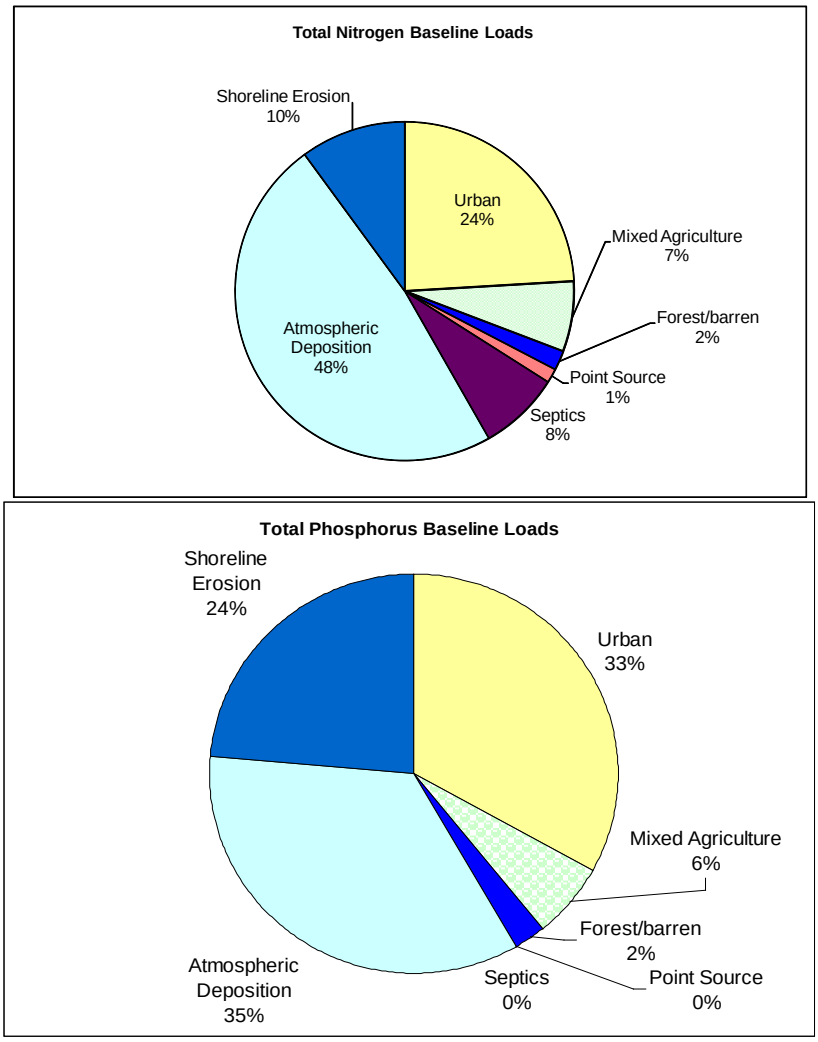

Figure C3: Nitrogen and phosphorus contributions from various sources to the MD 8-Digit Sinepuxent Bay.

7.0 Summary of TMDLs for the MD 8-Digit Sinepuxent Bay

Load reductions are applied only to controllable sources. Controllable sources are urban land, mixed agricultural land, and septic sources (nitrogen). For the purposes of this TMDL, shoreline erosion is not considered a controllable source. The reductions applied to atmospheric deposition were based on the allocation scenario (2025) for Worcester County in the Chesapeake Bay TMDL. See USEPA (2010) for further details regarding atmospheric deposition reductions. No reduction was required to meet the TMDLs for nutrients in the Sinepuxent Bay watershed.

The TMDLs for TN and TP for the MD 8-Digit Sinepuxent Bay are summarized in Tables C6 through C13 below, where:

TMDL Equation:

$TMDL = WLA_{ProcessWater}+WLA_{CAFO}+LA+MOS$

Table C6: MD 8-Digit Sinepuxent Bay Average Annual Nitrogen TMDL (lbs/yr)

Basin Name	TMDL	$WLA_{ProcessWater}$	WLA_{CAFO}	LA	MOS
Sinepuxent Bay	90,347	3,741	0	86,606	Implicit

Table C7: MD 8-Digit Sinepuxent Bay Growing Season Nitrogen TMDL (lbs/growing season)

Basin Name	TMDL	$WLA_{ProcessWater}$	WLA_{CAFO}	LA	MOS
Sinepuxent Bay	45,442	1,859	0	43,583	Implicit

Table C8: MD 8-Digit Sinepuxent Bay Nitrogen Maximum Daily Load (lbs/day)

Basin Name	MDL	$WLA_{ProcessWater}$	WLA_{CAFO}	LA	MOS
Sinepuxent Bay	465	10	0	455	Implicit

Table C9: MD 8-Digit Sinepuxent Bay Average Annual Phosphorus TMDL (lbs/yr)

Basin Name	TMDL	$WLA_{ProcessWater}$	WLA_{CAFO}	LA	MOS
Sinepuxent Bay	6,381	11	0	6,370	Implicit

Table C10: MD 8-Digit Sinepuxent Bay Growing Season Phosphorus TMDL (lbs/growing season)

Basin Name	TMDL	$WLA_{ProcessWater}$	WLA_{CAFO}	LA	MOS
Sinepuxent Bay	3,269	6	0	3,264	Implicit

Table C11: MD 8-Digit Sinepuxent Bay Maximum Daily Phosphorus Load (lbs/day)

Basin Name	MDL	$WLA_{ProcessWater}$	WLA_{CAFO}	LA	MOS
Sinepuxent Bay	37.51	0.03	0.00	37.48	Implicit

Table C12: MD 8-Digit Sinepuxent Bay Baseline Nitrogen Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
90,037	90,278	0%

Table C13: MD 8-Digit Sinepuxent Bay Baseline Phosphorus Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
6,229	6,381	0%