DNREC DIVISION OF
WATERSHED
STEWARDSHIP

LITTLE ASSAWOMAN BAY WATERSHED IMPLEMENTATION PLAN

2024

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Introduction

The Little Assawoman Bay Watershed Implementation Plan provides an update to the original Implementation Plan completed in 2011. It addresses specific elements required by U.S. EPA to be "included in watershed-based plans to restore waters impaired by nonpoint source pollution using incremental Section 319 funds" as stated in the Federal Register (Vol. 68, No. 205, pg. 60659-60660).

The *Little Assawoman Bay Total Maximum Daily Load* (TMDL), established in 2004, requires a 40% reduction in both nitrogen and phosphorus for the watershed to meet water quality standards. The reduction must come from nonpoint sources (NPS) since there are no point sources in this watershed. Pollutant loads for the Little Assawoman Bay were estimated using the Delaware Targeting and Planning (DTAP) model. A detailed description of the sources that inform DTAP and what it is used for can be found in Appendix A. Delaware Natural Resources and Environmental Control (DNREC) uses this model to estimate loads with various technologies and management actions, thereby identifying strategies for reducing pollutant loads. DTAP is used to support long-term evaluation of nonpoint source pollution reduction and planning. This plan is organized around the EPA A through I criteria for developing and implementing watershed management plans that help to restore and protect water quality, as outlined in the EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters. The nine elements (a through i) serve as the basis for structuring a watershed implementation plan. The implementation plan serves to create measurable results for achieving protection and restoration of water resources. The nine elements include: identification of causes of impairment, load reduction estimates from management measures, management measure descriptions, technical and financial assistance needed and sources of funding, public understanding and engagement, schedule for implementation, milestones, criteria for assessing achievement, and monitoring for evaluating effectiveness of management measures in achieving the criteria for successfully meeting water quality standards.

The geographic areas are broken into the sub watersheds of Miller Creek, Dirickson Creek, and the remainder of the area that drains to the Delaware portion of the Assawoman Canal and the Little Assawoman Bay. The Miller and Dirickson Creeks are headwater areas that drain to the Assawoman Canal and the Little Assawoman Bay. These are three distinct land areas that do not have any overlap among the land so are described separately throughout this document. However, they are hydrologically connected, which is why the TMDL is for the headwater Creeks and the Canal and Bay.

Identification of Causes & Sources of Impairment (a)

The Delaware portion of the Little Assawoman Bay and its headwaters is in Sussex County and is comprised of 31,150 acres of which 38% is natural, 35% developed, and 27% agricultural land use. These percentages consist of 11,896 acres of natural land, 10,761 acres of developed land, and 8,492 acres of agricultural land use. 55% of the assessed waters in the Little Assawoman Bay watershed are currently considered impaired. Of those, 40% is impaired by nitrogen and/or phosphorus, and 40% by bacteria and other microbes. As a result, 29% of the watershed suffers from degraded aquatic life, and 13% from low dissolved oxygen according to the EPA's Assessment, Total Maximum Daily Load Tracking and Implementation System (ATTAINS). The Little Assawoman Bay is tidally connected to the south by the larger Assawoman Bay, and to the north by the Indian River Bay. Figure 1 shows the spatial distribution of the land use sectors in the Little Assawoman Bay watershed. The additional land use acres are detailed in the text and come from the [United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) data] and construction notices of intent (NOIs), both of which are tabular and based on satellite imagery.

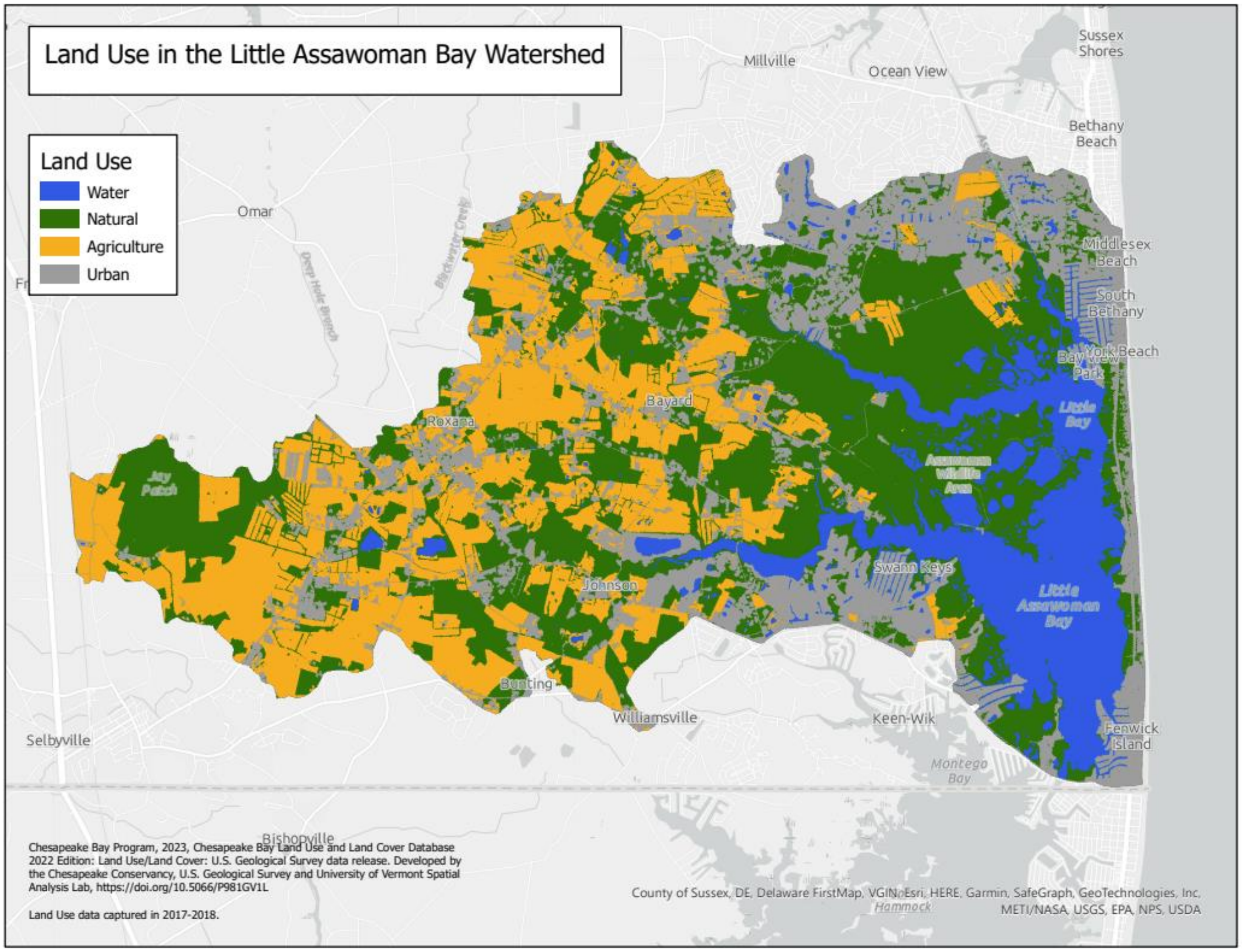


Figure 1: 2017-2018 Land Use of the Little Assawoman Bay Watershed

There are two major tributaries entering the Little Assawoman Bay, smaller Miller Creek, and the larger Dirickson Creek as shown in Figure 2. Miller Creek is positioned to the north of the Little Assawoman Bay, with a drainage area of approximately 99 acres. Dirickson Creek is positioned south and has a drainage area of approximately 1,359 acres. Much of the land area surrounding the Little Assawoman Bay and the creeks draining to it contain medium to high intensity developed land. In addition to the developed land, there are 7,897 acres of land dedicated to crops, and 5,199 acres of forested area. One major nonpoint source area positively affecting the Bay is the Assawoman Wildlife Area, which is dominated by wetlands. Fenwick Island borders the Bay to the east, and a smaller area of nonpoint source runoff is located at the southeast corner of the Bay near the southern inlet, where there is a developed land area along the beach to the west of U.S. Route 1. Erosion, sedimentation, and delivery of other nonpoint source pollutants such as nutrients from stormwater runoff also contribute to degradation of water quality.

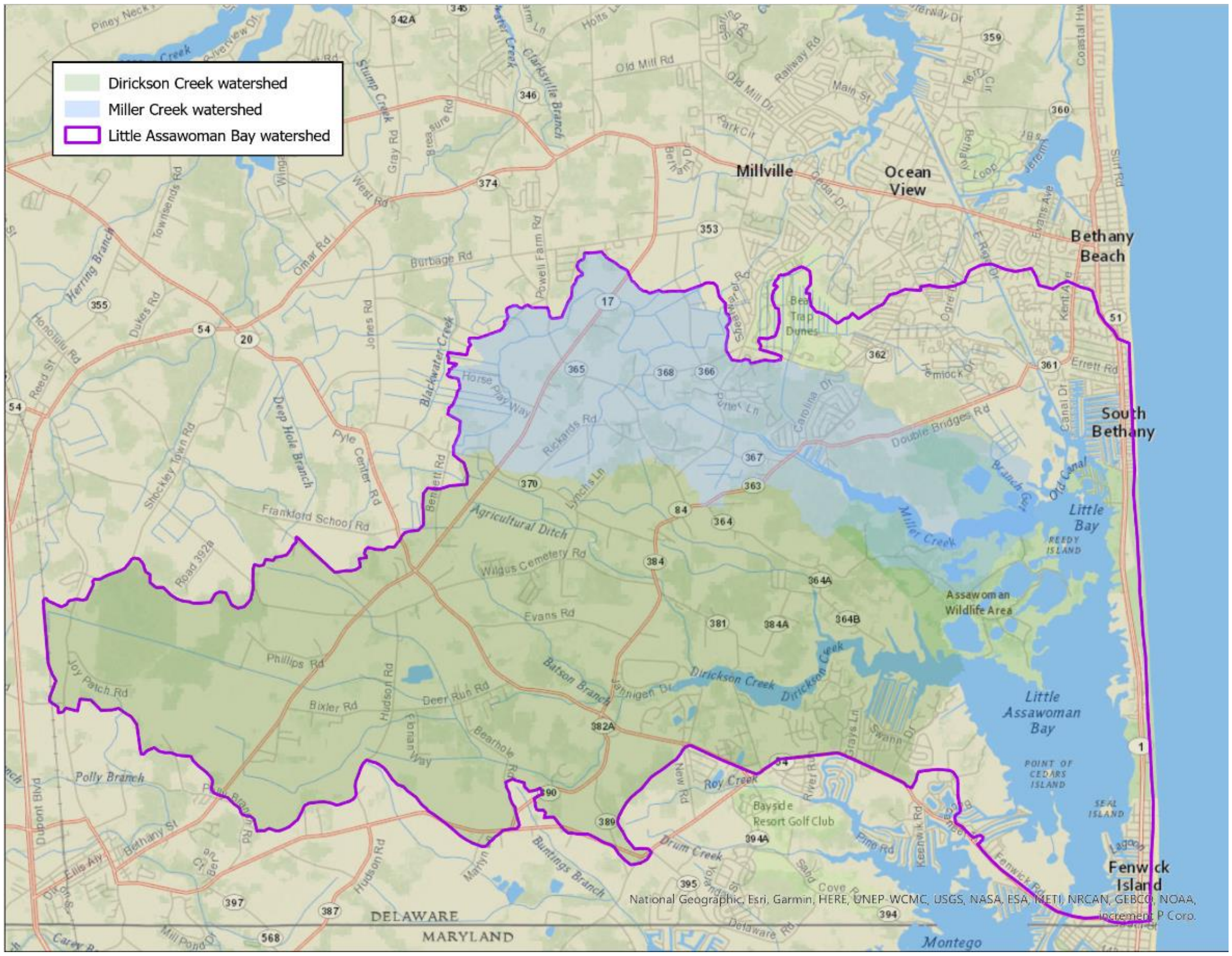


Figure 2: Little Assawoman Bay Watershed and its Tributaries

The designated uses of the Little Assawoman Bay are industrial water supply; primary contact recreation; secondary contact recreation; fish, aquatic life, and wildlife (including shellfish propagation); and exceptional recreational or ecological significance (ERES) waters, with some freshwater segments used as agricultural water supply. Primary contact recreation is any water-based recreation that involves total body immersion. Examples include swimming and kite boarding. Secondary contact recreation refers to water-based recreation that has a low likelihood for total body immersion. Examples of this include wading, boating, and fishing.

Nonpoint sources are identified in the TMDL as the most likely sources of pollution. Of those, ammonia, copper, dissolved oxygen (DO), enterococcus, habitat, nutrients, total suspended solids (TSS), and zinc are noted stressors. Table 1 lists the segments of the Little Assawoman Bay watershed, and the probable sources of impairment according to the 2022 State of Delaware Integrated 305(b)-303(d) Report. This plan addresses impairments for nutrients (nitrogen and phosphorus) and sediment. There are no identified point sources in the Little Assawoman Bay drainage area.

Table 1: Creeks and Waterbodies Flowing to Little Assawoman Bay and Their Primary Pollutants.

Segment	Description	Size	Pollutant or Stressor
Miller Creek	From the headwaters of Miller Creek to the confluence with Little Assawoman Bay	4.1 miles	DO Nutrients Enterococcus
	Beaver Dam Ditch—from the confluence of Blackwater Creek to the confluence with the next larger stream order	5.2 miles	DO Enterococcus Nutrients TSS Ammonia Zinc Habitat
Dirickson Creek	From the headwaters of Dirickson Creek to the confluence with Little Assawoman bay	3.7 miles	TSS Zinc Copper Enterococcus DO Nutrients
	Bearhole Ditch—from the confluence of the headwaters to the confluence with Batson Branch	2.5 miles	Habitat
	Agricultural Ditch—from the confluence of the headwaters to the confluence with Dirickson Creek	3 miles	Habitat
Little Assawoman Bay	Estuary from the confluence with Assawoman Canal to the confluence with Assawoman Bay	2.4 sq. mi.	Zinc TSS Enterococcus DO Copper

The land use and annual average loads were quantified using the DTAP model and include the estimated effect of existing management measures tracked through Delaware's BMP Tracker tool for practices implemented through June 30, 2022. These management practice data are updated in DTAP annually for the year July 1 through June 30. The estimated 2022 total loads are summarized in Table 2.

Table 2: Total Nitrogen (TN), Total Phosphorus (TP), and Total Suspended Sediment (TSS) in the Little Assawoman Bay, Apportioned by Land Use. Percentages are the percent of the total loads in each land use.

Land Use	TN (lbs/yr)	TN (%)	TP (lbs/yr)	TP (%)	TSS (lbs/yr)	TSS (%)
Agriculture	272,767	63%	4,510	46%	2,323,472	63%
Ag Open Land	0	0%	0	0%	0	0%
Cultivated Crops	217,472	50%	2,524	26%	2,200,990	59%

Land Use	TN (lbs/yr)	TN (%)	TP (lbs/yr)	TP (%)	TSS (lbs/yr)	TSS (%)
Pasture/Hay	5,378	1%	375	4%	119,119	3%
Production Area	49,917	11%	1,612	17%	3,363	0.09%
Developed	111,132	26%	4,073	42%	191,311	5%
Commercial	31,777	7%	701	7%	370,181	10%
Construction	7,859	2%	544	6%	299,258	8%
Highway	16,747	4%	356	4%	157,654	4%
Multi-Family Residential	8,493	2%	380	4%	72,069	2%
Single Family Residential	46,257	11%	2,093	22%	288,670	8%
Natural	32,455	7%	1,148	12%	191,311	5%
Forest	7,446	2%	107	1%	10,788	0.29%
Harvested Forest	1,273	0.29%	7	0.07%	3,062	0.08%
Open Space	3,357	1%	106	9%	172,822	5%
Water	17,133	4%	883	9%	0	0%
Wetland	3,247	1%	46	0.47%	4,639	0.13%
Septic	18,711	4%	0	0%	0	0%

Agriculture

The agricultural sector is comprised of crop, pasture/hay, and animal production areas. Crop area includes soybeans, small grains and grains, silage, corn, specialty crops, and other agronomic crops including vegetables. The pasture/hay sector includes pasture, leguminous hay, and other hay. Animal production area includes both permitted and non-permitted feeding spaces.

Cropland accounts for 80% of the total delivered nitrogen, 56% of the total delivered phosphorus, and 95% of the total delivered suspended sediment within the agricultural sector using the source assessment model, DTAP, described in Appendix A. For this reason, cropland is a crucial load source with high recovery potential.

Developed

The developed sector in the Little Assawoman Bay is comprised of commercial, construction, highway, and residential land area. Residential areas account for about half the total nitrogen and phosphorus loads in the developed sector using the source assessment model, DTAP, described in Appendix A. As the most significant single source of nutrient loads, residential land uses should be targeted for load reduction.

Natural

Natural land is a low-loading source sector. Natural land includes forest, harvested forest, open space, water, and wetlands. Many management measures seek to convert higher loading land uses to natural area because of their low loading rates. Maintaining, protecting, and increasing natural lands is one of the goals in this plan. The total nitrogen from forested land is 2%, and total phosphorus is 1%, of the total loads in the Little Assawoman Bay watershed.

Septic

An on-site wastewater treatment and disposal system – known commonly as a septic system – is a wastewater treatment facility located within property boundaries that collects, treats, and disposes of wastewater from a home or business. This is different from a municipal wastewater treatment facility which receives wastewater from multiple locations for treatment.

Summary

The most critical sources of nitrogen, phosphorus, and sediment in the Little Assawoman Bay watershed are residential in the developed sector and cropland in the agricultural (Table 2). For this reason, these land uses should be targeted for potential load reductions. Table 3 summarizes the loads in the Little Assawoman watershed as well as the headwater areas that drain into the Little Assawoman Bay. These load estimates include all management practices implemented through June 30, 2022. The loads shown in the table for Little Assawoman Bay are a sum of Miller Creek, Dirickson Creek, and the remaining land in the Little Assawoman Bay watershed. The data in the table was calculated using DTAP.

Table 3: Estimated Nitrogen, Phosphorus, and Suspended Sediment Loads for Both Headwater Creeks in the Little Assawoman Bay for the Year 2022

Sources	Total Nitrogen Delivered (lbs/yr)	Total Phosphorus Delivered (lbs/yr)	Total Suspended Sediment Delivered (lbs/yr)
Miller Creek			
Agriculture	15,856	280	136,593
Developed	11,990	481	137,328
Natural	5,460	184	29,089
Septic	3,472	0	0
Total	36,777	945	303,011
Dirickson Creek			
Agriculture	17,931	328	156,138
Developed	18,113	659	195,260
Natural	5,778	241	17,667
Septic	3,952	0	0
Total	45,773	1,228	369,065
Little Assawoman Bay			
Agriculture	205,193	3,294	1,738,010
Developed	50,926	1,793	522,655
Natural	9,980	298	97,799
Septic	3,864	0	0
Total	269,963	5,385	2,358,464
Little Assawoman Bay Total			
Agriculture	238,980	3,902	2,030,741
Developed	81,029	2,933	855,243
Natural	21,218	723	144,555
Septic	11,288	0	0

Total	352,515	7,558	3,030,539

Expected Load Reductions (b)

According to the Total Maximum Daily Loads (TMDLs) for the Little Assawoman Bay and Tributaries and Ponds of the Indian River, Indian River Bay, and Rehoboth Bay, the Little Assawoman Bay was assigned a 40% nitrogen, phosphorus, and sediment reduction from the 1990 baseline year. TMDLs were also established for Miller Creek and Dirickson Creek segments. The reductions proposed in this section meet or exceed the allocations for the Little Assawoman Bay TMDL. The target loads in this plan are calculated as an annual average load to account for seasonality in runoff. An example of this seasonality effect is seen in heavy rains that can occur soon after spring planting and fertilizer application.

With the implementation of existing management practices, estimated TN loads were reduced from 443,484 lbs/yr to 435,065 lbs/yr between the TMDL creation date of 1990 and 2022. This is a 2% reduction. By extending the timeframe to 2030, there is more time to implement management practices to reduce the pollutant load. With the proposed management practices, the agricultural TN load can be further reduced from 272,767 in 2022 to 123,019 pounds per year in 2030, less than half of the initial load. The TN load in the developed sector was the second largest load and can be reduced from 111,132 in 2022 to 62,976 pounds per year in 2030 (Table 4). Due to land use changes, the TN loads in the natural sector will increase, but with overall reductions among all sectors, the Little Assawoman Bay TMDL of 40% reduction for TN is met.

Table 4: Past, Current, Target, and Expected TN Loads by Source Sector in the Little Assawoman Bay

Sector	1990 TN (lbs/yr)	2022 TN (lbs/yr)	TMDL Allocation TN (lbs/yr)	2030 TN (lbs/yr)	TN Reduction Required (lbs/yr)
Agriculture	325,563	272,767	195,338	123,019	130,225
Developed	74,601	111,132	44,760	62,976	29,841
Natural	41,874	32,455	25,125	38,875	16,749
Septic	1,446	18,711	867	17,711	579
Total	443,484	435,065	266,090	243,581	177,394

Turning to TP, the implementation of existing management practices has reduced the TP from 11,406 lbs/yr to 9,731 lbs/yr between 1990 when the TMDL was established and 2022. This is a 15% reduction. To meet the required 40% reduction in TP, we propose extending the deadline to 2030 to implement additional management practices that will reduce the estimated TP lbs/yr to a 51% reduction from the 1990 estimated load. The agricultural TP loads in the Little Assawoman Bay can be reduced from 4,510 in 2022 to 2,498 pounds per year in 2030. Developed TP loads can be reduced from 4,073 in 2022 to 2,131 pounds per year in 2030 (Table 5). With these reductions, the Little Assawoman Bay TMDL of 40% reduction for TP is met.

Table 5: Past, Current, Target, and Expected TP Loads by Source Sector in the Little Assawoman Bay

Sector	1990 TP (lbs/yr)	2022 TP (lbs/yr)	TMDL Allocation TP (lbs/yr)	2030 TP (lbs/yr)	TP Reduction Required (lbs/yr)
Agriculture	7,594	4,510	4,557	2,498	3,037
Developed	2,554	4,073	1,532	2,131	1,022
Natural	1,258	1,148	755	1,015	503
Total	11,406	9,731	6,844	5,644	4,562

Between 1990 and 2022, an estimated 333,400 lbs/yr of TSS was reduced, or 8%. To meet the required 40% reduction in the TMDL, this plan includes management practices that will reduce the TSS load by 2,283,936 between 1990 and 2030, which is 57% and meets the TMDL requirement. The TSS load from agriculture can be reduced from 2,323,472 in 2022 to 789,895 pounds per year in 2030. The developed TSS load can be reduced from 1,187,832 in 2022 to 777,128 pounds per year in 2030 (Table 6). With these reductions, the Little Assawoman Bay TMDL of 40% reduction for TSS is met.

Table 6: Past, Current, Target, and Expected TSS Loads by Source Sector in the Little Assawoman Bay

Sector	1990 TSS (lbs/yr)	2022 TSS (lbs/yr)	TMDL Allocation TSS (lbs/yr)	2030 TSS (lbs/yr)	TSS Reduction Required (lbs/yr)
Agriculture	3,206,830	2,323,472	1,924,098	789,895	1,282,732
Developed	624,384	1,187,832	374,630	777,128	249,754
Natural	204,802	191,311	122,881	185,056	81,921
Total	4,036,016	3,702,616	2,421,610	1,752,080	1,614,406

A summary of the estimated, projected load reductions by 2030 for each land use is outlined in Table 7. Assuming total BMP implementation, these are the predicted surface runoff reductions. It will take longer, however, for the downstream surface and groundwater loads to decrease pollutant concentrations, and therefore for load reductions to be reflected in the monitored loads (Denver, 2010). The predicted load reductions are lower than the TMDL targets to account for possible variations in management practice effectiveness. Though there are not individual targets for Miller and Dirickson Creeks, the loads have been broken down to these creeks to provide a sense of the impact of management practice distribution across the entire watershed. The Little Assawoman Bay is the total of the entire watershed, including Miller and Dirickson Creeks.

Table 7: TMDL, Current (2022), and Projected (2030) Nitrogen, Phosphorus, and Sediment Load Reductions for Each of the Creeks and Waterbodies in the Little Assawoman Bay Assuming Full BMP Implementation

Land Use	TN Reduction Required by TMDL (lbs/yr)	2022 TN Reduction (lbs/yr)	2030 TN Reduction (lbs/yr)	TP Reduction Required by TMDL (lbs/yr)	2022 TP Reduction (lbs/yr)	2030 TP Reduction (lbs/yr)	TSS Reduction Required by TMDL (lbs/yr)	2022 TSS Reduction (lbs/yr)	2030 TSS Reduction (lbs/yr(
Miller Creek									
Agriculture	7,652	3,275	12,067	184	180	309	75,910	53,181	145,261
Ag Open Land	22	-54	54	1	3	3	46	116	116
Cultivated Crops	6,009	2,620	10,934	108	125	221	69,166	47,219	128,855
Pasture/Hay	298	252	730	25	28	61	6,596	5,792	16,236
Production Area	1,323	349	349	50	24	24	101	54	54
Developed	3,568	-3,070	2,586	132	-151	90	30,323	-61,520	-12,630
Commercial	1,064	208	286	22	-10	2	11,562	-5,153	1,514
Construction	0	1,150	-1,150	0	-81	-81	0	-44,501	-42,782
Highway	517	-105	416	10	-5	7	4,535	-2,024	3,548
Multi-Family Residential	504	-278	1,259	25	-8	63	4,501	-2,088	11,253
Single Family Residential	1,483	-1,329	1,775	74	-48	100	9,725	-7,755	13,838
Natural	2,670	1,216	409	76	6	37	11,744	270	7,971
Forest	740	215	150	10	2	24	1,031	195	2,578
Harvested Forest	115	6	23	1	-0.032	1	268	-14	669
Open Space	206	24	-679	6	0.018	2	10,207	29	4,129

Land Use	TN Reduction Required by TMDL (lbs/yr)	2022 TN Reduction (lbs/yr)	2030 TN Reduction (lbs/yr)	TP Reduction Required by TMDL (lbs/yr)	2022 TP Reduction (lbs/yr)	2030 TP Reduction (lbs/yr)	TSS Reduction Required by TMDL (lbs/yr)	2022 TSS Reduction (lbs/yr)	2030 TSS Reduction (lbs/yr(
Water	1,437	911	911	57	4	4	0	0	0
Wetland	171	61	5	2	1	6	238	61	595
Septic	192	-2,992	-2,992	0	0	0	0	0	0
Miller Creek Total	14,802	-1,571	12,070	392	35	436	117,977	-8,069	140,602
Dirickson Creek									
Agriculture	12,312	12,850	22,812	320	473	629	125,222	156,918	263,332
Ag Open Land	35	88	88	2	5	5	76	189	189
Cultivated Crops	9,261	9,349	18,596	166	255	361	106,601	126,606	217,394
Pasture/Hay	831	1,338	2,053	69	121	171	18,378	29,932	45,559
Production Area	2,185	2,074	2,074	83	91	91	167	190	190
Developed	3,702	-8,858	-1,186	129	-337	-24	31,817	-115,718	-48,085
Commercial	1,305	-2,697	-1,672	27	-67	-43	14,169	-35,291	-21463
Construction	0	-1,103	-1,103	0	-78	-78	0	-42,703	-41,055
Highway	605	-1,150	-157	12	-28	-6	5,316	-12,194	-1,581
Multi-Family Residential	244	-665	611	12	-28	30	2,183	-5,616	5,458
Single Family Residential	1,547	-3,243	1,136	78	-136	72	10,149	-19,914	10,556
Natural	3,480	2,922	1,937	119	56	59	8,031	2,412	-14,645
Forest	539	256	174	7	3	17	751	286	1,878

Land Use	TN Reduction Required by TMDL (lbs/yr)	2022 TN Reduction (lbs/yr)	2030 TN Reduction (lbs/yr)	TP Reduction Required by TMDL (lbs/yr)	2022 TP Reduction (lbs/yr)	2030 TP Reduction (lbs/yr)	TSS Reduction Required by TMDL (lbs/yr)	2022 TSS Reduction (lbs/yr)	2030 TSS Reduction (lbs/yr(
Harvested Forest	84	21	32	0.429	0.067	1	194	30	486
Open Space	143	56	-828	4	1	-12	7,054	2,087	-17,087
Water	2,692	2,581	2,581	106	52	52	0	0	0
Wetland	23	9	-22	0.313	0.091	1	31	9	78
Septic	169	-3,528	-3,528	0	0	0	0	0	0
Dirickson Creek Total	19,664	3,386	20,034	568	192	663	165,071	43,612	200,602
Little Assawoman Bay									
Agriculture	130,225	52,796	202,544	3,3038	3,084	5,096	1,282,732	883,359	2,416,935
Ag Open Land	372	929	929	20	49	49	780	1,949	1,949
Cultivated Crops	102,978	39,973	184,535	1,841	2,078	3,727	1,182,360	754,910	2,172,869
Pasture/Hay	4,380	5,573	10,752	361	528	890	97,871	125,558	241,175
Production Area	22,495	6,321	6,328	816	429	429	1,722	941	941
Developed	29,840	-36,532	11,625	1,022	-1,519	422	249,753	-563,448	-152,745
Commercial	9,725	-7,464	-2,113	196	-210	-89	130,567	-111,264	-40,744
Construction	0	-7,859	-7,859	0	-544	-544	0	-299,258	-287,809
Highway	5,318	-3,451	2,706	104	-97	38	45,938	-42,810	21,928
Multi-Family Residential	2,282	-2,786	5,652	110	-104	274	19,933	-22,235	49,418

Land Use	TN Reduction Required by TMDL (lbs/yr)	2022 TN Reduction (lbs/yr)	2030 TN Reduction (lbs/yr)	TP Reduction Required by TMDL (lbs/yr)	2022 TP Reduction (lbs/yr)	2030 TP Reduction (lbs/yr)	TSS Reduction Required by TMDL (lbs/yr)	2022 TSS Reduction (lbs/yr)	2030 TSS Reduction (lbs/yr(
Single Family Residential	12,514	-14,972	13,239	611	-565	743	80,315	-87,881	104,464
Natural	16,750	9,419	243	503	110	242	81,921	13,491	19,745
Forest	3,419	1,103	448	47	10	106	4,738	1,058	11,807
Harvested Forest	530	53	127	3	-0.001	7	1,224	-1	3,058
Open Space	1,505	405	-4,967	45	7	-8	73,988	12,147	-37
Water	9,853	7,500	7,500	389	90	90	0	0	0
Wetland	1,442	359	-109	20	3	48	1,971	288	4,918
Septic	578	-17,265	-17,265	0	0	0	0	0	0
Little Assawoman Bay Total	**177,393**	**8,419**	**199,902**	**4,562**	**1,675**	**5,762**	**1,614,406**	**333,400**	**2,283,936**

In the agricultural sector, most load reductions will come from cultivated crops. Nutrient management, as well as cover crops and grass buffers will be highly utilized to reach these target loads.

In the developed sector, most of the TN and TP load reductions will come from commercial, highway, and residential land uses. Grass buffers and runoff reduction will be highly utilized to reach these target loads.

The natural sector contains low-loading land uses. Therefore, there will be an increase in the nitrogen loads in this sector due to other, higher-loading land uses, being converted to forest. Forests in the natural sector are wooded areas that will help filter nutrients, sediment, and other pollutants.

The next section of this plan describes the management actions and resources to achieve these targets.

Proposed Management Measures (c)

Best management practices (BMPs) are implemented to reduce the nitrogen, phosphorus, and sediment loads to achieve the TMDL for the Little Assawoman Bay. The recommended new and increased level of BMP implementations will work in conjunction with BMPs that are already on the ground to achieve the load reductions required to meet the TMDL. Current and planned implementation includes all BMPs that have been implemented and active through June 30, 2022, and accounts for operation and maintenance, as well as replacement of existing BMPs when they fail.

Each BMP provides a nitrogen, phosphorus, and sediment load reduction. An annual pollutant load that reaches the Little Assawoman Bay TMDL is estimated for each source sector, considering the BMPs already implemented. The nutrient reductions have been calculated using DTAP. While the DTAP model includes land use changes, it is not predictive of changes due to crop prices, fertilizer prices, cost of construction, and other economic factors. Therefore, an adaptive approach to decision making will ensure changes in land use and land management address changes in pollutant loading. An adaptive management approach takes into consideration elements such as impacts of land change and climate variability, economic constraints, and resource leverage, making the plan flexible to the changing needs and support available as time progresses. For example, if funding or willingness to implement one BMP is constrained, but there is increased interest in an alternative BMP, then the amplified adaptation of one BMP may balance out the effects of lesser implementation of the other. It is also expected that new technology and innovations will be explored as they become available. Thresholds to be considered to trigger adaptation are amount of BMP implementation being met by milestone dates and the modeled and monitored load reductions from the BMPs implemented each year.

This section describes the suggested level of BMP implementation required to reach the target loads. The BMPs have differing effects when stacked on the same acre of land. Overall, BMPs work as a treatment train, and those interaction effects have been accounted for in the modeled loads. As such, the nitrogen, phosphorus, and sediment loads for the overall plan are shown in aggregate by land use, not by BMP. However, the expected load reduction if each BMP were implemented in isolation is shown as part of the description of each BMP.

Agriculture

The plan for the agricultural sector includes 12 BMPs that reduce nitrogen, phosphorus, and sediment loads. The use of existing practices will continue and be expanded upon or enhance newly planned BMPs. For example, **manure transport** is currently taking place and any additional manure transport is expected to enhance the plan beyond the specific targets. BMPs are apportioned to where there is most available land, knowing that an adaptive approach to planning will be utilized. For example, landowners must be willing to implement practices, and targeting is based on both optimal load reduction as well as willing landowners. Therefore, most of the change occurs in the remaining Little Assawoman Bay instead of Miller or Dirickson. The most impact in the Little Assawoman Bay comes downstream from Miller and Dirickson Creeks. Table 8 outlines the current and recommended agricultural BMPs for each of the creeks and waterbodies in the Little Assawoman Bay watershed. The practices in Table 8 include:

- **Conservation Plans** – Farm conservation plans are a combination of agronomic, management and engineered practices that protect and improve soil productivity and water quality, and to prevent deterioration of natural resources on all or part of a farm. Plans must meet technical standards. If implemented in isolation, not as a treatment train, a 5% nitrogen, 10% phosphorus, and 16% sediment reduction is expected.
- **Cover Crop** – A short-term crop grown after the main cropping season that reduces nutrient losses to ground and surface water by sequestering nutrients. If implemented in isolation, not as a treatment train, a 24% nitrogen, 7% phosphorus, and 10% sediment reduction is expected.

- **Ditch Controls** – A structure that diverts agricultural tile-drainage water to pass through a media chamber filled with a carbon source for denitrification of dissolved nitrate to occur. If implemented in isolation, not as a treatment train, an 18% nitrogen, and 27% phosphorus reduction is expected. There are many types of ditch controls depending on site design. However, they are all expected to have a similar pollutant load reduction.
- **Forest Buffers and Tree Planting** – Forest buffers are linear wooded areas that help filter nutrients, sediments and other pollutants from runoff as well as remove nutrients from groundwater. The recommended buffer width is 100 feet, with a 35 feet minimum width. Narrow, 10-foot buffers, are also an option, but are less effective. Buffers between 10 and 100 feet may be utilized, but they must have a 10-foot minimum to be effective. A single forest buffer may have a variation of widths along a stream, as a stream curves and the outward edge of the buffer remains straight. Both narrow and wide buffers are used in the BMP acres implemented and load reduction estimations. Tree planting can also occur in various environments to create canopy. If implemented in isolation, not as a treatment train, a 65% nitrogen, 42% phosphorus, and 56% sediment reduction is expected. Buffers are measured and reported in total acres, calculated from a length and a width.
- **Grass Buffer** – Grass buffers are linear strips of grass or other non-woody vegetation maintained to help filter nutrients, sediment, and other pollutants from runoff. The recommended buffer width for buffers is 100 feet, with a 35 feet minimum width. Narrow, 10-foot buffers, are also an option, but are less effective. Buffers between 10 and 100 feet may be utilized, but they must have a 10-foot minimum to be effective. A single buffer may have a variation of widths along a stream, as a stream curves and the outward edge of the buffer remains straight. Both narrow and wide buffers are used in the BMP acres implemented and load reduction estimations. If implemented in isolation, not as a treatment train, a 46% nitrogen, 42% phosphorus, and 56% sediment reduction is expected. Buffers are measured and reported in total acres, calculated from a length and a width.
- **Land Retirement** – Converts land area to pasture or hay without nutrients. Agricultural land retirement takes marginal and highly erosive cropland out of production by planting permanent vegetative cover such as shrubs, grasses, and/or trees. This BMP changes a higher loading land use, to a lower loading land use.
- **Nutrient Management** – The nutrient management BMP includes 6 elements that reduce nitrogen and phosphorus: 1) application rate modification; 2) P soil test used in plan; 3) manure analysis used in plan; 4) spreader must be calibrated within one year; 5) yield estimates used in plan; 6) legume residual N credits and manure mineralization are credited as part of the plan. It should be recognized that some level of nutrient loss to surface and groundwater will occur even by following the recommendations in a nutrient management plan, which is accounted for in the conservative modeled load reductions. If implemented in isolation, not as a treatment train, a 10% nitrogen, and 17% phosphorus reduction is expected.
- **Pasture Management** – Pasture management is defined as maintaining a 50% pasture cover with managed species (desirable, inherent) and managing high traffic areas. If implemented in isolation, not as a treatment train, an 8.5% nitrogen, 18% phosphorus, and 30% sediment reduction is expected.

- **Streambank Fencing** – Prevents livestock from entering the stream. If implemented in isolation, not as a treatment train, a 0.0008% nitrogen, 0.0991% phosphorus, and 0.0885% sediment reduction is expected.
- **Tillage Management** – Tillage management eliminates soil disturbance from deep plows. If implemented in isolation, not as a treatment train, a 6% nitrogen, 30% phosphorus, and 46% sediment reduction is expected.
- **Waste Management System** – Any structure designed for collection, transfer and storage of manures and associated wastes generated from the confined portion of animal operations and complies with NRCS 313 (Waste Storage Facility) or NRCS 359 (Waste Treatment Lagoon) practice standards. If implemented in isolation, not as a treatment train, a reduction of 0.48979 pounds of nitrogen and 0.01676 pounds of phosphorus per animal unit is expected.
- **Wetland Creation/Restoration** - Establish, re-establish, or create wetlands in a floodplain by manipulation of the physical, chemical, or biological characteristics to develop a wetland where one did or did not previously exist. If implemented in isolation, not as a treatment train, a 42% nitrogen, 40% phosphorus, and 31% sediment reduction is expected.

Table 8: Agricultural BMP Implementation, Current and Planned, for Each of the Creeks and Waterbodies in the Little Assawoman Bay

BMP	Unit	Current 2022 Implementation	Planned NEW 2030 Implementation	Total Implementation
Miller Creek				
Conservation Plans	acres	6	66	72
Cover Crop	acres	99	156	156
Ditch Controls	acres	2	66	68
Ag Forest Buffer	acres	3	14	17
Ag Grass Buffer	acres	4	133	137
Land Retirement	acres	4	66	70
Nutrient Management	acres	256	0	256
Pasture Management	acres	2	9	11
Streambank Fencing	feet	78	67	145
Tillage Management	acres	1	0	1
Waste Management System	count	111	0	111
Wetland Creation/Restoration	acres	23	13	36
Dirickson Creek				
Conservation Plans	acres	6	78	84
Cover Crop	acres	110	174	174
Ditch Controls	acres	3	77	80
Ag Forest Buffer	acres	4	15	19
Ag Grass Buffer	acres	5	155	160
Land Retirement	acres	4	78	82
Nutrient Management	acres	284	0	284
Pasture Management	acres	3	14	17

BMP	Unit	Current 2022 Implementation	Planned NEW 2030 Implementation	Total Implementation
Streambank Fencing	feet	117	77	194
Tillage Management	acres	1	0	1
Waste Management System	count	127	0	127
Wetland Creation/Restoration	acres	26	15	41
Remaining Little Assawoman Bay				
Conservation Plans	acres	85	946	1,031
Cover Crop	acres	1,529	2,398	2,398
Ditch Controls	acres	15	946	961
Ag Forest Buffer	acres	48	189	237
Ag Grass Buffer	acres	58	1,891	1,949
Land Retirement	acres	59	945	1,004
Nutrient Management	acres	3,934	4	3,938
Pasture Management	acres	17	76	93
Streambank Fencing	feet	637	946	1,583
Tillage Management	acres	10	5	15
Waste Management System	count	1,636	5	1,641
Wetland Creation/Restoration	acres	335	190	525
Total Little Assawoman Bay				
Conservation Plans	acres	97	1,090	1,187
Cover Crop	acres	1,738	2,728	2,728
Ditch Controls	acres	20	1,089	1,109
Ag Forest Buffer	acres	55	218	273
Ag Grass Buffer	acres	67	2,179	2,246
Land Retirement	acres	67	1,089	1,156
Nutrient Management	acres	4,474	4	4,478
Pasture Management	acres	22	99	121
Streambank Fencing	feet	832	1,090	1,922
Tillage Management	acres	12	5	17
Waste Management System	count	1,874	0	1,879
Wetland Creation/Restoaration	acres	384	218	602

Developed

The developed sector will make use of 8 BMPs to reduce nitrogen, phosphorus, and sediment loads. The recommended BMPs and their implementation amounts are outlined in Table 9. BMPs are apportioned to where there is most available land, knowing that an adaptive management plan will be utilized.

Therefore, most of the change occurs in the remaining Little Assawoman Bay instead of Miller or Dirickson Creeks. The most impact in the Little Assawoman Bay comes downstream from Miller and Dirickson Creeks. The practices include:

- **Erosion and Sediment (E&S) Control Level 2** – This level of performance reflects the more stringent erosion and sediment control requirements that have been adopted by Delaware's Sediment and Stormwater Program and conforms to the standard requirements in EPA's 2012 Construction General Permit. These include sediment treatment capacity (typically 3,600 cubic feet/acre), surface outlets, more rapid vegetative cover for temporary and permanent stabilization, and improved design specifications for individual erosion and sediment control practices to enhance sediment trapping or removal. If implemented in isolation, not as a treatment train, an 85% sediment reduction is expected.
- **Forest Buffers and Tree Planting** – Forest buffers are linear wooded areas that help filter nutrients, sediments and other pollutants from runoff as well as remove nutrients from groundwater. The recommended buffer width is 100 feet, with a 35 feet minimum width. Narrow, 10-foot buffers, are also an option, but are less effective. Buffers between 10 and 100 feet may be utilized, but they must have a 10-foot minimum to be effective. A single forest buffer may have a variation of widths along a stream, as a stream curves and the outward edge of the buffer remains straight. Both narrow and wide buffers are used in the BMP acres implemented and load reduction estimations. Urban tree planting is another practice which falls under the grass buffer BMP type. Tree planting can also occur in various environments to create canopy. This BMP changes a higher loading land use, to a lower loading land use. Buffers are measured and reported in total acres, calculated from a length and a width.
- **Grass Buffer** – Grass buffers are linear strips of grass or other non-woody vegetation maintained to help filter nutrients. The recommended buffer width for buffers is 100 feet, with a 35 feet minimum width. Narrow, 10-foot buffers, are also an option, but are less effective. Buffers between 10 and 100 feet may be utilized, but they must have a 10-foot minimum to be effective. A single buffer may have a variation of widths along a stream, as a stream curves and the outward edge of the buffer remains straight. Both narrow and wide buffers are used in the BMP acres implemented and load reduction estimations. If implemented in isolation, not as a treatment train, a 46% nitrogen, 42% phosphorus, and 56% sediment reduction is expected. Buffers are measured and reported in total acres, calculated from a length and a width.
- **Impervious surface elimination to pervious surface** – Reducing impervious surfaces to promote infiltration and percolation of runoff storm water. This BMP changes a higher loading land use, to a lower loading land use.
- **Nutrient Management** – An urban nutrient management plan is a written, site-specific plan which addresses how the major plant nutrients (nitrogen, phosphorus, and potassium) are to be annually managed for expected turf and landscape plants and for the protection of water quality. The goal of an urban nutrient management plan is to minimize adverse environmental effects, primarily upon water quality, and avoid unnecessary nutrient applications. It should be recognized that some level of nutrient loss to surface and groundwater will occur even by following the recommendations in a nutrient management plan, which is accounted for in the conservative modeled load reductions. If implemented in isolation, not as a treatment train, a 10% nitrogen, and 17% phosphorus reduction is expected.

- **Runoff Reduction** – Total post-development runoff volume that is reduced through canopy interception, soil amendments, evaporation, rainfall harvesting, engineered infiltration, extended filtration or evapo-transpiration. Stormwater practices that achieve at least a 25% reduction of the annual runoff volume are classified as providing runoff reduction, and therefore earn a higher net removal rate. **Conservation landscaping** is an example of runoff reduction and falls under this BMP type. Nutrient and sediment reduction value is based on inches treated, impervious acres, and total acres treated.
- **Stormwater Treatment** – Total post-development runoff volume that is reduced through a permanent pool, constructed wetlands or sand filters have less runoff reduction capability, and their removal rate is lower than runoff reduction. Nutrient and sediment reduction value is based on inches treated, impervious acres, and total acres treated.
- **Wetland Creation/Restoration** – Establish, re-establish, or create wetlands in a floodplain by manipulation of the physical, chemical, or biological characteristics to develop a wetland where one did or did not previously exist. If implemented in isolation, not as a treatment train, a 42% nitrogen, 40% phosphorus, and 31% sediment reduction is expected.

Table 9: Developed BMP Implementation, Current and Planned, for Each of the Creeks and Waterbodies in the Little Assawoman Bay

BMP	Unit	Current 2022 Implementation	Planned NEW 2030 Implementation	Total Implementation
Miller Creek				
E&S Level 2	acres	0	1	1
Developed Forest Buffer	acres	0.017	63	63
Developed Grass Buffer	acres	0	348	348
Impervious surface elimination to pervious surface	acres	0	20	20
Nutrient Management	acres	0	0	0
Runoff Reduction	acres	.365	129	129
Stormwater Treatment	acres	7	112	119
Wetland Creation/Restoration	acres	0	44	44
Dirickson Creek				
E&S Level 2	acres	0	0	1
Developed Forest Buffer	acres	.025	69	69
Developed Grass Buffer	acres	0	458	458
Impervious surface elimination to pervious surface	acres	0	19	19

BMP	Unit	Current 2022 Implementation	Planned NEW 2030 Implementation	Total Implementation
Nutrient Management	acres	0	0	0
Runoff Reduction	acres	.533	192	192
Stormwater Treatment	acres	10	160	170
Wetland Creation/Restoration	acres	0	54	54
Remaining Little Assawoman Bay				
E&S Level 2	acres	0	8	8
Developed Forest Buffer	acres	.919	303	304
Developed Grass Buffer	acres	0	2,057	2,057
Impervious surface elimination to pervious surface	acres	0	80	80
Nutrient Management	acres	0	8	8
Runoff Reduction	acres	15	866	881
Stormwater Treatment	acres	83	737	820
Wetland Creation/Restoration	acres	0	238	238
Total Little Assawoman Bay				
E&S Level 2	acres	0	10	10
Developed Forest Buffer	acres	1	435	436
Developed Grass Buffer	acres	0	2,863	2,863
Impervious surface elimination to pervious surface	acres	0	119	119
Nutrient Management	acres	0	8	8
Runoff Reduction	acres	16	1,186	1,202
Stormwater Treatment	acres	100	1,009	1,109
Wetland Creation/Restoration	acres	0	336	336

Natural

Four BMPs are planned to reduce nitrogen, phosphorus, and sediment loads in the natural sector. These BMPs will enhance the existing natural landscape's ecological function in the watershed. The breakdown of recommended natural BMPs is outlined in Table 10. The natural sector includes forests, wetlands, and open space. The practices include:

- **Forest Buffer** - Forest buffers are linear wooded areas that help filter nutrients, sediments and other pollutants from runoff as well as remove nutrients from groundwater. The recommended buffer width is 100 feet, with a 35 feet minimum width. Narrow, 10-foot buffers, are also an option, but are less effective. Buffers between 10 and 100 feet may be utilized, but they must have a 10-foot minimum to be effective. A single forest buffer may have a variation of widths along a stream, as a stream curves and the outward edge of the buffer remains straight. Both narrow and wide buffers are used in the BMP acres implemented and load reduction estimations. This can be applied to open space, changing a higher loading land use to a lower loading land use. Buffers are measured and reported in total acres, calculated from a length and a width.
- **Shoreline Erosion Control** – Any practice along tidal shorelines that prevents and/or reduces tidal sediments to the Bay. Shoreline practices can include living shorelines, revetments and/or breakwater systems and bulkheads and seawalls. This BMP has a pound reduction based on the land use it is applied to.
- **Stream Restoration** – Stream restoration is a change to the stream corridor that improves the stream ecosystem by restoring the natural hydrology and landscape of a stream and helps improve habitat and water quality conditions in degraded streams. If implemented in isolation, not as a treatment train, a reduction of 0.075 pounds of nitrogen, 0.068 pounds of phosphorus, and 248 pounds of sediment per foot is expected.
- **Wetland Creation/Restoration** - Establish, re-establish, or create wetlands in a floodplain by manipulation of the physical, chemical, or biological characteristics to develop a wetland where one did or did not previously exist. If implemented in isolation, not as a treatment train, a 42% nitrogen, 40% phosphorus, and 31% sediment reduction is expected.

Table 10: Natural BMP Implementation, Current and Planned, for Each of the Creeks and Waterbodies in the Little Assawoman Bay

BMP	Unit	Current 2022 Implementation	Planned NEW 2030 Implementation	Total Implementation
Miller Creek				
Forest Buffer	acres	0	3	3
Shoreline Erosion Control	feet	0	49	49
Stream Restoration	feet	159	515	674
Wetland Creation/Restoration	acres	0	29	29
Dirickson Creek				
Forest Buffer	acres	0	2	2
Shoreline Erosion Control	feet	0	25	25
Stream Restoration	feet	246	263	509
Wetland Creation/Restoration	acres	0	18	18
Remaining Little Assawoman Bay				

BMP	Unit	Current 2022 Implementation	Planned NEW 2030 Implementation	Total Implementation
Forest Buffer	acres	0	15	15
Shoreline Erosion Control	feet	0	223	223
Stream Restoration	feet	611	2,290	2,901
Wetland Creation/Restoration	acres	0	149	149
Total Little Assawoman Bay				
Forest Buffer	acres	0	20	20
Shoreline Erosion Control	feet	0	297	297
Stream Restoration	feet	1,016	3,068	4,084
Wetland Creation/Restoration	acres	0	196	196

Summary

The practices listed above will ensure that the Little Assawoman Bay meets or exceeds the established TMDLs, while allowing room for flexibility. For example, if the recommended urban forest buffer targets cannot be met, then additional nutrient management may be implemented instead. Another example is that, while small watersheds within the Little Assawoman watershed have been identified, site-specific implementation has not been established. Actual BMP location cannot be determined because implementation depends on factors such as permitting and landowner willingness. Considering this adaptive management approach, the measures outlined above are well within Delaware's ability to implement, based on financial need and public willingness. It is also expected that new technology and innovations will be explored as they become available. The management measures will be monitored to ensure proper operations and maintenance.

Technical and Financial Assistance Needs (d)

Technical Needs

DNREC has a variety of technical assistance programs to facilitate BMP implementation. While more staff is always helpful, existing and planned technical needs can be met with the help of grant funding. Enhancements to instruction plan review and inspections have reduced the time burden on existing instruction reviewers and inspectors. DNREC's Drainage Program provides technical assistance to landowners across Delaware to address constituent drainage concern issues. DNREC's Nonpoint Source Program aims to provide funding for reducing nonpoint source pollution in Delaware. The Nonpoint Source Program also hosts educational events and workshops for Delaware's residents, to educate them about Delaware's aquatic resources. DNREC's Sediment and Stormwater Program employs a comprehensive approach to sediment control, both during and after construction, and stormwater management that includes monitoring of stormwater quantity and water quality control. This program's responsibilities include sediment control and inspection during construction, post-construction inspection of permanent stormwater facilities, stormwater quantity and water quality control, and education/training related to stormwater.

The Sussex Conservation District (SCD) aids through cost-share funding, technical assistance, outreach, and education.

Financial Needs

State cost-share funds are used to fund urban projects with a demonstrated water quality benefit. The State Revolving Fund (SRF) has been expanded to include "green projects," including stormwater components. These "green projects" fund runoff reduction and stormwater treatment controls, including tree plantings and buffer establishment. The state also uses the Resource, Conservation and Development (RC&D) 21st Century Fund to finance flooding and drainage projects. The Sussex Conservation District Cost-Share Program provides financial assistance to landowners to implement BMPs to improve or enhance water quality. Other grant funding opportunities are available through Clean Water Act (CWA) Section 319 Grants and sources such as the National Fish and Wildlife Federation (NFWF). Funding for urban tree planting is provided primarily through the Delaware Forest Service's Urban and Community Forestry Program Grants. Table 11 outlines the potential funding sources available. Exact funding amounts and frequencies are dependent on congressional appropriations that are difficult to predict. The funding estimates in the table are based on historical amounts.

Funding Sources

Table 11: Funding Sources

Sector	Funding Source	Funding Amount	Strategic Use
Agriculture, Developed	Clean Water Act Section 319 Grant for Nonpoint Source Pollution	Varies – approximately $1.2M/year	Approximately $1.2 million/year federal funds from EPA administered by DNREC, Division of Watershed Stewardship, Nonpoint Source Program. Can utilize grant funds in EPA approved "priority watersheds." Funds agricultural, and urban/stormwater BMPs. https://dnrec.alpha.delaware.gov/watershed-stewardship/nps/
Agriculture, Developed	Surface Water Matching Planning Grant	Varies depending on state budget – approximately $250,000/year	$50,000 cap for grant awards with a 1:1 cash match and $100,000 cap per fiscal year administered by DNREC, Division of Watershed Stewardship, Nonpoint Source Program, with guidance from the Water Infrastructure Advisory Council (WIAC). Eligible projects include stormwater retrofits, water quality improvement projects, stream and wetland restoration, and other green infrastructure practices. https://dnrec.alpha.delaware.gov/environmental-finance/surface-water-planning-grants/
Developed	Community Water Quality Improvement Grant	Varies depending on state budget – approximately $250,000/year	Funding level can vary each fiscal year (approximately $250,000/year) administered by DNREC, Division of Watershed Stewardship, Nonpoint Source Program, with guidance from the Water Infrastructure Advisory Council (WIAC). Preference is given to projects involving cooperative partnerships and sponsors without a dedicated source of funds for repayment of Clean Water State Revolving Fund loans.

Sector	Funding Source	Funding Amount	Strategic Use
			https://dnrec.alpha.delaware.gov/environmental-finance/community-water-quality-improvement/
Agriculture, Developed	National Fish and Wildlife Foundation (NFWF)	Varies depending on grant	The NFWF provides funding for projects that sustain, restore, and enhance fish, wildlife and plants, and their habitats. The level of funding varies depending on year and guidelines. https://www.nfwf.org/apply-grant
Agriculture, Developed, Natural	Delaware Clean Water Trust (House Bill 200)	Approximately $50M	With an initial investment of $50 million, this Bill was created to protect Delaware's waterways and rebuild Delaware's drinking water infrastructure. This bill funds infrastructure for drinking water, stormwater and wastewater, and programs for drainage, waterway management and beach preservation, and other state and federally funded water-related projects. https://news.delaware.gov/2021/07/22/governor-carney-signs-clean-water-for-delaware-act/
Agriculture, Developed, Natural	Arbor Day Foundation Grants	Approximately $20,000	TD Green Space Grants award $20,000 in grants to support green infrastructure development, tree planting, forestry stewardship, and community green space expansion. https://www.arborday.org/programs/tdgreenspacegrants/
Agriculture, Developed	Non-Governmental Organizations	Varies depending on NGO funding capacity	Ex. Delaware Center for the Inland Bays, Delaware Wild Lands
Agriculture	Conservation Reserve Enhancement Program (CREP)	Varies – State investment per FY ranges from $25,000 - $100,000. Federal investment depends on new enrollment & re-enrollment commitments	Administered by the Farm Service Agency (FSA), farmers and ranchers are paid an annual rental rate in exchange for removing environmentally sensitive land from production.
Agriculture	Agricultural Management Assistance (AMA)	Varies – depending on budget. Approximately $250,000.	Administered by the Natural Resources Conservation Service (NRCS), the AMA helps agricultural producers use natural resource conservation practices to manage risk and solve natural resource issues. The AMA awarded Little Assawoman Bay $3,636 in 2020.
Agriculture	Conservation Stewardship Program (CSP)	Varies – depending on budget.	Administered by the NRCS, the CSP helps agricultural producers maintain and improve their existing conservation systems. The CSP provided $30,169 to assist the Little Assawoman Bay in 2020 and 2021.

Sector	Funding Source	Funding Amount	Strategic Use
		Approximately $1.2 M	
Agriculture	Environmental Quality Incentives Program (EQIP)	Varies – range has been between $5M - $7M/year	Administered by the NRCS, the EQIP provides financial and technical assistance to agricultural producers to address natural resource concerns and deliver environmental benefits. The EQIP provided $3,816 in 2020 and $443 in 2021 to Little Assawoman Bay.
Agriculture	Agricultural Conservation Easement Program (ACEP) - Wetland Reserve Easement Program (WRE)	Varies – approximately $1M	The WRE Program, through the NRCS, provides technical and financial assistance to private landowners to protect, restore, and enhance wetlands in exchange for retiring eligible land from agriculture.
Agriculture, Developed, Natural	State of Delaware General Funds	Varies - $100,000 historically.	The Tree for Every Delawarean Initiative is a partnership that includes the Urban and Community Forestry (UFC) programs in the Department of Agriculture's Delaware Forest Service, the Delaware Department of Natural Resources and Environmental Control's Division of Climate, Coastal and Energy and other stakeholders. https://dnrec.alpha.delaware.gov/tedi/
Agriculture, Developed	Delaware Water Pollution Control Revolving Fund (aka Clean Water State Revolving Fund)	Varies	Administered by the DNREC's Environmental Finance Program. The Environmental Finance Office provides planning, engineering, and financial assistance in the form of low-interest loans and grants to eligible applicants that request assistance to promote water quality projects which protect natural resources and reduce the risk of pollution from septic tanks, underground storage tanks, and other activities. These include all types of non-point source, watershed protection, restoration, and estuary management projects, as well as more traditional municipal wastewater treatment projects.
Agriculture, Developed	Resource Conservation and Development Fund (RC&D)	Varies – historically $5M	The Resource, Conservation and Development (RC&D) Fund was established by the Twenty-First Century Fund Investments Act of 1995 that resulted from a settlement with the State of New York. The RC&D portion of the Act was created to provide funding to enhance the health of communities by improving watershed and drainage infrastructure statewide. The fund is implemented by a partnership between the Department of Natural Resources and Environmental Control (DNREC) and Delaware's three Conservation Districts. The New Castle

Sector	Funding Source	Funding Amount	Strategic Use
			Conservation District takes the lead on projects located in New Castle County. Kent and Sussex Conservation Districts are leads on a portion of the prioritized projects, as assigned by DNREC, to increase the number of projects constructed. The DNREC Drainage Program administers the RC&D Program.
Developed	Delaware Urban and Community Forestry Program	$500 up to $5,000	Administered by the Delaware Department of Agriculture's Forestry Program. The Delaware Urban and Community Forestry Program offers annual grants of up to $5,000 for tree planting or tree management projects on public land. Grants are open to all Delaware municipalities, homeowner associations, and certified 501(c)(3) non-profits, including schools and churches. Grants require a 50-50 match in either cash (non-federal funds) or in-kind services, which can include volunteer or staff time, equipment rental, or supplies. Requests range from a minimum of $500 to a maximum of $5,000 in **only one** of two project categories: tree planting or tree management, which can include a professional tree inventory. All applicants must schedule a site visit with Urban and Community Program staff to review their project. Site visits must be scheduled at least one week in advance. Applications are evaluated after the deadline by a committee of the **Delaware Community Forestry Council**. Eligible projects must be performed on public lands within the community. Priority will be given to first-time applicants, **Tree Friendly Communities**, and projects with a focus on promoting diversity, equity, and inclusion.
Agriculture	Agricultural Conservation Easement Program (ACEP) – Agland Easements (ALE)	Varies – Approximately $2-3M	The Agricultural Conservation Easement Program (ACEP) protects the agricultural viability and related conservation values of eligible land by limiting nonagricultural uses which negatively affect agricultural uses and conservation values, protect grazing uses and related conservation values by restoring or conserving eligible grazing land, and protecting and restoring and enhancing wetlands on eligible land. Agricultural Land Easements (ALE) help private and tribal landowners, land trusts, and other entities such as state and local governments protect croplands and grasslands on working farms and ranches by limiting non-agricultural uses of the land through conservation easements.

The total annualized cost estimates for the proposed BMP implementation are summarized in Table 13. For total annualized cost, capital and opportunity costs are amortized over the BMP lifespan and added to annual operations and maintenance (O&M) cost. Costs represent a single year of the cost rather than the cost over the entire lifespan of the practice. Total annualized costs are annualized average costs per unit of BMP (e.g. $/acre treated/year). These costs are for a single year and are not accumulated over time. The reason for this is that once the TMDL is met, BMPs will need to remain in place to control loads and new BMPs will need to be implemented to offset new growth. The expense does not go away when the allowable loads are met, and the expenses must be included in future annual budgets. As such, providing total up-front costs is misrepresentative since costs cannot be capped if loads are to be maintained. It is also difficult to predict when a BMP is going to be implemented. Using this cost formula makes evaluations of costs among years more comparable. The Total Annualized Cost formula is:

- annualized costs = (capital * annualization factor) + O&M costs + (land * annualization rate)
- annualization factor = i/((1+i)^n – 1) + i
- i = annualization rate, which his always 5%
- n = period of annualization (also called lifespan)

Direct costs by both private and public entities are included, but technical assistance is not. Costs are for all new BMPs, excluding those that are currently implemented.

First, we show a summary of the annualized funding needs for each source sector, the two creeks, and the remaining area of the Little Assawoman Bay in Table 13. The next table shows the cost per BMP for each BMP so comparisons may be made among BMPs. Finally, we drill down to the finest level of detail to show the cost for the planned amount of each BMP at 2030 levels of implementation for each of the two creeks and the remaining area of the Little Assawoman Bay.

The total annualized costs in Table 13 were calculated for each BMP by multiplying the total annualized cost per unit (Table 12) by the total planned implementation (Table 8, Table 9, Table 10). These cost estimates account for only the new, planned BMPs with the assumption that the maintenance of existing BMPs is already being funded. The high cost of restoration in the natural sector is due to the amount of stream restoration and wetland creation/restoration required to restore a natural habitat that functions as an effective buffer and trap for nitrogen and phosphorus.

The total annualized costs per unit of BMP are summarized in Table 12.

Table 12: BMP Total Annualized Costs per Unit

BMP	Sector	Total Annualized Cost Per Unit
E&S Level 2	Developed	$6342/acre
Forest Buffer	Agriculture	$394/acre
Forest Buffer	Developed	$266/acre
Forest Buffer	Open Space	$304/acre
Grass Buffer	Agriculture	$230/acre
Grass Buffer	Developed	$139/acre
Impervious surface elimination to pervious surface	Developed	$57,460/acre
Nutrient Management	Developed	$2/acre
Nutrient Management	Agriculture	$6/acre
Wetland Creation/Restoration	Agriculture	$2,193/acre
Wetland Creation/Restoration	Developed	$2,193/acre

BMP	Sector	Total Annualized Cost Per Unit
Wetland Creation/Restoration	Natural	$2,193/acre
Conservation Plans	Agriculture	$26/acre
Cover Crop	Agriculture	$82/acre
Ditch Controls	Agriculture	$34/acre
Land Retirement	Agriculture	$92/acre
Pasture Management	Agriculture	$1/acre
Streambank Fencing	Agriculture	$1,223/foot
Tillage Management	Agriculture	$0/acre
Waste Management System	Agriculture	$28,778/count
Shoreline Erosion Control	Natural	$140/foot
Stream Restoration	Natural	$105/foot
Runoff Reduction	Developed	$3,969/acre
Stormwater Treatment	Developed	$1,789/acre

Table 13: Summary of Annualized Funding Needs per Source Sector and Area

Sector	Miller Creek	Dirickson Creek	Remaining Little Assawoman Bay	Total Little Assawoman Bay
Agriculture	$169,389	$194,730	$2,567,350	$2,787,579
Developed	$2,029,533	$2,340,466	$10,291,654	$14,664,026
Natural	$125,444	$71,197	$602,987	$799,628
Total	$2,324,366	$2,606,393	$13,461,991	$18,251,233

Agriculture

A summary of proposed agricultural BMPs and their costs can be found in Table 14. The per-acre cost of BMP implementation is lowest in the agricultural sector. Much of the implementation is focused in agricultural areas. Tillage management is $0 per acre, since there is no cost associated with refraining from deep tillage.

Table 14: Projected Total Annualized Funding Requirements for Agricultural BMPs

BMP	Miller Creek	Dirickson Creek	Remaining Little Assawoman Bay	Total Little Assawoman Bay
Conservation Plans	$1,716	$2,028	$24,596	$28,340
Cover Crop	$12,792	$14,268	$196,636	$223,696
Ditch Controls	$2,244	$2,618	$32,164	$37,026
Ag Forest Buffer	$5,516	$5,910	$74,466	$85,892
Ag Grass Buffer	$30,590	$35,650	$434,930	$501,170
Land Retirement	$6,072	$7,176	$86,940	$100,188
Nutrient Management	$-	$0	$24	$24
Pasture Management	$9	$14	$76	$99
Streambank Fencing	$81,941	$94,171	$1,156,958	$1,333,070
Tillage Management	$0	$0	$0	$0

BMP	Miller Creek	Dirickson Creek	Remaining Little Assawoman Bay	Total Little Assawoman Bay
Waste Management System	$0	$0	$143,890	$0
Wetland Creation/Restoration	$28,509	$32,895	$416,670	$478,074
Total	$169,389	$194,730	$2,567,350	$2,787,579

Developed

A summary of proposed urban BMPs and their costs can be found in Table 15. Cost of implementation is highest in the developed sector. As a result, much of the implementation in this plan is focused in the agriculture sector.

Table 15: Projected Total Annualized Funding Requirements for Developed BMPs

BMP	Miller Creek	Dirickson Creek	Remaining Little Assawoman Bay	Total Little Assawoman Bay
E&S Level 2	$6,342	$0	$50,736	$63,420
Developed Forest Buffer	$16,758	$18,354	$80,598	$115,710
Developed Grass Buffer	$48,372	$63,662	$285,923	$397,957
Impervious surface elimination to pervious surface	$1,149,200	$1,091,740	$4,596,800	$6,837,740
Nutrient Management	$0	$0	$16	$16
Runoff Reduction	$512,001	$762,048	$3,437,154	$4,707,234
Stormwater Treatment	$200,368	$286,240	$1,318,493	$1,805,101
Wetland Creation/Restoration	$96,492	$118,422	$521,934	$736,848
Total	$2,029,533	$2,340,466	$10,291,654	$14,664,026

Natural

A summary of proposed natural BMPs and their costs can be found in Table 16. Protecting and maintaining existing natural lands is as important as creating new natural lands for environmental improvements.

Table 16: Projected Total Annualized Funding Requirements for Natural BMPs

BMP	Miller Creek	Dirickson Creek	Remaining Little Assawoman Bay	Total Little Assawoman Bay
Forest Buffer on open space	$912	$608	$4,560	$6,080
Shoreline Erosion Control	$6,860	$3,500	$31,220	$41,580
Stream Restoration	$54,075	$27,615	$240,450	$322,140
Wetland Creation/Restoration	$63,597	$39,474	$326,757	$429,828
Total	$125,444	$71,197	$602,987	$799,628

Information, Education, and Public Participation (e)

The Delaware Center for Inland Bays (CIB) conducted an online survey in 2018, reaching out to a diverse group of individuals including full and part-time residents, as well as visitors of the Little Assawoman Bay area. The purpose of the CIB survey was to gain an understanding of how stakeholders and the public view the Bay, and what issues they believe are most important. This information was used for the development of the Comprehensive Conservation Management Plan as well as for this Implementation Plan since the survey. Questions and respondents are the same that DNREC would ask. To avoid survey fatigue, combined with pandemic restrictions, there was no separate, public meeting conducted for this implementation plan.

Over five hundred people responded to the survey. When asked about water quality in the Inland Bays, 59% said the water quality had stayed the same or worse, and 27% thought it had gotten better. People were also asked what they believe are the biggest threats to the health of the Bay now and in the future, and what actions they feel would be most effective to promote the health of the Bay moving forward. Most of the respondents indicated that their concern was about the developed areas, which is why there are practices included in this plan in the developed sector even though those are somewhat less cost-effective than practices in the agricultural sector. The goal is to reduce natural to developed land use change, but DNREC does not have land use authority over the county. The responses to the survey questions are summarized in Figure 3 and Figure 4.

Figure 3: Survey Responses to "What do you think is the biggest threat to the health of the Inland Bays today and in 10 years?

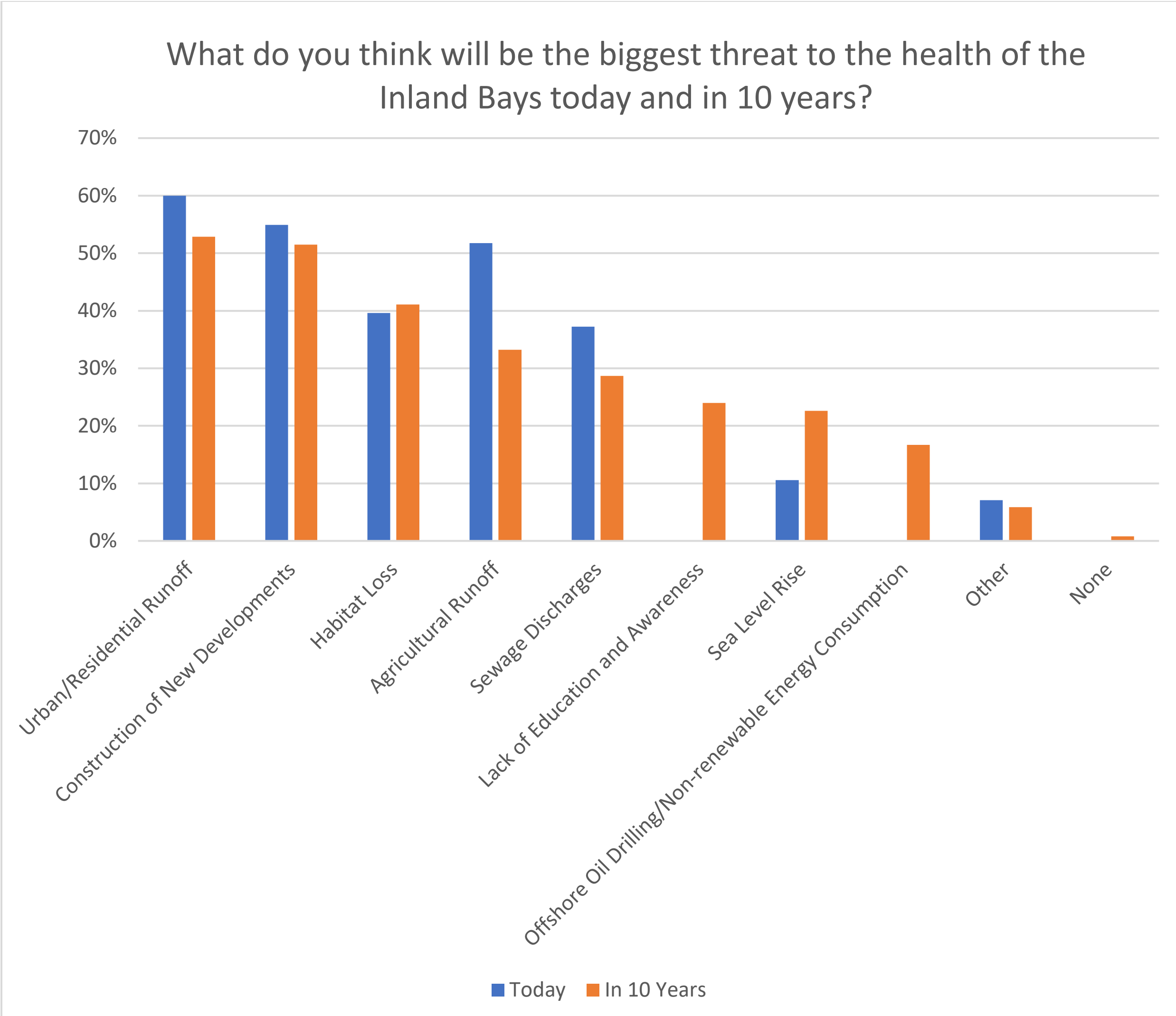
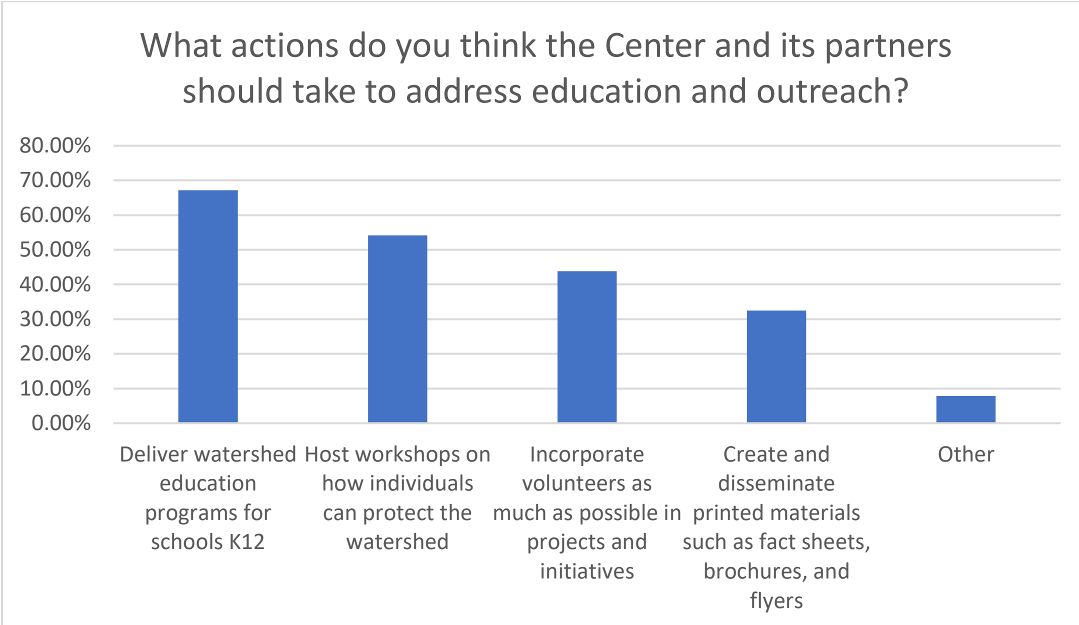


Figure 4: Survey Responses to "What actions do you think the Center and its partners should take to address education and outreach?"



When asked how the survey responders use the Bay, most said they use the Bay for secondary contact recreation including boating, hunting/fishing/crabbing/clamming as well as, visiting bayfront parks and preserves, and dining at waterfront restaurants. Most of the responders are full time residents. Therefore, outreach efforts should be targeted at those living near the Little Assawoman Bay, as they have the most influence and investment in the health of the Bay.

The EPA has produced an [Environmental Justice Screen Tool](), which DNREC utilizes to identify and prioritize underserved communities. Once these communities have been identified, DNREC creates outreach activities on the protecting and restoring the environment targeted to these communities.

DNREC will continue to engage local, regional, and federal stakeholders by way of direct mailings, emails, and newsletters; hosting webcast viewings with facilitated discussions; using the Environmental Justice Screen Tool along with social media; and in-person discussions with local officials when possible. The goal of these workshops is to engage and interact with local governments and provide tools and resources for funding and implementing watershed treatment projects. Past community outreach efforts included events/topics such as Sustainable Landscaping in Community Open Space, Becoming an Outdoors Woman Weekend, Coast Day, and the Blackbird Creek Fall Festival. DNREC also hosts tree plantings, rain barrel art contests, watershed photo contests, and Community Canopy tree giveaway. In addition to hosting workshops and distributing educational materials, DNREC will also continue to keep their website and social media accounts up to date with the most recent information pertaining to water quality goals in Delaware.

DNREC's Reclaim Our River Program – a partnership between community volunteers, local nonprofit organizations, and state and federal agencies – offers the public a monthly series of water quality-oriented events, workshops, presentations, and recreational opportunities to learn about the WIP process, what it means for them, and what they can do to help improve water quality. DNREC's stakeholder outreach strategies are outlined in Table 17.

Table 17: Stakeholder Outreach Strategies for the Little Assawoman Bay Watershed Plan

Stakeholder Group	Outreach Plan
Boaters	• Signs at boat ramps
Hunters/Fishers/Crabbers/Clammers	• Signs in local tackle shops/public lottery buildings • DNREC hosts press releases when changes are made to the Fish Advisories. The advisories are also published in the DE Fishing Guide. Links to the advisory table are also available on the DWS and FW websites. • DNREC is working to translate fish advisory materials and other items into languages other than English
Bayfront Park and Preserve Visitors	• Educational signage around the park
Residents	• The Reclaim Our River Program has expanded its public outreach efforts utilizing Facebook and radio campaigns to highlight the Delaware Livable Lawns Program, pet waste management, healthy soil practices, Nanticoke Watershed Alliance's Creekwatchers Program, and the importance of pollinators.
Local Farmers and Agricultural Organizations	• Ag Week: An annual conference held in January, which consolidates farm-based educational meetings while recognizing and celebrating the industry's importance. • Additional Outreach to Farmers: Ongoing efforts, such as DDA nutrient management workshops, to reach out to local farmers and agricultural organizations to inform them of the increased efforts in nutrient management reporting and cover crop implementation. • Soil Health Field Days and Meetings: The Sussex Conservation District (SCD) holds Soil Health Field Days and Meetings that bring together farmers, state and federal agencies, and other vested partners to learn about soil health practices. These events are typically held at participating farms in the County and will include agronomic field tours and guest speaker(s) from around the country that discuss how they incorporate soil health practices on their farming operations. • Sussex County Buffer/Setback Initiative: The Sussex County buffers and wetlands workgroup

	will review county codes and ordinances to make recommendations to the County Council on buffer widths.

DNREC has developed a Watershed Stewardship Marketing and Communications Plan, which can be found in Appendix B. This Plan's mission is to create an informed, diverse community of citizens and local leaders with the knowledge and resources to achieve the goals of the Division of Watershed Stewardship. A few of the marketing and communications objectives are to develop outreach programs that encourage and inspire individuals to adopt practices that improve water quality throughout the state, maintain the flow of information and provide liaison between Federal and State agencies, state and local governments, stakeholder groups, media outlets collaborating agencies and organizations, and the public; and strengthen and/or create partnerships with other agencies/stakeholders, both public and private. Marketing and communication strategies include: assisting in the coordination of virtual and/or in-person meetings with stakeholders; maintaining social media accounts and website; assisting in the coordination of virtual and/or in-person outreach campaigns as well as education and training activities for stakeholders in support of the Delaware NPS Program grant deliverables for outreach and education; representing the Department in marketing or advertising activities such as meetings, press conferences or other promotional events; conducting marketing research to target specific groups, determine effectiveness of marketing activities, and recommend enhancements or refining of marketing strategies; and identifying channels of promotion, distribution, or advertising products or services and reviewing current channels of communication to explore additional opportunities. DNREC is also working to translate materials into languages other than English. Effectiveness of these outreach strategies can be measured by:

- Increased attendance of virtual and in-person stakeholder meetings, outreach campaigns, and education and training activities
- Expanded coverage of social media accounts and website, and advertising activities such as meetings, press conferences or other promotional events
- Expanded channels of communication
- Positive survey feedback from landowners and the community

Implementation Schedule and Milestones (f and g)

This section outlines the target loads and BMPs that need to be implemented to achieve and exceed the required TMDL load reductions of 40% by 2030. These estimated loads consider the land use changes as well as the effect of BMPs. The loads are shown below as totals, as well as broken out by sector. The total loads include those from agriculture, developed, natural, and septic source sectors. Note that if all elements of this plan are completed as outlined, the 40% reduction is expected to be exceeded, which will help accommodate new and increased loads that are not projected in the future land use. These water quality improvement projects also help to make more livable communities, adding multiple co-benefits in addition to meeting the regulatory requirements. Since this area of Delaware attracts tourists, it is economically important to have clean water as well as attractive communities. Table 18 outlines the interim and final nutrient and sediment loads for the Little Assawoman Bay milestone years, provided that all BMPs outlined in this plan are fully implemented. 1990 is the baseline year in which the TMDL was established, 2022 is the most recent progress year at the time of plan development, and 2030 is the TMDL target year. The milestone year of 2026 was selected because it is the midpoint between 2022 and 2030.

Table 18: Interim and Final Nutrient/Sediment Loads for Little Assawoman Bay for Milestone Years and 2030

	1990 Load	2022 Load	2026 Load	2030 Load	Percent Load Reduction between 2030 and 1990
Nitrogen Load (lbs/yr)	443,484	435,065	339,323	243,581	55%
Phosphorus Load (lbs/yr)	11,406	9,731	7,688	5,644	49%
Sediment Load (lbs/yr)	4,036,016	3,702,616	2,727,348	1,752,080	43%

Table 19 outlines the anticipated, monitored nutrient concentrations for two of the monitoring stations, Little Assawoman Bay @ Rt. 54 (The Ditch) and Little Assawoman Bay Mid-Bay (Ocean Park Lane). Here, the baseline year is 2021 because data have not yet been collected for 2022. The estimated decrease is based on an average hydrology, which may be different than the actual future hydrology and is different than the last year of monitored data. Hydrologic patterns, including those influenced by climate change may influence the monitored data results on a year-to-year basis. For example, in especially wet years, the nutrient concentrations will be more diluted and appear lower, but an increase in sediment runoff may occur due to sediment runoff and mobilization. In contrast, dry years may result in less runoff but the nutrient that do enter the streams will be more concentrated. The long-term monitoring data trend is expected to reflect pollutant reductions. **By 2026, we expect to see a 22% decrease in dissolved inorganic nitrogen and 21% decrease in total phosphorus following implementation of the BMPs described in section C (Proposed Management Measures (c)) of the plan assuming average hydrological conditions.**

Table 19: Interim and Final Nutrient Concentrations for Monitoring Stations, Little Assawoman Bay @ Rt. 54 (The Ditch) and Little Assawoman Bay Mid-Bay (Ocean Park Lane)

	Little Assawoman Bay @ Rt. 54 (The Ditch) (mg/L)			Little Assawoman Bay Mid-Bay (Ocean Park Lane) (mg/L)		
	2021	2026	2030	2021	2026	2030
Dissolved Inorganic Nitrogen	0.04	0.03	0.02	0.05	0.04	0.03
Dissolved Inorganic Phosphorus	0.01	0.005	0.003	0.01	0.01	0.01

Figure 5 shows the value and percent change in total, modeled nitrogen (lbs/yr) for each of the milestone years.

Figure 5: Change in Total Nitrogen (lbs/yr) 1990-2030

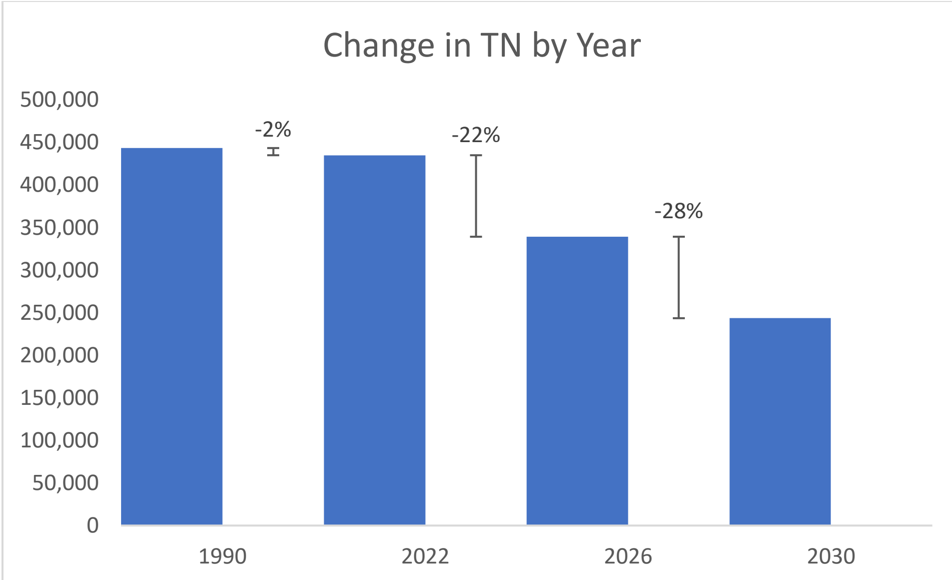


Figure 6 shows the value and percent change in total phosphorus (lbs/yr) for each of the milestone years.

Figure 6: Change in Total Phosphorus (lbs/yr) 1990-2030

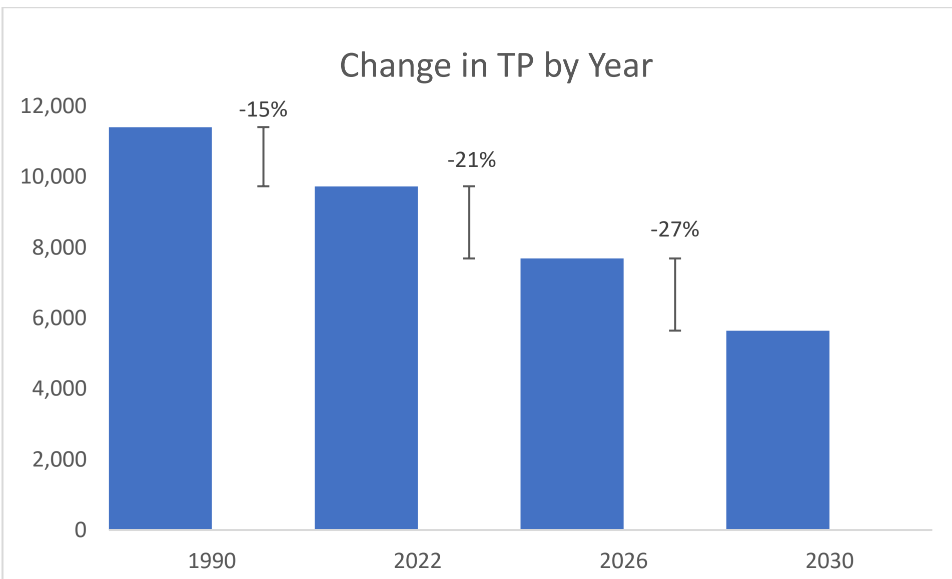


Figure 7 shows the value and percent change in total suspended solids (lbs/yr) for each of the milestone years.

Figure 7: Change in Total Suspended Sediment (lbs/yr) 1990-2030

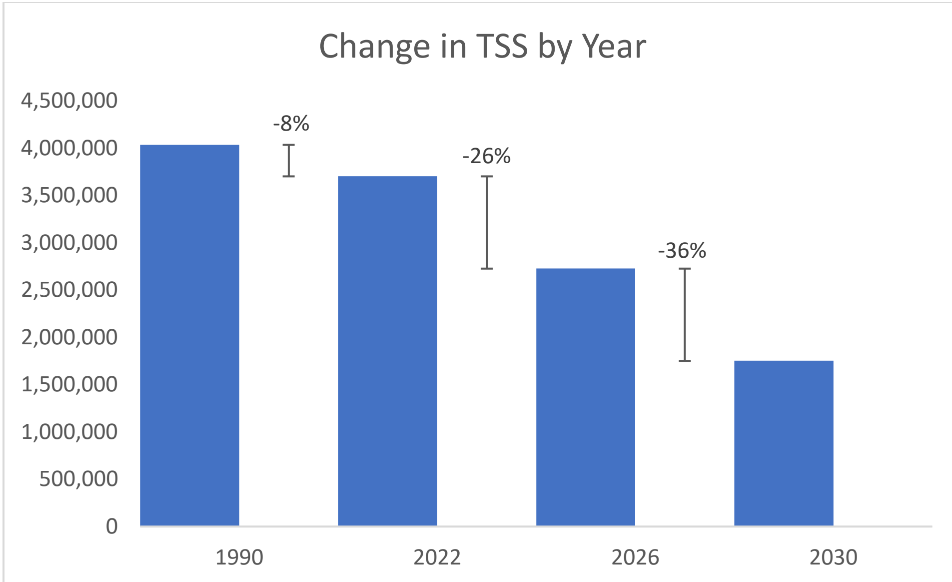


Table 20 outlines the projected nitrogen loads for each creek and waterbody in the Little Assawoman Bay watershed by sector in 2030, assuming total planned BMP implementation.

Table 20: Nitrogen Load Targets for 2030 (lbs/yr)

Segment	Agriculture	Developed	Natural	Septic	Total
Miller Creek	7,063	6,334	6,267	3,472	23,135
Dirickson Creek	7,969	10,441	6,763	3,952	29,125
Remaining Little Assawoman Bay	107,987	46,201	25,845	11,287	191,321
Total Little Assawoman Bay	123,019	62,976	38,875	18,711	243,581

Table 21 outlines the projected phosphorus loads for each creek and waterbody in the Little Assawoman Bay watershed by sector in 2030, assuming total planned BMP implementation.

Table 21: Phosphorus Load Targets for 2030 (lbs/yr)

Segment	Agriculture	Developed	Natural	Septic	Total
Miller Creek	152	239	153	0	544
Dirickson Creek	173	346	238	0	757
Remaining Little Assawoman Bay	2,172	1,546	624	0	4,343
Total Little Assawoman Bay	2,497	2,131	1,015	0	5,644

Table 22 outlines the projected suspended sediment loads for each creek and waterbody in the Little Assawoman Bay watershed by sector in 2030, assuming total planned BMP implementation.

Table 22: Sediment Load Targets for 2030 (lbs/yr)

Segment	Agriculture	Developed	Natural	Septic	Total
Miller Creek	44,514	88,438	21,388	0	154,340
Dirickson Creek	49,724	127,627	34,723	0	212,075
Remaining Little Assawoman Bay	695,658	561,063	128,946	0	1,385,665
Total Little Assawoman Bay	789,896	777,128	185,057	0	1,752,080

Table 23 outlines the projected total nitrogen, phosphorus, and suspended sediment loads for each creek and waterbody in the Little Assawoman Bay watershed in 2030, assuming total planned BMP implementation.

Table 23: 2030 Little Assawoman Bay Milestones (lbs/yr)

Segment	Nitrogen	Phosphorus	Sediment
Miller Creek	23,135	544	154,340
Dirickson Creek	29,125	757	212,075
Remaining Little Assawoman Bay	191,321	4,343	1,385,665
Total Little Assawoman Bay	243,581	5,644	1,752,080

Table 24 outlines the current BMP implementation, the 2026 mid-point target implementation, and the 2030 target implementation for Miller Creek, Dirickson Creek, and the Little Assawoman Bay watershed. The 2026 milestone targets include the BMPs already implemented in 2022.

Table 24: Miller Creek, Dirickson Creek, and Little Assawoman Bay Milestones for BMP Implementation

BMP	Unit	2022 Implementation	2026 Milestone	2030 Milestone
Agriculture				
Miller Creek				
Conservation Plans	acres	6	39	72
Cover Crop	acres	99	128	156
Ditch Controls	acres	2	35	68
Ag Forest Buffer	acres	3	10	17
Ag Grass Buffer	acres	4	71	137
Land Retirement	acres	4	37	70
Nutrient Management	acres	256	256	256
Pasture Management	acres	2	7	11
Streambank Fencing	feet	78	112	145
Tillage Management	acres	1	1	1
Waste Management System	count	111	111	111

BMP	Unit	2022 Implementation	2026 Milestone	2030 Milestone
Wetland Creation/Restoration	acres	23	30	36
Dirickson Creek				
Conservation Plans	acres	6	45	84
Cover Crop	acres	110	142	174
Ditch Controls	acres	3	42	80
Ag Forest Buffer	acres	4	12	19
Ag Grass Buffer	acres	5	83	160
Land Retirement	acres	4	43	82
Nutrient Management	acres	284	284	284
Pasture Management	acres	3	10	17
Streambank Fencing	feet	117	156	194
Tillage Management	acres	1	1	1
Waste Management System	count	127	127	127
Wetland Creation/Restoration	acres	26	33.5	41
Remaining Little Assawoman Bay				
Conservation Plans	acres	85	558	1,031
Cover Crop	acres	1,529	1,964	2,398
Ditch Controls	acres	15	488	961
Ag Forest Buffer	acres	48	143	237
Ag Grass Buffer	acres	58	1,004	1,949
Land Retirement	acres	59	532	1,004
Nutrient Management	acres	3,934	3,936	3,938
Pasture Management	acres	17	55	93
Streambank Fencing	feet	637	1,110	1,583
Tillage Management	acres	10	13	15
Waste Management System	count	1,636	1,639	1,641
Wetland Creation/Restoration	acres	335	430	525
Total Little Assawoman Bay				
Conservation plans	acres	97	642	1,187
Cover Crop	acres	1,738	2,233	2,728
Ditch Controls	acres	20	565	1,109
Ag Forest Buffer	acres	55	164	273
Ag Grass Buffer	acres	67	1,157	2,246
Land Retirement	acres	67	612	1,156
Nutrient Management	acres	4,474	4,476	4,478
Pasture Management	acres	22	72	121
Streambank Fencing	feet	832	1,377	1,922
Tillage Management	acres	12	15	17

BMP	Unit	2022 Implementation	2026 Milestone	2030 Milestone
Waste Management System	count	1,874	1,877	1,879
Wetland Creation/Restoration	acres	384	493	602
Developed				
Miller Creek				
E&S Level 2	acres	0	0.5	1
Urban Forest Buffer	acres	0.017	32	63
Urban Grass Buffer	acres	0	174	348
Impervious surface elimination to pervious surface	acres	0	10	20
Nutrient Management	acres	0	0	0
Runoff Reduction	acres	0.365	65	129
Stormwater Treatment	acres	7	63	119
Wetland Creation/Restoration	acres	0	22	44
Dirickson Creek				
E&S Level 2	acres	0	0.5	1
Urban Forest Buffer	acres	0.025	35	69
Urban Grass Buffer	acres	0	229	458
Impervious surface elimination to pervious surface	acres	0	10	19
Nutrient Management	acres	0	0	0
Runoff Reduction	acres	0.533	96	192
Stormwater Treatment	acres	10	90	170
Wetland Creation/Restoration	acres	0	27	54
Remaining Little Assawoman Bay				
E&S Level 2	acres	0	4	8
Urban Forest Buffer	acres	0.919	152	304
Urban Grass Buffer	acres	0	1,029	2,057
Impervious surface elimination to pervious surface	acres	0	40	80
Nutrient Management	acres	0	4	8
Runoff Reduction	acres	15	448	881
Stormwater Treatment	acres	83	452	820
Wetland Creation/Restoration	acres	0	119	238
Total Little Assawoman Bay				
E&S Level 2	acres	0	5	10
Urban Forest Buffer	acres	1	219	436

BMP	Unit	2022 Implementation	2026 Milestone	2030 Milestone
Urban Grass Buffer	acres	0	1,432	2,863
Impervious surface elimination to pervious surface	acres	0	60	119
Nutrient Management	acres	0	4	8
Runoff Reduction	acres	16	609	1,202
Stormwater Treatment	acres	100	605	1,109
Wetland Creation/Restoration	acres	0	168	336
Natural				
Miller Creek				
Forest Buffer	acres	0	2	3
Shoreline Erosion Control	feet	0	25	49
Stream Restoration	feet	159	417	674
Wetland Creation/Restoration	acres	0	15	29
Dirickson Creek				
Forest Buffer	acres	0	1	2
Shoreline Erosion Control	feet	0	13	25
Stream Restoration	feet	246	378	509
Wetland Creation/Restoration	acres	0	9	18
Remaining Little Assawoman Bay				
Forest Buffer	acres	0	8	15
Shoreline Erosion Control	feet	0	112	223
Stream Restoration	feet	611	1,756	2,901
Wetland Creation/Restoration	acres	0	75	149
Total Little Assawoman Bay				
Forest Buffer	acres	0	10	20
Shoreline Erosion Control	feet	0	149	297
Stream Restoration	feet	1,016	2,550	4,084
Wetland Creation/Restoration	acres	0	98	196

The implementation schedule and expected milestones allow us to expected progress and be able to assess if it is necessary to amend the plan if the milestones are not being reached by the target dates. For example, funding may need to be shifted to different programs if the implementation targets are not being met. Alternatively, some practices may need to be targeted in different locations, or different practices may need to be implemented based on the monitored load results. Many human activities and natural processes affect agricultural water-quality responses and, therefore, need to be considered to confidently identify BMP effects. The milestones provide an opportunity to do so on a predetermined schedule.

Load Reduction Evaluation Criteria (h)

Using tables outlined in section f and g, along with new tracking and load estimator systems, evaluating progress toward the TMDL will be simpler and more transparent. The coupling of the BMP Tracker and the DTAP tools will be useful for tracking management practices, land use change, and predicted water quality changes over time. The DNREC BMP Tracking and Reporting Application is a means of collecting and managing the nonpoint source sector BMPs implemented in the State of Delaware. A central repository of BMP data from multiple agencies and departments allows a streamlined approach to generate reports needed for BMP tracking, BMP reporting, and water quality assessment.

The monitoring stations listed in Table 25 will continue to monitor nutrient levels on the Little Assawoman Bay Watershed. **Error! Reference source not found.** shows a map of the monitoring stations in the Little Assawoman watershed. The yellow squares represent stations that provide real-time water quality measurements for water level, flow rate, nutrients, pesticides, metals, bacteria, physical, and other (organic carbon). The nutrients collected include total nitrogen and total phosphorus, and the physical characteristics include total suspended solids. The purple circles represent locations where synoptic water quality data is available. These stations may have data from as recently as last week, or decades old, depending on the location. On average, the sites collectively sample for nitrogen 10 times per year, phosphorus 6 times per year, and sediment 5 times per year. However, in recent years, monitoring frequency has increased. In 2022, nitrogen was measured 78 times, phosphorus 117 times, and sediment 39 times among all the monitoring locations. The numbers inside the circles are the number of single monitoring stations within that cluster. The northern-most red line on the map is Miller Creek, and the red line to the north is Dirickson Creek. The Little Assawoman Bay is filled in with green. Monitoring stations are located throughout the watershed, including Miller and Dirickson Creeks. The EPA's How's My Waterway Tool provides an interactive version of this map, where you can select a monitoring station to see the most up-to-date water quality data in that location. DNREC Watershed Assessment and Management Section (WAMS) oversees the water quality monitoring stations across the state. WAMS collects the station data. It is then compiled and presented in the 303(d) and 305(b) Integrated Report that is drafted every even numbered calendar year.

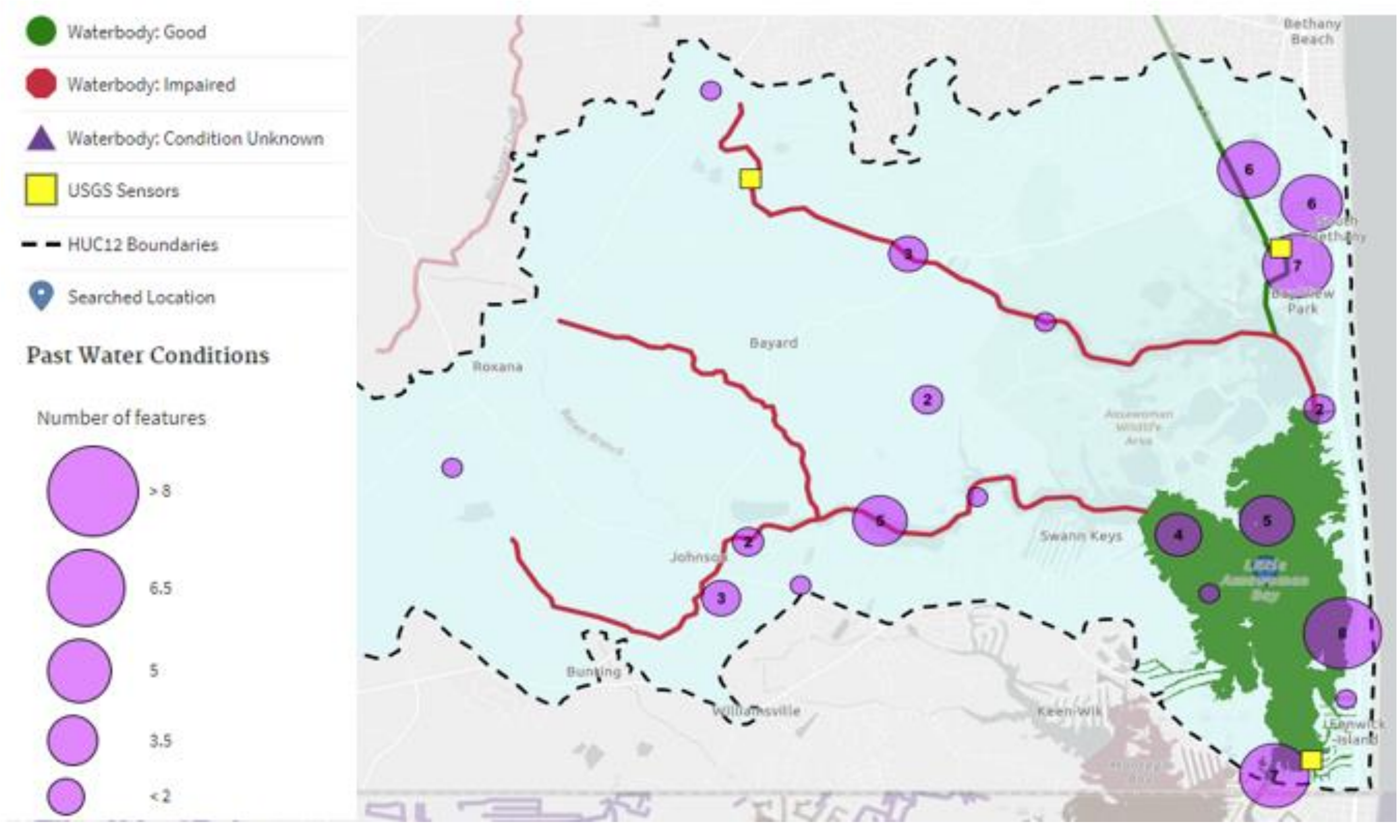


Figure 8: Monitoring Stations in the Little Assawoman Bay Watershed

Monitoring Component (i)

There are currently 63 monitoring locations in the Little Assawoman Bay. These stations are distributed amongst all the stream reaches in the watershed. Decreases in loads can be attributed to BMPs implemented upstream of the monitoring locations. The water is monitored by a combination of state, federal, tribal, and local agencies. Universities, volunteers, and others also help detect water quality concerns. The monitoring stations that are detecting current water conditions are all managed by the U.S. Geological Survey. At these locations, which are represented in Figure 8 by yellow squares, water is constantly being monitored in real-time using water quality sensors. These stations measure nitrogen, phosphorus, and sediment, as well as water level and flow rate. The monitoring locations that have historical data available measure bacteria, metal, nutrient (including nitrogen and phosphorus), per- and polyfluoroalkyl substances, pesticide, physical (including sediment), and other levels, depending on the location. Samples from these locations are tested at different frequencies depending on the site. A summary of the names, types and organizations who manage these monitoring locations is in Table 25.

Table 25: Monitoring Locations in the Little Assawoman Bay

Organization Name	Monitoring Location Type	Monitoring Location Name
Delaware Center for Inland Bays	Other-Surface Water	Anchorage Canal @ Rt 1
		Anchorage Canal near elbow
		Brandywine Canal
		Carlisle canal

Organization Name	Monitoring Location Type	Monitoring Location Name
		Jefferson Canal West side @ tidal gage
		Layton Canal, South Bethany
		Petherton canal, between lots 156 and 162
		Petherton canal/rt1
		Russell Canal east dead end
		Russell Canal west dead end
		South end of York Canal
		Sussex Place Canal
		W. Georgetown St. Canal – Fenwick
		York Canal - mid-canal west side
	Estuary	Coastal Kayaks, knee deep wading sample
		Dirickson Creek at Road 381 bridge
		Fenwick Island Tide Gauge
		Mulberry Landing
		Swan Cove-pier
		Upper Dirickson Creek @ Rt20
	Pond-Sediment	The Hamlet at Dirickson Pond
Delaware Department of Natural Resources and Environmental Control	Canal Transport	Assawoman Canal @ Muddy Neck Rd. (Rd. 361)
	River/Stream	Beaver Dam Ditch @ Beaver Dam Rd. (Rd. 368)
		Beaver Dam Ditch at Rd. 84 Bridge
		Beaver Dam Ditch, Rt. 17 Bridge
	Estuary	Dirickson Creek @ Old Mill Bridge Rd. (Rd. 381)
		Little Assawoman Bay @ Rt. 54 (The Ditch)
		Little Assawoman Bay Mid-Bay (Ocean Park Lane)
		Miller Creek @ Double Bridges Rd. (Rd. 363)
Environmental Monitoring and Assessment Program	Estuary	Little Assawoman Bay (15 monitoring locations)
		Rehoboth Bay
EPA National Aquatic Resources Survey (NARS)	Estuary	Little Assawoman Bay (2 monitoring locations)
	Other-Surface Water	NCCA10-1632
USGS Maryland Water Science Center	Stream	Bear Ditch Tributary Near Bunting, DE
		Williams Canal Ditch Near Bethany Beach, DE
	Well	Qj41-02

Organization Name	Monitoring Location Type	Monitoring Location Name
		Qj41-04
		Qj41-07
		Qj41-08
		Ri22-03
		Ri22-04
		Ri22-10
		Ri23-04
		Rj22-05
		Rj22-06
		Rj22-07
		Rj22-08
Maryland Dept. of the Environment In House Water Data	Estuary	The Ditch

Table 26 outlines the date range of sampling, along with the average number of nitrogen, phosphorus, and sediment samples taken each year for each of the monitoring locations in the Little Assawoman Bay watershed that sample for these elements. These monitoring stations will continue sampling at the same frequency, with the hope of reaching the established milestone targets until 2030.

Table 26: Average Number of Nitrogen, Phosphorus, and Sediment Samples for Each Monitoring Station, including Date Range of Sampling

Monitoring Location Name	Date Range of Sampling	Average N Samples per Year	Average P Samples per Year	Average TSS Samples per Year
Anchorage Canal @ Rt 1	2016-2020	0	15	15
Assawoman Canal @ Muddy NecK Rd. (Rd. 361)	1998-2009	6	0	6
BEARHOLE DITCH TRIBUTARY NEAR BUNTING, DE	1999	2	0	0
Beaver Dam Ditch @ Beaver Dam Rd. (Rd. 368)	1998-2023	32	2	9
Beaver Dam Ditch at Rd. 84 Bridge	2000-2002	9	0	3
Beaver Dam Ditch, Rt. 17 Bridge	2000-2002	8	0	3
Dirickson Creek @ Old Mill Bridge Rd. (Rd. 381)	1998-2023	25	2	7
Dirickson Creek at Road 381 bridge.	2016-2020	0	15	15

Monitoring Location Name	Date Range of Sampling	Average N Samples per Year	Average P Samples per Year	Average TSS Samples per Year
Fenwick Island Tide Gauge	2016-2020	0	14	14
Layton Canal, South Bethany	2016-2020	0	15	15
Little Assawoman Bay	2003	1	1	1
Little Assawoman Bay	2004	1	0	1
Little Assawoman Bay	2003	1	1	1
Little Assawoman Bay	2005	0	0	1
Little Assawoman Bay	2004	1	0	1
Little Assawoman Bay	2005	0	0	1
Little Assawoman Bay	2005	0	0	1
Little Assawoman Bay	2005	0	0	1
Little Assawoman Bay	2006	0	0	1
Little Assawoman Bay	2002	0	0	1
Little Assawoman Bay	2000	0	0	1
Little Assawoman Bay	2001	0	0	1
Little Assawoman Bay @ Rt. 54 (The Ditch)	1998-2023	24	2	7
Little Assawoman Bay Mid-Bay (Ocean Park Lane)	1998-2023	24	2	7
Miller CreeK @ Double Bridges Rd. (Rd. 363)	1998-2008	20	0	5
Mulberry Landing	2016-2020	0	14	14
NCA_DE-10167	2015	1	1	0
NCCA10-1632	2010	1	1	0
Qj41-02	1985-1986	2	0	0
Ri22-03	1988-2013	7	0	0
Ri22-04	1988	4	0	0
Ri22-10	2003-2012	5	0	0
Ri23-04	2000-2008	7	2	0

Monitoring Location Name	Date Range of Sampling	Average N Samples per Year	Average P Samples per Year	Average TSS Samples per Year
Rj22-05	1977	0	1	0
Rj22-06	1977	0	1	0
Rj22-07	1977	0	1	0
Rj22-08	1977	0	1	0
The Ditch	1998	36	24	6
WILLIAMS CANAL DITCH NEAR BETHANY BEACH, DE	2000	5	0	0

The TMDL established target loads for Little Assawoman Bay. By identifying the source sectors that are contributing the highest loads to the Bay, prioritization of BMP implementation was determined. Using the DTAP tool, a recipe of recommended BMP implementation has been created which, when fully implemented, will either meet or exceed the TMDLs.

Implementation will be achievable via a combination of technical and financial assistance, as well as public education and outreach. Strategies for meeting these needs have been outlined thoroughly, validating that the necessary support is available. A milestone schedule has been established to reasonably achieve the target BMP implementation by the year 2030. Once implementation is complete, load reduction progress will be tracked and monitored by several water quality monitoring stations that are already in place today. The achievement of meeting these reductions will have significant impacts on the plant and wildlife residing in the Bay, will have a positive societal impact on the humans who call the Little Assawoman Bay their home, and will allow the Bay to be delisted.

Appendix A

Introduction

The Delaware Targeting and Planning (DTAP) model is used to facilitate accelerated and targeted water quality improvements. This appendix outlines the user components, data required, and functionality of the application. This resource provides an overview of the calculations and references the source data from which calculations are made.

Scope

The Delaware Department of Natural Resources and Environmental Control (DNREC) uses DTAP to identify opportunities for achieving the load reductions outlined in the established total maximum daily loads (TMDLs) for various watersheds within the State of Delaware, and new goals or milestones. DTAP can be used to support long-term evaluation of nonpoint source pollutant reduction and planning for implementation where site-specific monitoring is not feasible.

Users engage DTAP to answer questions such as:

- What is the effect of urban stormwater treatment's anticipated impact on pollutant loads?
- What are the anticipated effects of tillage on nutrients and sediment?
- What is the anticipated effect of various combinations of BMPs on limiting nutrient and sediment runoff?
- At what location should BMPs be implemented to reduce the most pollutants?
- Which BMPs are most cost-effective?

To answer these questions, users will need to be able to identify contaminant loads in a defined geographic location and determine which are the most cost-effective BMPs that can be targeted to control pollutants.

The geographic area includes the portions of Delaware that are within the Piedmont, Delaware and Inland Bays, and Atlantic Ocean Basins.

The pollutant loads considered include:

- Total nitrogen (pounds)
- Total phosphorus (pounds)
- Total suspended solids (pounds)
- Bacteria (fecal coliform most probably under (MPN))

The best management practices (BMPs) will function to show a change in pollutant load because of a change in land use, land management, or structural practice. Most BMPs are modeled as efficiencies or land use changes. Some have multiple measurements that locate the efficiency on a curve. Others are simple reductions in pollutant amount based on user input.

Capabilities

The primary capabilities of DTAP are to:

- Integrate with the Delaware BMP Tracking and Reporting Application for existing BMPs.
- Allow users to add in-design and planned BMPs.
- Allow flexibility to easily develop, assess, and adjust planning scenarios.
- Track pollutant reductions for multiple projects and scenarios.
- Utilize current approved base data including land use, loading rates, and BMP load algorithms.
- Show output of the pollutant load from each land use in a geographic area with the selected planned BMPs in addition to the implemented BMPs that are in the BMP Tracking and Accounting Tool.
- Show output at the edge of a small stream for the modeled land uses.
- Show output of the BMPs and implementation levels selected by the user, and the amount of reduction in pollutants.
- Designed in such a way that the modules are friendly to those without a modeled background. The requirement for users is knowledge of the various BMPs and land uses, which can be selected from a list.

Data Calculations

Loading Rates for Each Land Use in Each Hydrological Area

The base loading rates serve as the starting point in each scenario. These loading rates are the pounds of total nitrogen, total phosphorus, total suspended sediment, and fecal coliform most probable number (MPN) for each land use in each NDH catchment. The loading rates may vary for each land use in each NHD catchment. BMP load reductions are calculated from these base loads.

The Chesapeake Bay Program's model CAST has edge-of-stream loading rates for TN, TP, and TSS for the entire Delaware counties for each CAST land use for all years modeled by DTAP. These loading rates are mapped to the DTAP land uses and downscaled from the CAST land-river segments to the NHD+ v.2 scale. This is done by taking the loading rates for the weighted average of the appropriate aggregation of CAST land uses and land-river segment and apportioning that loading rate to the DTAP land use and segment for each year between 1990 and 2025. The DTAP land use categories are aggregations of CAST land use categories. In this way, DTAP maintains consistency with CAST's logic while modeling the non-Chesapeake Bay portions of Delaware without excessive complexity.

The loads vary for each year (1990-2025) because the atmospheric deposition and mix of land in the DTAP land uses changes each year. The base loads assume no BMPs are implemented since the user adds the BMPs as part of the scenario creation process. It is the addition of BMPs by the user that changes the base loads to the scenario loads.

The 49 CAST load sources are mapped to the 17 DTAP sources as a many to one match. The edge-of-stream loading rate for the weighted average of the CAST land uses in a CAST land-river segment is multiplied by the acres in the DTAP land use NHD catchment. Where an NHD catchment overlaps more than one CAST model segment, then the average loading rate is proportionally adjusted by the are in the NHD area. These land use loading rates serve as the base load from which BMP reductions are calculated in scenarios. This calculation is performed for each year and each land use in each of DTAP's NHD catchments.

The CAST edge-of-stream loads include the Spatially Referenced Regression on Watershed Attributes (SPARROW) derived land-to-water factors. These factors serve to deprecate the loads as they move from the land to the edge of a small stream and include floodplain effects. These factors range from zero to one. These characterize the loads based on a regression equation from the USGS SPARROW model.

Area of Each Land Use

The process for developing the land use acres at the NHD+V2 scale is to base it on the 2013 1-m land from the U.S. Geological Survey/Chesapeake Bay Program Land Data Team. The 1-m data currently is available only for 2013. The NLCD is used for interpolations between 2011, 2006, 2001, and 1992. Years beyond 2013 are projected. There is a separate land use for each available year. Years are 1990 to 2025. Other years can be added as we approach 2025.

Note that there are six NHD+v2.0 FeatureIDs that are water only and are not included. These are: 8075530, 8075616, 8075880, and 8075886.

Geographic Land Use Computations

The union of the NHD and CAST modeling segments are computed. The percent of each NHD catchment in each CAST modeling segment is determined for each land use with the 1-m data for the 2013 year. The USA Contiguous Albers Equal Area Conic USGS (WKID 102039) projection was used. The ArcGIS function of Union is different than an Intersection. Union was the appropriate function for this purpose because this method ensured that the sets maintained all elements and segment portions were not excluded, keeping the total acres the same.

The land use must be simplified to match between the 2013 1-m 13 categories and the NLCD categories. The best match is to use natural, developed, agriculture, and other. According to NASS, 2016 NLCD pasture should be used for mapping pasture and the CDL used for mapping cropland. The problem is where they overlap. Once all four NLCD years (2001, 2006, 2011, and 2016) and the 2013 are aggregated, the actual change is calculated among the four NLCD years to result in a land use for each of the four classes and each NHD catchment. Lastly, the proportion of each 2013 1-m class within each of the four NLCD simplified classes is calculated and applied to all years. That allows each of the four categories to change over time. However, the proportion of the land uses within those four land use categories does not change over time and stays true to the 2013 1-m data. Below is a summary of these steps.

1. Aggregate NLCD data to the four classes for all year by NHD.
2. Aggregate the Chesapeake Bay Land Use data to the four classes for all years by NHD.
3. Compute change in acres for the two sources and four timespans and interpolate linearly.
4. Calculate the proportion of each 2013 1-m land use class within each of the four NLCD simplified classes.
5. Apportion changes to the areas from the four classes to the 2013 1-m land classes using the proportion calculated in step 3 for each year and NHD.
6. Linearly interpolate between the 2013 and 2025 land use for all land classes.

The DTAP names are substituted for the NLCD and Chesapeake Bay Program Land Data Team's land use names.

- Cultivated Crops = CRP

- Commercial = TCI
- Commercial = INR
- Highway = IR
- Multi-Family Residential = TCT
- Single Family Residential = TG
- Forest = FORE
- Harvested Forest = HFOR
- Open Space = MO
- Water = WAT
- Wetland = WLF
- Wetland = WLO
- Production Area = FEED
- Ag Open Land = AOP
- Pasture/Hay = PAS
- Construction = CON

Agricultural Land Use Computations

Once the geographical attributes to each year of land use are complete, the data are further divided into additional categories. The crop and pasture have feeding space and agricultural open land added using a proportioning method. All data are from scenarios without BMPs, also referred to as "no action" scenarios. The crop and pasture acres are determined using the downscaling method, described in the geographical methods. The production area, or feeding space method, is the same that is used in CAST. It is determined by the number and type of animals reported in the National Agricultural Statistical Service's Agricultural Census and set number of acres per animal type. The production area is proportioned to NHD catchments based on the acres of crop and pasture. These are added to the agricultural land use with subtraction of crop and pasture to keep the total size of agriculture the same as before the feeding space was added.

The agricultural open land is based on the agricultural census acres of wild hay acres. A ratio of wild hay to other crops of pasture type are computed. This is multiplied by the total pasture acres, and then the pasture acres are reduced to accommodate the newly added agricultural open land.

Urban and Natural Land Use Calculations

The agricultural, urban, and natural land uses are combined into one dataset. The construction acres are proportionally taken from all land uses in the area they exist in the NHD catchment in that year. Delaware supplied construction acres by NHD catchments, HUC-12 and construction start date. HUC-12s not located in Delaware were deleted. These were determined to have inaccurate latitude and longitude locations. Analysis showed that construction occurred in urban areas, natural areas, and agricultural areas where poultry houses and other farm buildings are constructed. Construction is calculated from the NOI data available for the years 2007 to 2019. The average active construction time is 1.7 years. Discussions with the Sediment and Stormwater Program concluded that we would use two years as the average length of time a site is in active construction. Years between 2010 and 2019 follow the same pattern as is shown below with 2010 and 2011 examples.

- 2010 acres include the cumulative total of the 7/1/2008 to 12/31/2008, all of 2009, and 1/1/2010 to 6/30/2010 acres.
- 2011 acres include the cumulative total of the 7/1/2009 to 12/31/2009, all of 2010 and 1/1/2011 to 6/30/2011 acres.

The data are calculated from the NOI 2007 to 2019 data using a rolling average time period at the HUC-8 scale. Years between 1990 and 2009 are back casted. Years between 2019 and 2025 are linearly projected.

For each year, the construction acres are distributed to the NHD catchments in the proportion of the catchment in the HUC-8. The other land uses are decreased proportionally to account for the addition of construction acres. As such, all land area is kept the same total acreage.

The harvested forest land use is added by multiplying the forest land use acres by 1.5 and reducing the forest acres proportionally in each NHD catchment and year.

The CSO acres are supplied by Delaware and where the system type is combined, rather than stormwater, then all the land uses in that NHD catchment are designated as CSO. The land use is not changed to CSO, but rather attributed as CSO.

Direct Loads

The direct loads to the stream are modeled from the following sources:

- Rapid infiltration basins (RIBs) and Spray irrigation
- Industrial wastewater (exposure only)
- Municipal Wastewater

BMP Costs

There is a cost per unit for each BMP that comes directly from CAST.

Appendix B

Watershed Stewardship

Marketing and Communications Plan

Mission: Create an informed, diverse community of citizens and local leaders with the knowledge and resources to achieve the goals of the Division of Watershed Stewardship.

Communication Channels:

Websites Social Media Press Handouts	Email Events Workshops Presentations	Interviews TV/Radio Newsletter Mail

Partners

• Nanticoke Watershed Alliance • Delaware Nature Society/ Abbotts Mill Nature Center • University of Delaware • Chesapeake Bay Program • Nanticoke Watershed Conservancy • The Nature Conservancy • Delmarva Poultry Industry • Shore Rivers • Friends of the Bohemia • All state parks • Delaware Master Gardeners	• Salisbury University • Delaware State University • Environmental Protection Agency • US Department of Agriculture Natural Resources Conservation Service Farm Service Agency • DE Department of Agriculture • DE Department of Transportation • New Castle County • Kent County • Sussex County • New Castle Conservation District	• Kent Conservation District • Sussex Conservation District • All Delaware Towns • All Delaware Cities • Elected Officials • Community Leaders

Marketing & Communications Objectives:

- Develop key messages and education/outreach materials for the Chesapeake Bay Phase III Watershed Implementation Plan (CB WIP), Nonpoint Source Program, and statewide efforts of the Division of Watershed Stewardship.
- Support the education and outreach efforts of the CB WIP subcommittees, NPS Program, and other programs within the Division of Watershed Stewardship, throughout the state.
- Maintain the goals of the CB WIP Phase III Strategic Communications Plan as well as other EPA approved WIP's, pollution control strategies and plans throughout the state with measurable outcomes.
- Develop outreach programs that encourage and inspire individuals to adopt practices that improve water quality throughout the state.
- Maintain the flow of information and provide liaison between Federal and State agencies; state and local governments; stakeholder groups; media outlets; collaborating agencies and organizations; and the public.
- Strengthen and/or create partnerships with other agencies/stakeholders, both public and private.

Marketing and Communications Strategies:

I. Assist in the coordination of virtual and/or in-person meetings with stakeholders.

   - Contact partners and stakeholders to encourage participation.
   - Assist in scheduling virtual and/or in-person meetings.

II. Maintain social media accounts and website.

   - Maintain and expand Division of Watershed Stewardship Facebook account.
   - Assist in website updates.
   - Share digital outreach materials through social media.

III. Assist in the coordination of virtual and/or in-person outreach campaigns as well as education and training activities for stakeholders in support of the Delaware NPS Program grant deliverables for outreach and education.

- Develop and/or promote quarterly interactive activities supporting the Division of Watershed Stewardship goals through social media.
- Maintain updated contact lists for Chesapeake Bay WIP stakeholders and provide updates quarterly.
- Share information on webcasts pertaining to healthy watersheds with stakeholders.
- Coordinate participation and exhibit at outreach events throughout the state.
- Notify stakeholders of education and training opportunities through social media.

IV. Represent the Department in marketing or advertising activities such as meetings, press conferences or other promotional events.

- Focus on successes and issue regular press releases.
- Conduct social media campaigns.
- Participate in, in-person events, activities, or workshops.
- Serve as Delaware representative of the Chesapeake Bay Program Communications Workgroup and provide updates to stakeholders.
- Serve as Delaware representative of the Chesapeake Bay Program, Stewardship Workgroup and provide updates to stakeholders.
- Serve on DNREC Earth Month Planning Committee
- Serve as Delaware representative on the Chesapeake Bay Executive Council Planning Committee

V. Conduct market research to target specific groups, determine effectiveness of marketing activities, and recommend enhancements or refining of marketing strategies.

- Use social media to reach target audiences with daily posts, determine effectiveness through analytics and incorporate DEIJ goals.
- Identify stakeholder groups that are not currently represented and create meaningful opportunities and programs to recruit and engage them.
- Promote environmental justice through the meaningful involvement and fair treatment of all people, regardless of race, color, national origin, or income.
- Enhance communication and outreach with underrepresented stakeholders
- Determine new strategy for in-person outreach efforts as COVID-19 restrictions change.

VI. Identify channels of promotion, distribution, or advertising products or services. Review current channels of communication and explore additional opportunities.