11. WATER RESOURCES

Introduction

The Water Resources Element (WRE) articulates the County's policy framework for sustaining public drinking water supplies and protecting the County's waterways and riparian ecosystems by effectively managing point and nonpoint source water pollution.

Worcester County intends to meet its requirements under Maryland's stormwater regulations with continued support in developing restoration work plans and implementing water quality best management practices (BMPs) to address the impacts of stormwater runoff and nutrient loadings. This chapter aligns with the State of Maryland's Eight Sustainable Growth Planning Principles, in particular concerning growth areas, infrastructure, and sustainability.

This chapter identifies opportunities to manage existing water supplies, wastewater effluent, and stormwater runoff, in a way that balances the needs of the natural environment with the County's projected growth. In this way, the WRE creates a framework to protect the local and regional ecosystems while ensuring clean and adequate drinking water for future generations of Worcester County residents. Climate change, including sea-level rise, stronger storms, and prolonged droughts, poses new challenges for water supply reliability and watershed health. Accordingly, the WRE is designed to serve not only as a regulatory compliance tool but also as a proactive resilience strategy to safeguard the County's communities and resources.

Goals and Objectives

The goal of the WRE is to preserve and protect the County's existing water resources for their ecological value and importance to the water supply, while also addressing the impacts of future growth. Objectives include providing adequate public services, protecting drinking water supplies, preserving ecological functions, accommodating growth through compact patterns, and ensuring that future development minimizes disruption to environmental resources.

To strengthen accountability, the County will establish measurable objectives which are listed below:

1. Provide Adequate Public Services

   Water Supply and Infrastructure Resilience

   - *Action Item 11.1.1:* Reduce unaccounted water loss to below 10% of system withdrawals by 2030.
   - *Action Item 11.1.2:* Update design standards for water and wastewater infrastructure to account for increased flood frequency and intensity.
   - *Action Item 11.1.3:* Require siting of new wells, pumping stations, and treatment facilities outside of FEMA 100-year and 500-year floodplains where feasible.
   - *Action Item 11.1.4:* Require abandonment of private wells in areas with new public service connections.
   - *Action Item 11.1.5:* Requiring annual monitoring and public reporting of water and wastewater performance.

   Wastewater Services

- *Action Item 11.1.6:* All new private systems up to 50,000 GPD must incorporate enhanced nutrient removal technology.
- *Action Item 11.1.7:* Spray irrigation sites will undergo performance monitoring to confirm nutrient uptake effectiveness.
- *Action Item 11.1.8:* No new surface water discharges will be approved in sensitive and impaired watersheds.
- *Action Item 11.1.9:* Worcester County will develop a nutrient trading framework for agricultural, municipal, and development sectors.
- *Action Item 11.1.10:* Worcester County will adopt a goal of reducing septic nitrogen loads by 20% by 2035.
- *Action Item 11.1.11:* All Critical Area septic systems must be upgraded to BAT (Best Available Technology) by 2030.
- *Action Item 11.1.12:* The County will incentivize cluster and shared BAT systems for dispersed rural lots.

2. Protect Drinking Water Supplies

Contaminant Monitoring & Response

- *Action Item 11.2.1:* Monitor and address emerging contaminants such as PFAS and microplastics.
- *Action Item 11.2.2:* Establish a County-wide program to test public water systems and representative private wells for PFAS and other emerging contaminants.
- *Action Item 11.2.3:* Coordinate with MDE, USGS, and EPA to establish clear action thresholds for PFAS.
- *Action Item 11.2.4:* Incorporate PFAS monitoring results into water appropriation permitting and Water and Sewer Plan amendments.

Aquifer Protection

- *Action Item 11.2.5:* Monitor aquifer water levels for saltwater intrusion risks tied to sea-level rise, especially in the Pocomoke and Ocean City aquifers.
- *Action Item 11.2.6:* Prioritize monitoring in the Pocomoke aquifer area due to chloride risks.
- *Action Item 11.2.7:* Adopt wellhead protection ordinances for Pleistocene aquifer-dependent systems.

3. Preserve Ecological Functions

Groundwater & Land Use Decisions

- *Action Item 11.3.1:* Connect land use policies with groundwater recharge requirements.
- *Action Item 11.3.2:* Prioritize low-impact land development practices that maintain natural infiltration.

Stormwater and Non-Point Source Pollution

- *Action Item 11.3.4:* Require all new development greater than one acre to implement green infrastructure BMPs (e.g., bioretention, permeable pavement, green roofs).
- *Action Item 11.3.5:* Establish a retrofit program with a goal of converting at least 25% of existing stormwater facilities to enhanced BMPs by 2035.
- *Action Item 11.3.6:* Create a stormwater utility fee to fund retrofits and long-term maintenance.
- *Action Item 11.3.7*: Developers must meet nutrient reduction standards through on-site BMPs or participation in nutrient trading.

4. Accommodate Growth Through Compact Patterns

Growth and Infrastructure Coordination

- *Action Item 11.4.1:* Expand use of water conservation technologies in new developments.
- *Action Item 11.4.2:* Ensure that land use decisions and infrastructure planning support compact development and reduce strain on ecological systems.

5. Ensure that Future Development Minimizes Disruption to Environmental Resources

Unified Approach to Environmental Stewardship

- *Action Item 11.5.1:* Integrate climate resilience throughout the water management framework.
- *Action Item 11.5.2:* Establish measurable targets for nutrient reduction, water conservation, and infrastructure resilience.

Water Supply – Current Conditions and Groundwater

Worcester County's water supply relies entirely on groundwater resources, primarily from four aquifers: the Pleistocene, Pocomoke, Ocean City, and Manokin. Studies have shown both the productivity of these aquifers and their vulnerability to saltwater intrusion and over-pumping. While older reports provide a foundation, more recent USGS and MDE data will be incorporated into ongoing assessments to ensure planning decisions reflect current conditions. Development proposals in sensitive recharge areas must demonstrate no-net-loss of infiltration capacity, and future planning will emphasize cross-jurisdictional coordination with Delaware for aquifers shared across state lines.

Available Groundwater Resources

According to the State of Maryland, Department of Geology, *Mines and Water Resources Bulletin 16*, 1955, "The quantity of groundwater in the sedimentary deposits of Somerset, Wicomico, and Worcester Counties is estimated at 600,000 billion gallons."[1] Much of this water cannot be recovered because it exists in clay formations or at depths down to 8,000 feet and much is highly mineralized, which limits its uses.

[1] http://www.mgs.md.gov/publications/report_pages/BULL_16.html

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As *Bulletin 16* states, "Of greater importance than the quantity of water stored in the sediments is the quantity of groundwater recharge by infiltration from rainfall and from bodies of surface water." The importance of aquifer recharge is obvious when wells are impacted by drought or saltwater intrusion due to over-pumping. Reclaiming, reusing, and returning groundwater to the aquifer source is the best way to protect and preserve the water resources locally.

In 2016, the United States Geological Survey (USGS) published a report documenting a regional assessment of groundwater availability in the Northern Atlantic Coastal Plain Aquifer System that identified the amount, location, and character of groundwater supply sources to help Coastal Plain counties facilitate sound management of these sources.[2] The report noted that, due to population increases and changes in land use the water levels in many of the confined aquifers are decreasing by as much as two feet per year. The report emphasizes the need to balance the water withdraw with the aquifer recharge and the potential effects of long-term climate change on changes in aquifer recharge and in sea-level rise.

General Hydrology

Worcester County lies within the Atlantic Coastal Plain Physiographic Province. This province includes roughly the area east of Interstate 95 in Maryland. It is underlain by unconsolidated elastic sediments of Lower Cretaceous to recent age, which thicken to the southeast so that they appear wedge-shaped. The thickness of these sediments is greater than 8,500 feet beneath the Atlantic shore. There are five small community water systems that pump water from the Quaternary sediments, an unconfined aquifer. This aquifer has been studied considerably, and hydrologic, lithologic, and geochemical data is available in several Maryland Geological Survey reports (1955, 1972, 1974, 1982, 2013 and 2018)

The County has four main sand and gravel aquifers that yield substantial quantities of groundwater. The four aquifers used in Worcester County, in order of increasing depth, are the Pleistocene, Pocomoke, Ocean City, and Manokin Aquifers.

Figure 11-1 shows a cross section of these aquifers in northern Worcester County. **Figure 11-2** shows the areas of the County where the principal aquifers, Pleistocene, Pocomoke, and Manokin Aquifers, are used, and **Table 11-1** lists the aquifer nomenclature-depths, thickness, and soil characteristics. A brief explanation of each aquifer follows.

[2] https://pubs.usgs.gov/publication/pp1829

Figure 11-1. Cross Section of Aquifers in Northern Worcester County, Maryland.

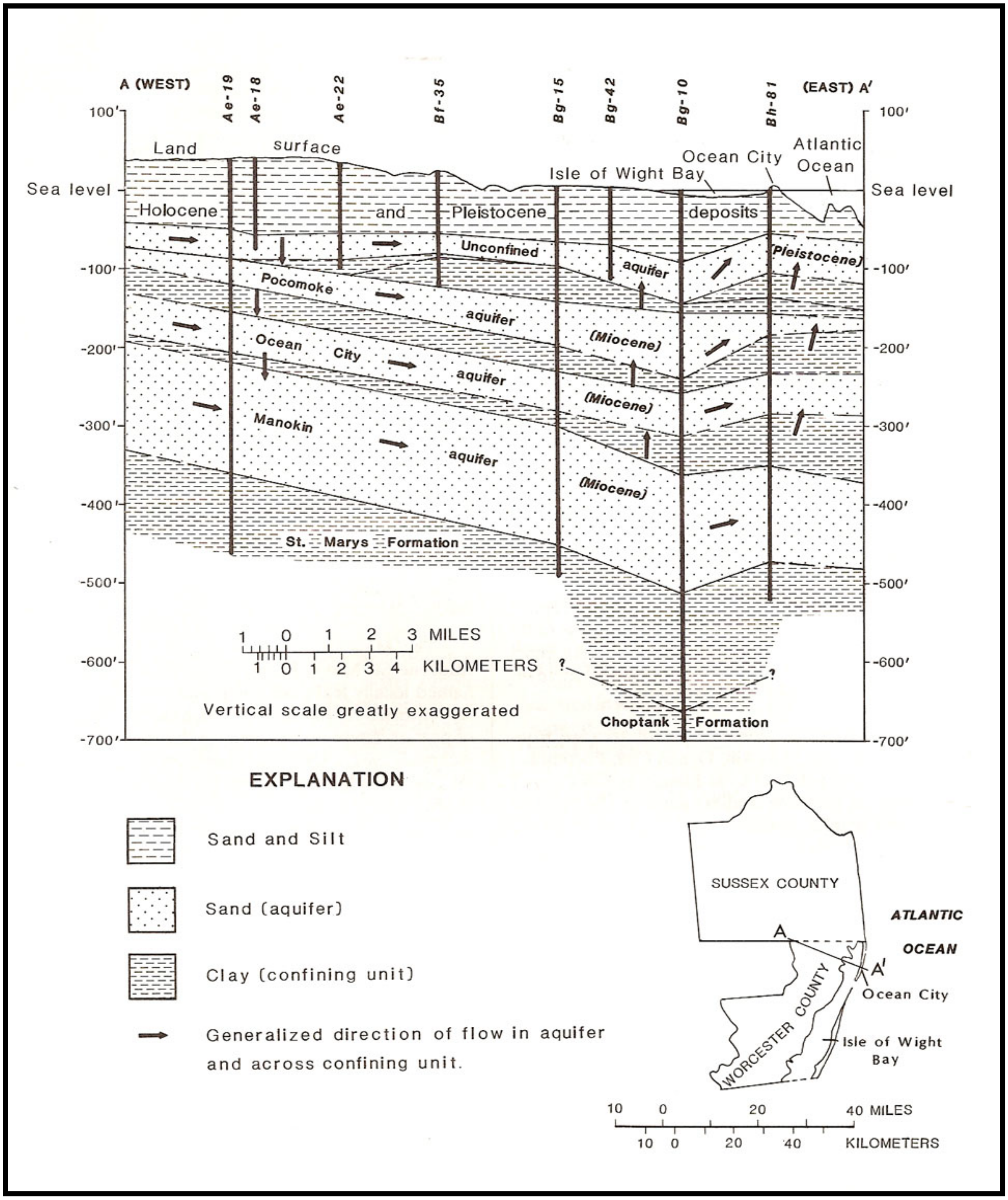

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Figure 11-2. Principal Aquifers in Worcester County, Maryland

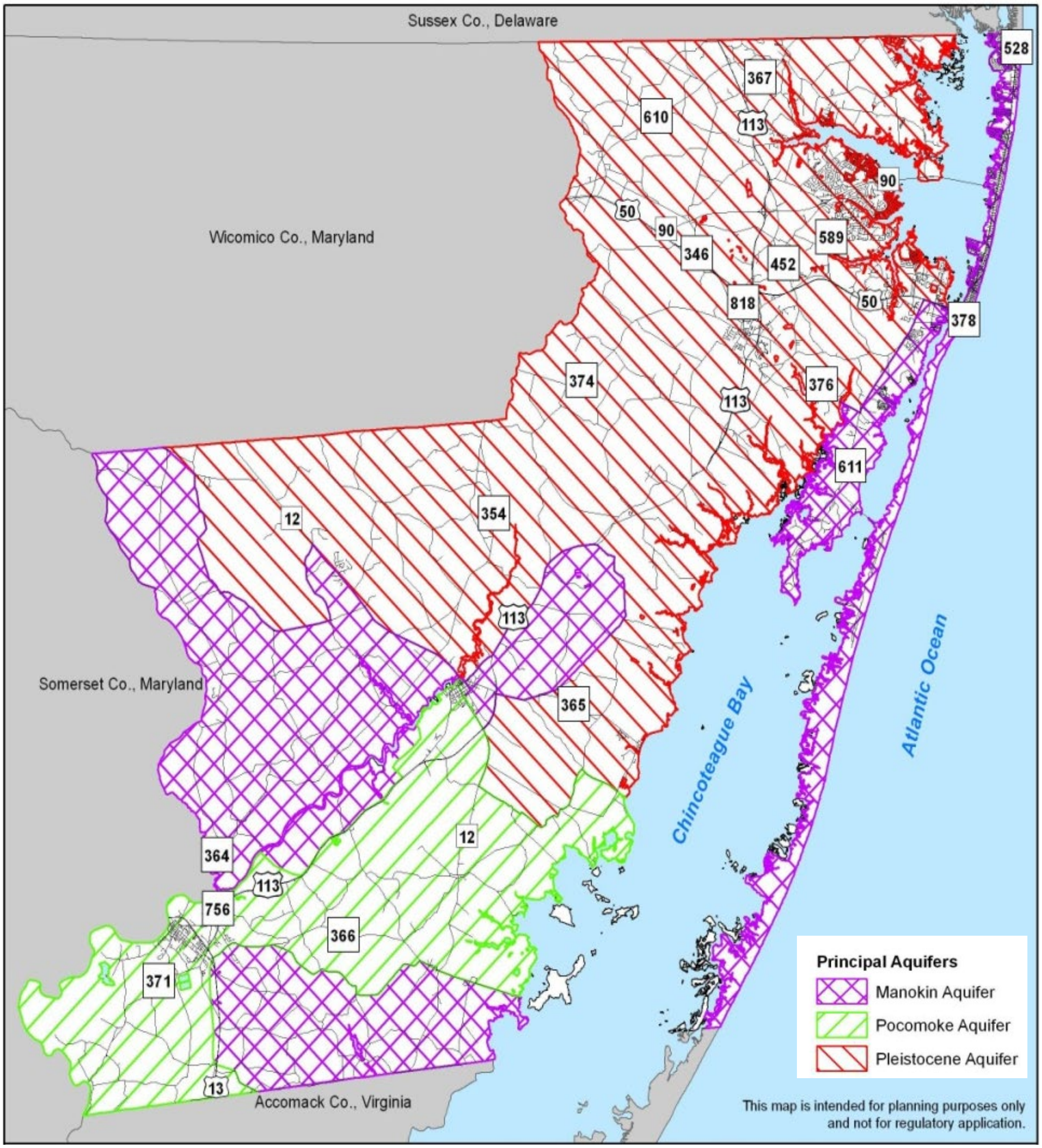


Table 11-1. Coastal Plain Stratigraphic Nomenclature and Aquifers of the Eastern Shore of Maryland

System	Series (Group)	Geologic Unit	Thickness (feet)	Hydrogeologic Unit(s)	Dominant Lithologic Character
Quaternary & Tertiary	Holocene	Holocene deposits	0 – 40	-----	Soil, alluvial sand and silt, dune sand, and peat. Disconformable base.
	Pleistocene & Pliocene (Columbia Group)	Shoreline complex	0 – 230	Columbia Aquifer	Lenticular deposits of sand, silt, clay, and peat. Some beds of coarse sand and fine gravel. Tan; some gray and blue clay.
		Salisbury Formation: Beaverdam Fm. and Pensaukan Fm. of Owens and Denny (1979)			Beaverdam Sand: Light gray to light tan, fine to coarse grained, moderately sorted, feldspathic sand. Pensauken Formation: Light tan to orange tan, medium to coarse grained, moderately to poorly sorted, pebbly feldspathic sand.
Tertiary	Miocene (Chesapeake Group)	Upper Miocene Aquifer Complex [Yorktown and Cohansey Formations of Rasmussen and Slaugheter (1955)]	0 – 50	Upper confining bed	Lenticular silts, clays, and fine sands. Green-blue silt and fine gray sand most common, but occasionally includes blue-green pebbly clay.
			0 – 80	Pocomoke Aquifer	Sand, gray or tan-gray; coarse and pebbly generally, but locally fine.
			0 – 85	Lover confining bed	Blue and gray clayey silt and sand; some peat. Some beds of shell and calcite and/or limestone.
				Ocean City Aquifer	Coarse gray sand, fine gravel.
			0 – 240	Manokin Aquifer	Fine to very coarse gray sand, and some lignite or peat. Some silty sand and clay. Occasional beds of shell and/or “rock”.
		St. Marys Formation	0 – 190	Confining layer	Gray fossiliferous clay, silt, fine sand, and silty and sandy clay.
		Choptank Formation	0 – 240	Frederica Aquifer and confining layer	Gray fine sand. Thin Beds of shell and calcite. Green or brown clay and fine sand. Thin beds of shell and calcite or limestone.

The Pleistocene Aquifer

In many areas of the County, adequate quantities of groundwater can be obtained within the upper 100 feet of land surface from the Pleistocene Aquifer. The aquifer is very productive and is the most used; however, the deeper confined aquifers are becoming more utilized now. The Town of Berlin and the Ocean Pines community both utilize this aquifer, along with many smaller public water systems and hundreds of private wells. Agricultural wells are usually limited to this aquifer as well. This aquifer is generally considered to be unconfined, although in many areas it is partially confined by shallow silty clay layers. It receives recharge by local precipitation and is vulnerable to surface contamination and saltwater intrusion.

This aquifer is also referred to as the Columbia Aquifer or Quaternary Aquifer in MGS reports. The Quaternary sediments are mostly surficial, of fluvial and estuarine origin and are composed predominantly of sand and gravel with some layers of silty clay and clay. The aquifer functions as a water-table aquifer. Its thickness ranges from a few feet to 220 feet, with the thickest layers located in the northeast and southeast parts of the County. In general, the regional movement of groundwater is from areas with a high-water table, corresponding to topographic highs, towards streams and the Chesapeake Bay and the Atlantic Ocean. In areas with high water tables, there may be hydraulic connections with underlying aquifers, and water may move downward to recharge these underlying aquifers. Aquifer tests conducted on Quaternary sediments indicate that transmissivity ranges from 100 to 50,000 feet^2/day.

The Pocomoke Aquifer

The Pocomoke Aquifer is present in the southeastern two-thirds of Somerset County and most of Worcester County. The aquifer pinches out up dip in northeastern Worcester County. The altitude of the top of the Pocomoke aquifer decreases from its sub crop area to about 200 feet below sea level beneath Ocean City in Worcester County, Maryland. The Pocomoke Aquifer is composed of individual sands 10 to 20 feet thick, which cumulatively reach a maximum thickness of over 100 feet at Ocean City.[3] Transmissivity of the Pocomoke aquifer calculated at three sites in Worcester County ranges from 1,070 feet^2/d at Pocomoke City to 9,170 feet^2/d near Ocean City. A belt of above-average transmissivity extends northeastward from Newark, Maryland to Isle of Wight Bay, near Ocean City.

The Ocean City Aquifer

The Ocean City Aquifer is present in Maryland in the eastern half of Worcester County and the easternmost portion of Wicomico County. The altitude of the top of the Ocean City aquifer ranges from about 150 feet below sea level in northern Worcester County near the Wicomico County boundary, to 254 feet below sea level south of Ocean City. The aquifer pinches out up dip in eastern Wicomico County. The aquifer ranges from about 30 to 110 feet thick and dips at about 10 feet/mi. The aquifer is thickest in the Town of Ocean City. Transmissivity of the Ocean City aquifer calculated at eight sites in

[3] http://www.mgs.md.gov/groundwater/coastal_plain_aquifers_mobile.html

Worcester County ranges from 670 to 5,500 $feet^2$/d. The most transmissive portion of the aquifer occurs in the fine to coarse sands that dominate the section in the southern portion of the Town of Ocean City.

The Manokin Aquifer

The Manokin aquifer is present in Maryland in Wicomico, Worcester and Somerset Counties. The altitude of the top of the aquifer decreases from its sub crop area in the western portion of Wicomico County to approximately 370 feet below sea level at Ocean City and southeastern Worcester County. Individual sands within the Manokin aquifer average 10 to 20 feet thick, with the greatest cumulative thickness reaching 195 feet in Worcester County. The aquifer generally dips to the southeast at about 5 to 10 feet/mi. Transmissivity of the Manokin aquifer ranges from 480 to 14,800 $feet^2$/d. At Salisbury, transmissivity is as high as 7,440 $feet^2$/d. Storage coefficient ranges from 2×10^{-4} to 1×10^{-3}As described above, the County's sole source of potable water is withdrawn from four aquifers.

The Pleistocene Aquifer is the most used; however, the deeper confined Manokin and Pocomoke Aquifers, as shown in **Figure 11-3**, supply potable water to the southern and far eastern and central western parts of the County. The deeper aquifers are confined (artesian) aquifers, except for the Pocomoke Aquifer in a small area of Bishopville. The recharge areas for these aquifers may be several miles away. These aquifers are less susceptible to surface contamination but more impacted by over-pumping. Ocean City, Snow Hill, and Pocomoke utilize these aquifers, along with many smaller public systems and private wells. Combined, these aquifers have supplied and are likely to continue to supply an adequate amount of water to users in the County. In the following discussion, the *Groundwater Protection Report* is summarized.

Water Supply Infrastructure

Table 11-2. Non-transient Water Systems by Use

Use	Transient, Non-Community	Non-Transient, Non-Community
Mobile Home Parks	4	2
Golf Courses	8	0
Commercial Centers	4	9
Hotel/Motel	5	2
Racetracks	0	1
Campgrounds	8	2
Industrial	4	1
Daycare/schools	2	7
Offices	3	2
Restaurants	33	0
Parks and Recreation	17	0

TOTAL	88	26

Source: Worcester County Department of Environmental Programs, August 2025.

The County provides water service to approximately 16,900 customers through 16 supply wells and multiple treatment facilities, with Ocean City as the largest provider. To maintain reliable and resilient service, the County will require all community water systems to prepare asset management plans addressing long-term maintenance, replacement, and funding. The County will also establish a program to monitor and reduce unaccounted-for water losses and will prioritize interconnections between systems to enhance redundancy during emergencies. County-wide PFAS testing will be initiated for all public systems and a representative sample of private wells, with thresholds for action established in coordination with MDE and USGS.

Groundwater is the sole source of potable water in the County. There are 19 community water systems: four municipalities (Ocean City, Pocomoke City, Berlin, and Snow Hill), six County-owned systems, six mobile home parks, and three systems serving apartment complexes. There are 26 non-transient non-community water systems that serve a variety of large non-residential uses. **Table 11-2** lists the number of non-transient systems by use. In addition, there are 88 transient non-community water systems that serve a variety of commercial, government, office, and seasonal residential uses. There are also 4 non-transient, non- community systems within Ocean City, two that serve hotels and two that serve condominiums that provide secondary water treatment for their users.

Depending on their location, these water systems may use the shallow Pleistocene Aquifer or the deeper confined aquifers. Many of these water systems have multiple wells. The largest water supplier in the County is the Ocean City municipal system, which has 24 wells in the Ocean City Aquifer. The wells are strategically distributed across three water treatment plants in Ocean City: 15th Street Water Treatment Plant, 44th Street Water Treatment Plant and the Gorman Avenue Water Treatment Plant. The Mystic Harbour Water Service Area, which partially overlaps the West Ocean City Service area, currently has several hundred domestic and commercial wells at varying depths. These wells serve a variety of uses including existing residences. If these wells fail, user(s) must connect to a public water distribution network if it is readily accessible to the property.

Water Planning Areas

Water planning areas are tied to designated growth centers, with expansion requiring amendments to the Water and Sewer Plan. To strengthen this framework, all amendments must be supported by groundwater availability analyses that confirm long-term aquifer recharge capacity. New W1 designations will not be approved in FEMA-designated floodplains, ensuring that infrastructure investments are resilient to climate-related risks. Future amendments must explicitly demonstrate that proposed expansions will not exceed sustainable withdrawal levels.

A water planning area is an area designated as planned to receive public water service from a town or the County. The estimated time for receiving service is represented by one of the following designations: Present to two years (W1), future service 3-5 years (W2), or future service 6-10 years (W3). The areas served by private community systems can be designated W1 but are not planning areas.

Creating or amending a planning area requires an amendment to the *Water and Sewer Plan*. However, the inclusion of any water system in the *Water and Sewer Plan* does not legally obligate the County or any of its political subdivisions to take any action to implement such projects or to enforce the implementation of such projects.

The *Comprehensive Plan* has designated growth areas near existing population centers and attempted to continue the County's compact development pattern. **Figure 11-3** shows the water system planning areas overlain on areas zoned for development and planned for growth at urban densities. This approach will assist in the containment of water service costs.

Most of the existing water systems serve communities or uses with limited expected growth. Growth in such areas will generally be infill or modest service area expansion over the next ten years. Some of the water service areas will expand in accordance with the County's planned growth strategy. An amendment to the *County Water and Sewer Plan* is necessary for expansion of a water or sewer planning area. Compliance with this plan is a prerequisite for state approval of both groundwater discharge and groundwater appropriation permits.

Water Management Strategy Area

The St. Martin's River/Ocean Pines area has been identified as vulnerable to saltwater intrusion.[4] **Figure 11-4** shows the general boundary line for the strategy area. To address this, all new wells in the strategy area will be required to undergo saltwater intrusion modeling prior to permitting. Worcester County, in partnership with MDE and USGS, will implement annual chloride monitoring and public reporting to provide early warning of aquifer deterioration.

[4] https://mde.maryland.gov/programs/Water/water_supply/Pages/WaterManagementStrategyAreas.aspx

Figure 11-3. Water Planning Areas - Generalized Boundaries for W1, W2, and W3

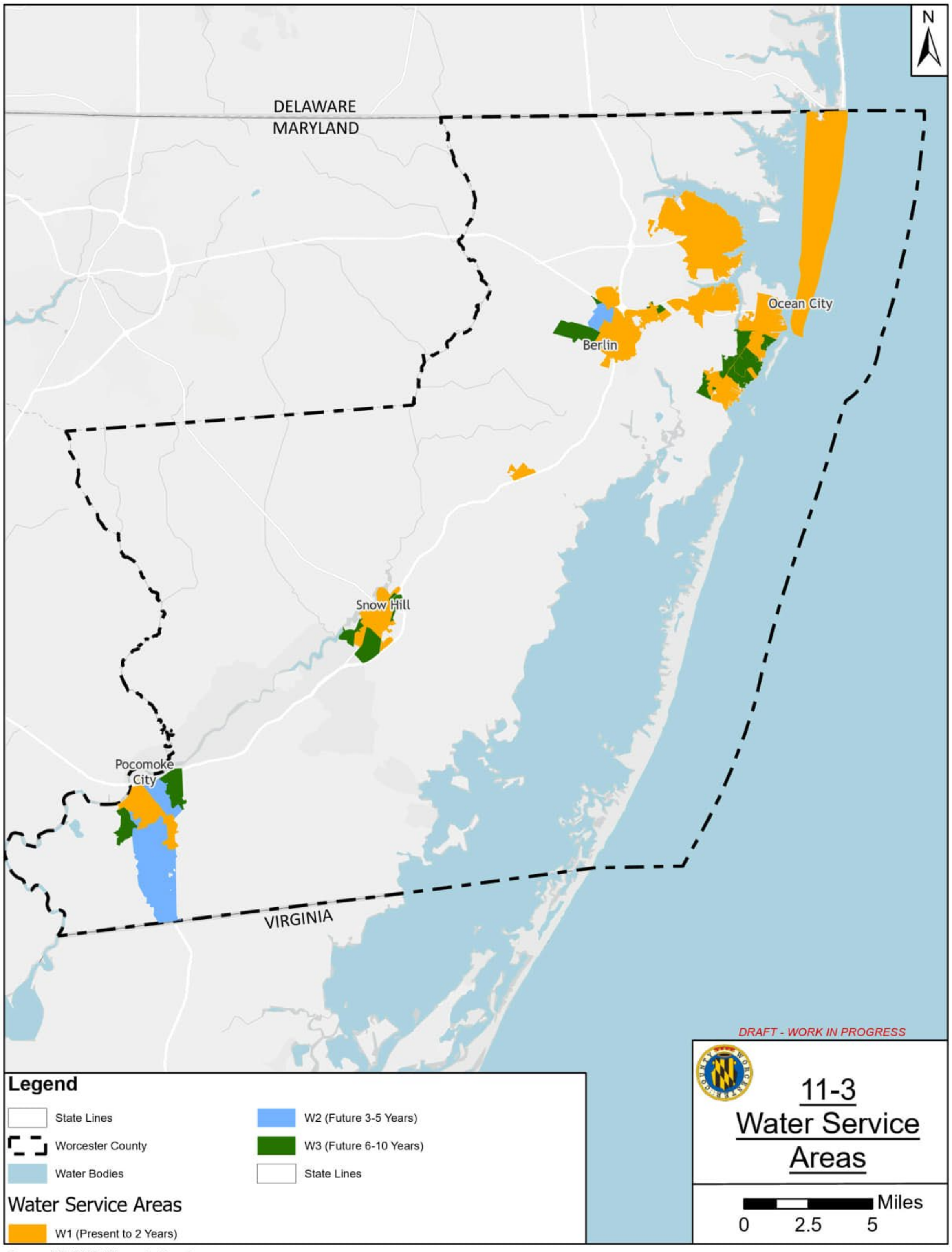
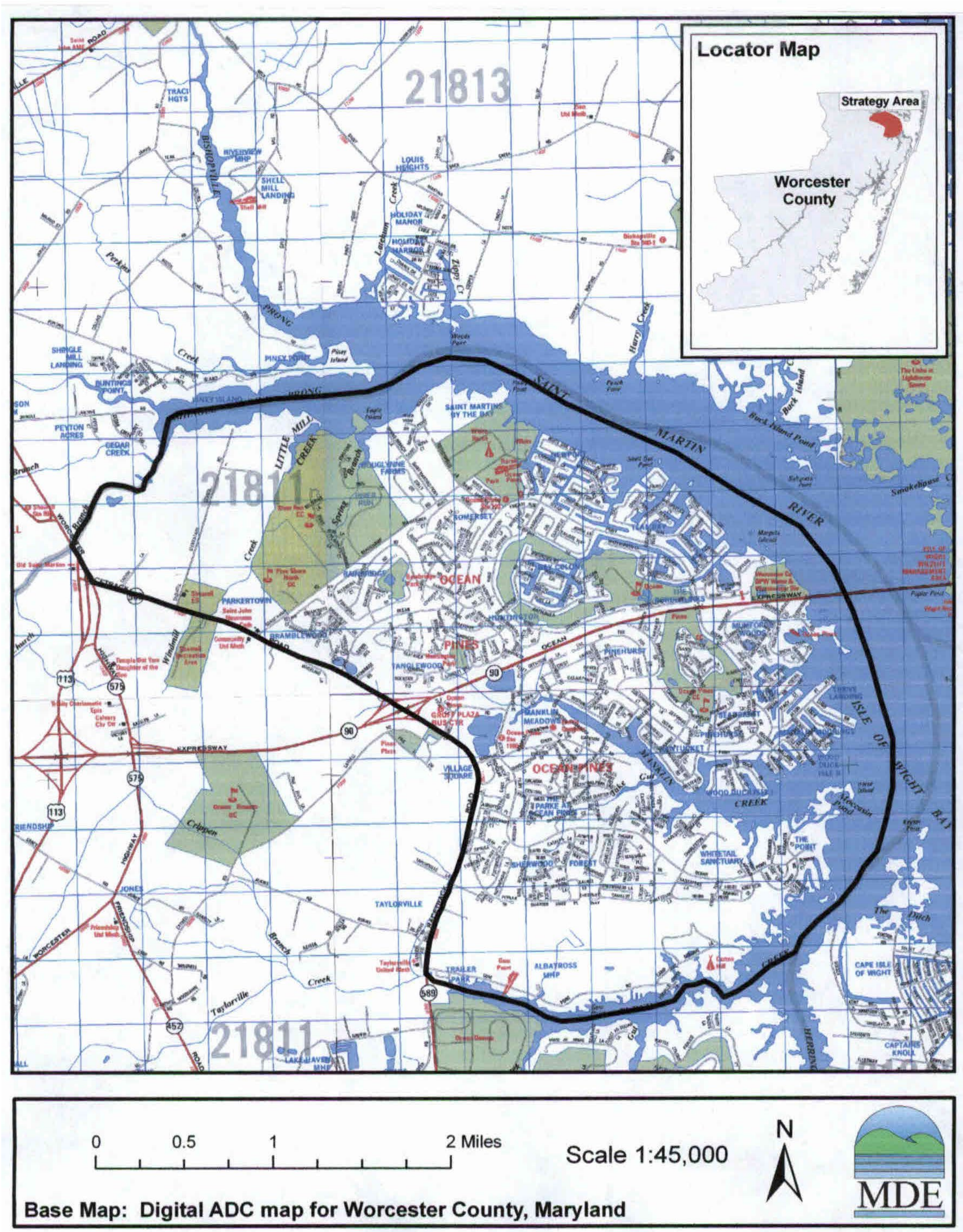


Figure 11-4. St. Martins River/Ocean Pines Water Management Strategy Area



Additional State regulations address unaccounted water for capacity development for new systems, water appropriations, and water conservation plumbing fixtures. The Code of Maryland Regulations (COMAR) 26.04.01.36.G (b) requires a plan for tracking unaccounted for water. This regulation is intended to keep systems informed about how much water is leaking in distribution systems.

The MDE also issues water withdrawal permits for beneficial appropriations or use (COMAR 26.17.06.05.A). This regulation assists local jurisdictions by adding further scrutiny to the permitting process; for example, during the permit review process applicants are required by the State to determine unaccounted water in their permit application. Applicants must also certify that they will install water conserving fixtures that will conform with the State Plumbing Code. For instance, COMAR 09.20.01.02.H (1) requires low flow toilets to be installed for all new facilities. Furthermore, COMAR 09.20.01.02.J (9) and 12-605 to 12-607 in the Annotated Code of Maryland prohibits the installation or sale of a plumbing fixture which is not an approved plumbing fixture. Thus, no high flow plumbing fixtures can be legally sold or installed in buildings in the County. The County's *Water and Sewer Plan*, according to COMAR 26.03.01.07, must also conform with Maryland's Water Conservation Plumbing Fixtures Act (MWCPFA).

Water Supply Assessment and Rural Water Supply

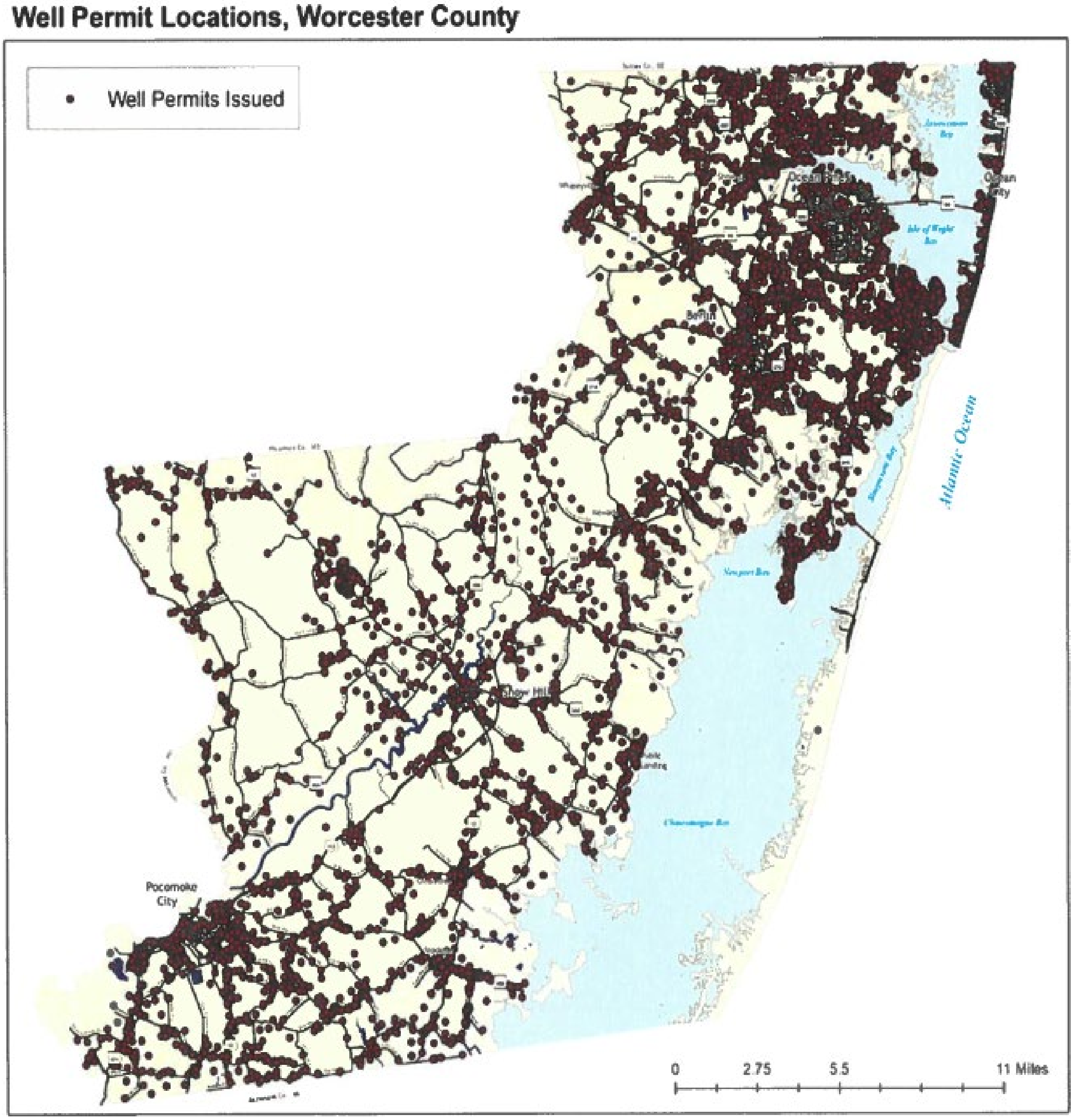
Groundwater withdrawals are projected to increase from 31 to 38 million gallons per day over the next 20 years, with agriculture accounting for roughly one-third of this demand. To ensure sustainability, Worcester County will require annual agricultural irrigation reporting to improve accuracy of water use data. The County will also support cost-share programs to encourage precision irrigation and water reuse in farming operations. In areas such as southwestern Worcester County, where the Pocomoke Aquifer shows signs of stress, the County will develop contingency measures that may include alternate supplies and drought restrictions.

Groundwater Withdrawals

Maximum daily groundwater withdrawals in Worcester County are estimated at approximately 31 million gallons per day, or GPD (**Table 11-3**). In the future, withdrawals are projected to increase to approximately 37 million gallons per day. This reflects a 17 percent increase in withdrawals from all uses. Three fourths of the withdrawal will be in municipal water systems. Public water systems including major community water and municipal water serving residential and commercial areas as well as major industry have the potential to withdraw up to 19.5 million GPD of groundwater. Maximum withdrawal by public water systems is projected to increase by approximately 5.6 million gallons per day. There are a few industrial users on individual wells which withdraw up to 90,000 GPD of groundwater. The maximum daily withdrawal for private residential wells is approximately 2.1 million GPD, which includes approximately 5,533 wells.

Agriculture withdraws an average of 9.3 million gallons of water daily, accounting for nearly one third of the potential water usage in the County. This is common for most of Maryland's Eastern Shore, where farmers use groundwater for crop irrigation and livestock (primarily poultry) watering. Agriculture's groundwater withdrawal may increase by nearly 1 million GPD in the future.

Figure 11-5. Well Permit Locations, Worcester County



Source: Database from Department of Environmental Programs, August 2025.

Table 11-3. Existing and Future Maximum Daily Groundwater Withdrawals (GPD)

Use	Existing Use	Future Use
Major Community Water System	3,995,000	4,623,500
Municipal Water System	15,564,000	20,570,000
Industrial	90,000	90,000
Agriculture water use*	9,352,500	10,194,225
Private residential well	2,100,000	2,306,250
Total Groundwater usage	31,101,500	37,783,975
Natural groundwater available[5]	Adequate	Adequate
Recharge rate	Adequate	Adequate
Groundwater remaining	Adequate	Adequate

Source: Maryland Department of Environmental Programs
*Agricultural water use is based on daily average amount not to exceed annual withdrawal permits.

Rural Water Supply

Worcester County is still largely a rural County, with agriculture as a primary industry (second to tourism). Poultry production and agricultural crop production (particularly corn and soybean) are the largest consumers of water in rural areas. While groundwater is the main source of water for farm irrigation, there is some surface water also used for irrigation in the southern areas of the County. Farm irrigation wells are restricted to the Pleistocene Aquifer but many poultry house wells utilize the deeper aquifers. Sufficient groundwater resources currently exist to supply the requirements of domestic wells in rural areas of the County and for the future, based on projected growth rates in those areas.

One area of concern is southwestern Worcester County, including the area surrounding Pocomoke City. This area utilizes the Pocomoke Aquifer only. The transmissivity of this aquifer has been decreasing over the years. Below the Pocomoke Aquifer, the groundwater is high in chlorides. Over-withdrawal of the Pocomoke Aquifer, causing decreased pressure in the aquifer and a large cone of depression, could causes chloride problems in the future. Monitoring water use in this region, including withdrawals from neighboring Somerset County, should be undertaken to ensure supplies are adequate for future growth in the area.

Projected Water Demand

Population growth is expected to increase demand by approximately 2.1 million gallons per day. To address capacity constraints, Worcester County will prepare a capacity gap action plan identifying areas where growth should be redirected or where additional infrastructure investment is needed. New

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[5] Sustainability of the Ground-Water Resources in the Atlantic Coastal Plain of Maryland by Robert J. Shedlock and David W. Bolton, https://pubs.usgs.gov/fs/2006/3009/

development will be required to demonstrate water efficiency at least 20 percent above state code minimums. Major subdivisions will be required to incorporate rainwater harvesting and greywater reuse systems as standard practice.

The following assessment was conducted to estimate potential water supply demand based on the County's *Comprehensive Plan.* The county-wide assessment required consideration of all persons living within municipal boundaries and in the County regardless of whether a private or public water supply is provided. The *Comprehensive Plan's* growth projections estimate approximately 5,000 more residents and approximately 2.1 million more gallons per day of water demand. **Table 11-4** shows the *Comprehensive Plan*'*s* allocation of population growth among the designated growth areas and identifies the additional water supply that will be needed to meet this demand.

Table 11-4. Growth Projects on Water Demand

Growth Area	Population Increase	Residential EDUs Generated	Non-Residential EDUs Generated	GPD/EDU	Additional Demand Projected (GPD)
1	1067	483	0	250	120,800
3	671	304	407	250	177,700
4	1261	570	0	250	142,600
5	0	0	351	250	87,900
6	2	1	810	250	202,800
7	154	70	4	250	18,500
9	15	33	0	250	8,300
10	201	91	0	250	22,800
11	6	3	0	250	700
12	382	173	0	250	43,300
14	33	15	369	250	96,200
15	2	1	707	250	176,900
16	0	0	99	250	24,900
17	0	0	162	250	40,700
18	0	0	15	250	3,700
19	0	0	73	250	18,300
20	0	0	1,187	250	296,700
21	0	0	37	250	9,400
22	0	0	139	250	34,800
23	79	36	763	250	199,700
24	0	0	318	250	79,500
26	92	42	0	250	10,400
28	142	64	0	250	16,200
29	4	2	0	250	500
30	0	0	133	250	33,300
31	379	171	0	250	42,900
33	195	88	333	250	105,400
35	174	79	0	250	19,800
36	0	0	192	250	48,000
Totals	**4,859**				**2,082,700**

Water System Capacity for Future Projected Growth

Table 11-5 lists the County and municipal public water systems and pertinent system facts. Except for Briddletown, Newark, Pocomoke, and the Village of Showell, the majority of the water systems in the County have more than enough planned capacity to supply water to the projected population under the growth assessment. The difference between the planned capacity and current capacity is the capacity for growth. Beyond this, additional users can be hooked up to existing water distribution systems while considering improvements needed for infrastructure distribution as well as the location of potential users relative to nearest water distribution system.

New Development Water Supply Policy

The County's policy regarding providing potable water to new development within a public water service area is that the developer(s) and/or property owner(s) associated with the growth area or the service area's expansion shall bear the responsibility for all costs associated with the water system's expansion. This includes costs that accommodate the proposed development, including infrastructure and treatment system costs. Treatment facilities and public infrastructure for new and expanded public water areas are built by the developer(s) and turned over to the County for operation and management of the systems.

Table 11-5. County and Municipal Water Systems

Water System	No. of Wells	Source Aquifer	Current Capacity (GPD)[1]	Planned Capacity (GPD)[2]
Assateague Pointe	2	Ocean City	35,000	64,000
Berlin	**3**	**Pleistocene**	**490,000**	**1,000,000**
Briddletown[1]	0	Pleistocene	0	0
The Landings	2	Ocean City	115,000	200,000
Mystic Harbour	3	Ocean City (1) Pocomoke (2)	512,500	1,000,000
Newark	2	Manokin (1) Pocomoke (1)	142,500	142,500
Ocean City	21	OC/Manokin	16,600,000	18,100,000
Ocean Pines	5	Pleistocene	1,500,000	2,000,000
Pocomoke	**5**	**Pocomoke**	**860,000**	**860,000**
Riddle Farms	2	Manokin	205,000	228,000
Village of Showell	**n/a**	**n/a**	**n/a**	**n/a**
Snow Hill	**3**	**Manokin**	**320,000**	**1,094,000**

Notes: Bold text indicates growth areas.

1. Briddletown is served by a contract with Berlin.
2. The current capacity for water means that the figure shown is the maximum treatment capacity of the water treatment system in conjunction with the average withdrawal limit under the water appropriation permit for the system.
3. The planned capacity is a number that was planned for the system and either has been achieved or will be achieved by infrastructure improvements and/or increases in water appropriation permits in the future. Planned capacity should be the increased capacity level needed to meet projected growth.
4. Water demand projections outside the County Growth Areas include: private residential wells which are expected to increase by 9% and the major community water systems which are projected to increase by 14% by 2025.

Water System Conclusion and Recommendations

An adequate water supply is necessary for growth and development within the County. Equally important is water system infrastructure, which may be the limiting factor for expansion of any water service area. While the quantity of groundwater in the County may be adequate, the quality of the water may make use of the water economically unfeasible, due to treatment costs.

Protection of the groundwater in areas that use the shallow Pleistocene Aquifer is highly recommended. Abandonment of water appropriation permits for areas connected to public water is highly recommended. Well-head protection ordinances should be considered for these systems. If they are approved, they should be adopted and implemented for each of the water systems that utilize this aquifer. While the deeper aquifers are not susceptible to surface contaminants, in Ocean City and Pocomoke, caution should be exercised so that increased withdrawals do not lead to saltwater intrusion either from lateral saltwater movement or upwelling from salty formations below.

Specific recommendations for water system improvements to address both quantity and quality as well as system maintenance needs are as follows.

- Adopt wellhead protection ordinances for Pleistocene aquifer-dependent systems.
- Require abandonment of private wells in areas with new public service connections.
- Prioritize monitoring in Pocomoke aquifer area due to chloride risks.
- Monitor aquifer water levels for saltwater intrusion risks tied to sea-level rise, particularly in the Pocomoke and Ocean City aquifers.
- Update design standards for water and wastewater infrastructure to account for increased flood frequency and intensity and require siting of new wells, pumping stations, and treatment facilities outside of FEMA 100-year and 500-year floodplains where feasible.
- Establish a County-wide program to test public water systems and a representative sample of private wells for PFAS (per- and polyfluoroalkyl substances) and other emerging contaminants of concern.
- Coordinate with the Maryland Department of the Environment (MDE), the U.S. Geological Survey (USGS), and the EPA to establish clear action thresholds for PFAS.
- Incorporate PFAS monitoring results into water appropriation permitting and Water and Sewer Plan amendments.

Wastewater Services

Worcester County's wastewater services guide development patterns and protect water quality. To further reduce nutrient loads, all new private systems up to 50,000 GPD will be required to incorporate enhanced nutrient removal technology. Spray irrigation sites will undergo performance monitoring to confirm nutrient uptake effectiveness. No new surface water discharges will be approved in sensitive and impaired watersheds, reflecting the County's commitment to protecting the Coastal and Chesapeake Bays.

11. WATER RESOURCES

Current Wastewater Conditions

The County adopted a policy in the 1980s that all wastewater services serving more than one lot or processing more than 5,000 gallons per day (GPD) must be owned and operated by the County or a municipality. This policy resulted from health and management issues with private systems in the County. It has recently been amended to permit certain larger systems up to 50,000 GPD that serve or plan to serve a shopping center, planned commercial development, unified development or cooperative campgrounds and mobile home parks to be privately owned. Provisions for County oversight and other safeguards have been provided. Systems with flows of 10,000 GPD or more must obtain an Individual Groundwater Discharge Permit from MDE per COMAR 26.04.02.05, as do systems utilizing spray irrigation for wastewater disposal of treated effluent, regardless of discharge volume. For areas outside of public service areas, development relies on on-site septic waste disposal systems. In the following discussion, the County's current wastewater planning areas and facilities, policy regarding new development and the current and future state of septic systems in the County are discussed.

Sewer Planning Areas

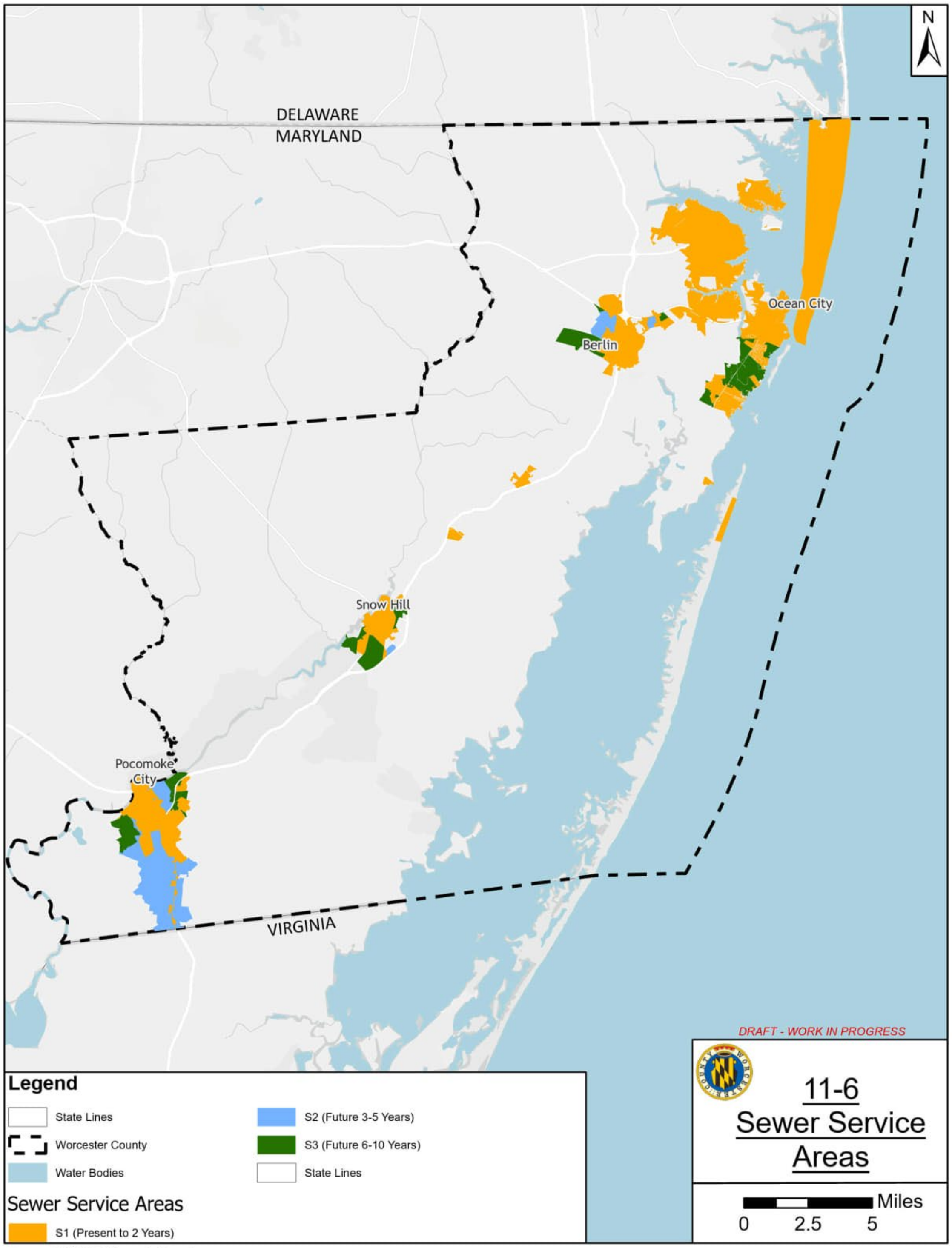
Worcester County has 13 wastewater treatment plants with varying levels of capacity. To ensure long-term compliance with nutrient reduction goals, all WWTP expansions will require demonstration of nutrient offsets. The County will prepare a resiliency plan to address the vulnerability of WWTPs in flood-prone areas. Facilities with remaining capacity will be prioritized for ENR upgrades to ensure consistent performance under stricter nutrient caps.

Sewer planning areas are generally adjacent to existing population centers and municipalities. A sewer planning area is an area designated as planned to receive public sewer service from a municipality or the County. The estimated time for receiving service is represented by one of the following designations: Present to two years (S1), future service 3-5 years (S2), or future service 6-10 years (S3). The areas served by private community systems can be designated S1 but are not planning areas. Creating or amending a planning area requires an amendment to the *Water and Sewer Plan*. However, the inclusion of any sewer system in the *Water and Sewer Plan* does not legally obligate the County or any of its political subdivisions to take any action to implement such projects or to enforce the implementation of such projects. Generalized sewer planning areas are shown in **Figure 11-6** along with the general location of existing wastewater treatment plants (WWTP). Using **Table 11-6** each WWTP can be named and described by its facility and discharge type.

As shown in **Figure 11-6** and **Table 11-6**, there are 13 Existing and one (1) Planned WWTPs located in the Coastal Bays Watershed: nine are owned and operated by the Worcester County Government while the National Park Service, Town of Berlin, and Ocean City each own and operate WWTPs in the watershed.

Currently, eight of the County-owned and operated WWTPs utilize spray irrigation and two discharge treated effluent via injection wells; thus, eliminating nutrient point sources from the Coastal Bays Watershed. There are three WWTPs in the watershed that discharge directly to surface waters. Converting these to spray irrigation in the future would eliminate the nutrient point sources from the watershed. The Ocean Pines WWTP will continue to discharge to St. Martin's River. This plant uses best available technology and exceeds ENR standards. In turn, this plant will serve to accept effluent from households previously on septic systems, lowering overall nonpoint source nutrient contributions to the Isle of Wight Bay.

Figure 11-6. Sewer Planning Areas



Source: MD iMAP, Worcester County

Generalized boundaries for S1, S2, and S3 are shown above. Use **Table 11-6** to identify facility descriptions.

11. WATER RESOURCES

Table 11-6. Wastewater Treatment Plant Description

ID No.	Watershed Name	Facility Type	Facility Name	Capacity (GPD)	Discharge Type
1.	Sinepuxent Bay	Major Community	Assateague Pointe	64,000	Spray
2.	Isle of Wight Bay	Major Community	Edgewater (Sussex County, DE)	61,000	Ocean outfall (DE)
3.	Sinepuxent Bay	Owned and operated by National Park Service	Federal Assateague Park	20,000	Overland flow *Spray in the future
4.	Newport Bay	Major Community	The Landings	100,000	Injection wells
5.	Assawoman Bay	Major Community	Lighthouse Sound	40,000	Spray irrigation onto golf course
6.	Sinepuxent Bay	Major Community	Mystic Harbor	450,000	Shallow groundwater injection wells and spray irrigation onto golf course
7.	Newport Bay	Major Community	Newark	58,000	Surface transitioning to spray irrigation
8.	Isle of Wight Bay	Major Community	Ocean Pines	2,500,000	Surface water discharge
9.	Isle of Wight Bay	Major Community	Riddle Farm	280,000	Spray onto adjacent golf course
10.	Isle of Wight Bay	Major Community	River Run	112,000	Spray in a dedicated spray field
11.	Isle of Wight Bay	Industrial *Planned for residential in the future	Village of Showell	Planned Facility	Surface (Industry permit) *Spray in the future if permitted for residential use
12.	Lower Pocomoke River	Municipal	The City of Pocomoke	1,470,000	Surface
13.	Newport Bay	Municipal	Town of Berlin	750,000	Spray in two dedicated spray fields
14.	Isle of Wight Bay	Municipal	Town of Ocean City	14,000,000	Ocean outfall
15.	Lower Pocomoke River	Municipal	Town of Snow Hill	500,000	Surface

Note: Overland flow treatment directs effluent into a wetland where three processes occur: transpiration, infiltration, and evaporation.

There are two plants whose discharge type is ocean outfall, Edgewater and Ocean City. The County sends wastewater from West Ocean City to the Town of Ocean City WWTP where treated effluent is discharged to the Atlantic Ocean. The Town of Snow Hill and the City of Pocomoke's WWTP are located along the Pocomoke River in the Chesapeake Bay Watershed and discharge directly to the river. Continued management of these wastewater services will help to reduce nutrient loads overall, is vital to the continuation of the County's concentrated development pattern, and the Comprehensive Plan's implementation.

Current Facility Parameters

Specific parameters for existing WWTPs owned and operated by either the County or a municipality are shown in **Table 11-7**. The average current flow estimates the average daily wastewater flow by gallons from current users. To determine the current committed capacity, the designated number of gallons per day per equivalent dwelling unit (GPD/EDU) is multiplied by the total number of users. The sum equals the current committed capacity and shall not exceed the permitted capacity. The difference between the permitted and committed capacity is the remaining capacity, implying that additional users may utilize wastewater services. In some cases, WWTPs have the capacity to serve expansions of growth, while others are very limited, having committed most of their capacity to undeveloped or developed properties within their service areas. However, to determine a WWTPs remaining capacity the factors below must also be considered.

- *Disposal Capacity:* A WWTP utilizing spray irrigation is limited by the ability of the service area to locate suitable land area for the purpose of spraying treated effluent.
- *Discharge Limits:* Increasing volume of treated effluent that is sprayed may exceed the land's ability to absorb and process the treated effluent per design standards.
- *Treatment Capacity:* Each WWTP must meet total nitrogen and total phosphorus standards measured on a pounds per year basis. Increasing the volume of treated effluent will increase nutrient loads. WWTPs cannot exceed nutrient caps and/or permit limits, whichever is more restrictive.
- *Physical Constraints:* The infrastructure may not function properly if permitted design limitations for the disposal method are exceeded or volume increases.

Despite having a small remaining capacity, these plants do have committed capacity that will be available to support new growth whether from undeveloped land or the intensification of uses on previously developed lands. Each municipality is currently upgrading or planning to upgrade their WWTP as necessary to conform with State treatment standards while accommodating new growth.

Table 11-7. Current Facility Parameters

Facility Name	Average Current Flow (GPD)	Current Committed Capacity (GPD)	Current Permitted Capacity (GPD)	Estimated Remaining Capacity (GPD)	Percent Remaining Capacity
Assateague Pointe	34,500	37,640	41,930	4,290	10%
Edgewater (Sussex County, DE)	60,750	60,750	60,750	0	0%
The Landings	32,000	32,000	100,000	68,000	68%
Lighthouse Sound	27,750	27,750	37,950	6,600	19%
Mystic Harbour	187,000	187,000	363,000	176,000	48%
Newark	45,500	45,500	57,000	11,500	20%
Ocean Pines	1,010,000	1,010,000	2,600,000	1,590,000	61%
Riddle Farm	54,000	54,000	277,750	223,750	81%
River Run	55,000	55,000	112,000	57,000	51%
Village of Showell	**Planned Growth Area**				
The City of Pocomoke	707,000	707,000	1,470,000	763,000	52%
Town of Berlin	407,000	407,000	343,000	64,000	16%
Town of Ocean City	8,688,000	11,200,000	14,000,000	2,800,000	20%
West Ocean City	653,000	1,205,120	1,000,000	0	0%
Town of Snow Hill	303,000	330,500	500,000	169,500	34%

Septic System Assessment

There are approximately 6,600 septic systems countywide, with a significant portion located in Critical Areas. Worcester County will now require the use of Best Available Technology (BAT) systems for all new or replacement septic systems. A mandatory five-year inspection and pump-out program will be instituted to ensure existing systems function properly. The County will also create a septic-to-sewer conversion fund, with priority given to watersheds under TMDL nutrient restrictions.

For areas outside sewer service areas, development relies on waste disposal systems located on-site, commonly known as “septic systems”. Currently, there are approximately 6,613 septic systems in Worcester County as shown in **Figure 11-7**. There are approximately 3,576 septic systems located in the Coastal Bays Watershed, 1,562 are located in the Critical Area **(Table 11-8)**. The Isle of Wight Bay Watershed has the highest number of septic systems followed by the Newport Bay Watershed, 1,677 and 1,090 respectively. By 2035, the County anticipates an overall reduction of 229 septic systems in the

Coastal Bays Watershed. There are approximately 3,037 septic systems in the Chesapeake Bay Watershed **(Table 11-9)**. Of this amount, 1,647 septic systems are located in the Lower Pocomoke River Watershed. There are currently only 202 septic systems in the Chesapeake Bay Critical Area. By 2035, the County anticipates 67 less septic systems in the Chesapeake Bay Watershed Critical Area.

By 2035, it is anticipated that an additional 183 septic systems will be added in the Coastal Bays watershed and 178 septic systems will be added to the Chesapeake Bay Watershed, for a net increase of 361 septic systems in the County.

To estimate the number of septic systems by 2035, the County estimated the number of septic systems that may be connected to a public WWTP and estimated the number of new septic systems in the County based upon an annual application rate of 60 permits per year for 10 years. **Tables 11-18 and 11-19** shows where the County anticipates connecting septic systems and new septic systems based upon the number of potential lots in each watershed for both inside and outside the critical areas.

Development near the water with septic systems is discouraged by the *Comprehensive Plan* and is expected to be very limited. Inland sites are also very limited and will be widely dispersed. This will result in negligible water quality impacts, if standards requiring best available technology are applied. As a result, the remainder of this section focuses on the few existing wastewater service areas where limited increases in capacity are planned and the facilities needed to address the designated growth areas.

Figure 11-7. Worcester County Septic System Locations

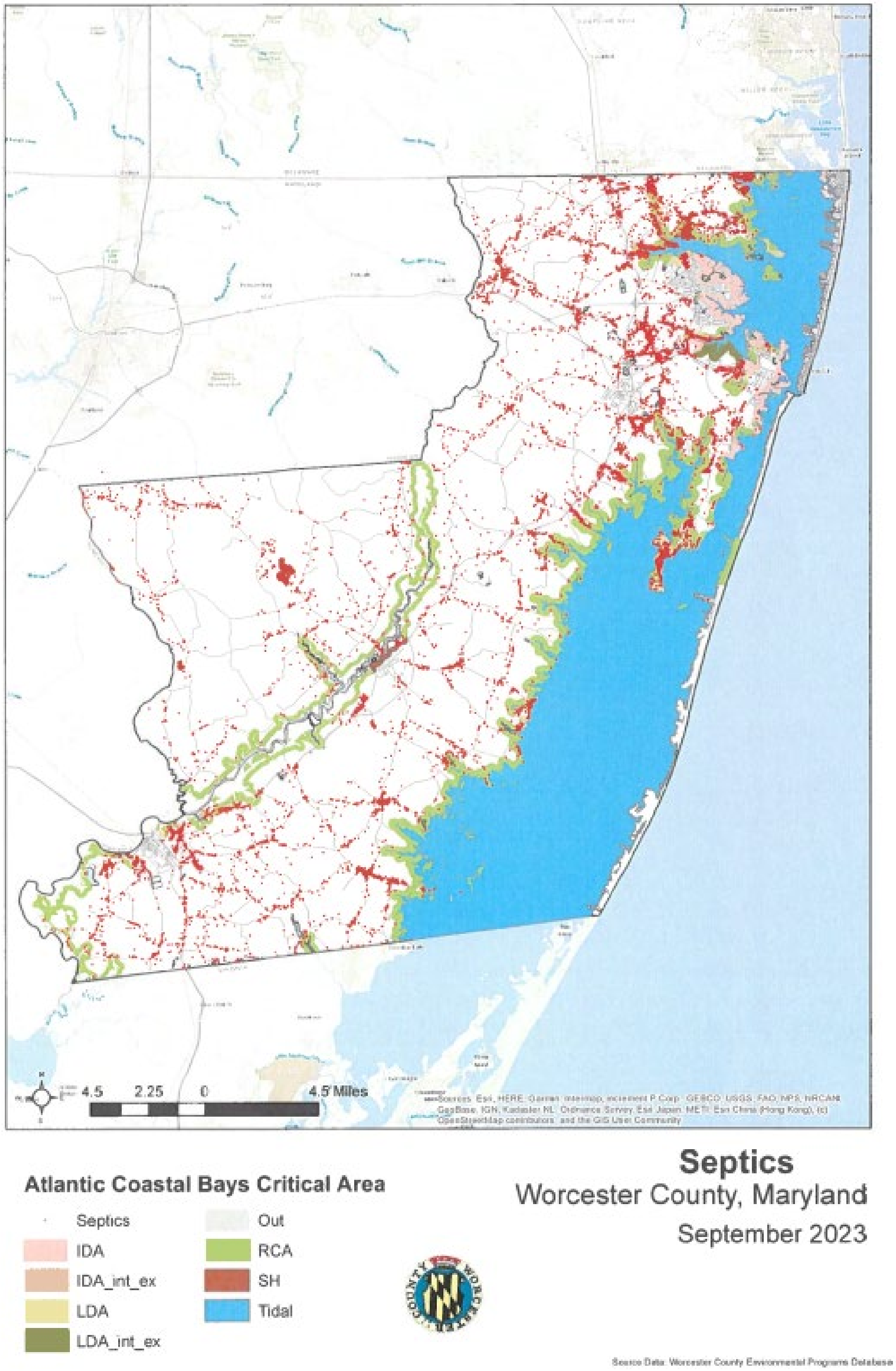


Table 11-8. Septic Systems in the Coastal Bays Watershed

Watershed Name	No. Septic (2025)	Potential Lots for New Septic	Predicted Additional Net No. of septic systems 2025-2035[6]
Assawoman Bay	**380**	**372**	**35**
Inside Critical Area	258	254	24
Outside Critical Area	122	118	11
Chincoteague Bay	**182**	**717**	**67**
Inside Critical Area	182	182	17
Outside Critical Area	0	535	50
Isle of Wight Bay	**1,677**	**1,467**	**62**
Inside Critical Area	618	599	6
Outside Critical Area	1,059	877	56
Newport Bay	**1,090**	**919**	**5**
Inside Critical Area	331	282	-34
Outside Critical Area	759	637	39
Sinepuxent Bay	**247**	**211**	**15**
Inside Critical Area	173	165	-34
Outside Critical Area	74	46	39
Total Inside CA	**1,562**	**1,482**	**23**
Total Outside CA	**2,014**	**2,213**	**161**
Grand Total	**3,576**	**3,695**	**183**

[6] The predicted additional number of septic systems in **Tables 11-8** and **11-9** is based upon the current county wide average of 60 new system permits per year over the 10-year window distributed proportional to the number of potential lots within each area that would be served by septic systems less the predicted number of systems expected to switch from septic to WWTP from **Table 11-10**. A negative number indicates that it is anticipated more systems will be removed from septic systems and put on WWTP than the number of new permits expected within the watershed area.

Table 11-9. Septic Systems in the Chesapeake Bay Watershed

Watershed Name	No. Septic (2025)	Potential Lots for New Septic	Predicted Additional Net No. of septic systems 2025-2035
Dividing Creek	**216**	**211**	**20**
Inside Critical Area	4	0	0
Outside Critical Area	212	211	20
Lower Pocomoke River	**1,647**	**1,425**	**53**
Inside Critical Area	171	0	-67
Outside Critical Area	1,476	1,425	132
Nassawango Creek	**381**	**365**	**34**
Inside Critical Area	16	0	0
Outside Critical Area	365	365	34
Upper Pocomoke River	**792**	**763**	**71**
Inside Critical Area	11	0	0
Outside Critical Area	781	763	71
Wicomico Creek	**1**	**1**	**0**
Inside Critical Area	0	0	0
Outside Critical Area	1	1	0
Total Inside CA	**202**	**0**	**-67**
Total Outside CA	**2,835**	**2,765**	**257**
Grand total	**3,037**	**2,765**	**178**

Table 11-10. Septic Tank Connections to Public WWTP

Watershed Name	2026-2036	
	Outside Critical Area	**Inside Critical Area**
Coastal Bays Watershed		
Assawoman Bay	0	25
Chincoteague Bay	0	0
Isle of Wight Bay	25	50
Newport Bay	20	60
Sinepuxent Bay	0	5
Grand Total	**45**	**140**
Chesapeake Bay Watershed		
Dividing Creek	0	0
Lower Pocomoke River	12	67
Nassawango Creek	0	0
Upper Pocomoke River	0	0
Wicomico Creek	0	0
Grand Total	**12**	**67**

Pollution Impacts

Nutrient caps established through TMDLs will be directly tied to County strategies for wastewater and septic management. Worcester County will develop a nutrient trading framework that allows agricultural, municipal, and development sectors to participate in cost-effective nutrient reduction projects, provided they meet or exceed state standards.

Total nitrogen and total phosphorus (more generally referred to as “nutrients”) from WWTPs contribute to degraded water quality in the Chesapeake and Coastal Bays and their tributaries. Maryland's involvement in the *Chesapeake Bay 2000 Agreement* requires water and sewer planning to consider the assimilative capacity of a water body—the amount of nutrients the stream can handle while preserving water quality. This section describes the key limits on assimilative capacity as they apply to the County’s WWTPs.

Table 11-11. Nutrient Limits of Public WWTP

Facility Type	Facility Name	Permit No	Date of Expiration	Receiving Water	Discharge Type	Annual Average Effluent Permit Limitations (GPD)	Annnual Max Total Nitrogen (lbs/yr)	Annnual Max Total Phosphorous (lbs/yr)
Major Community	Assateague Point	24DP2608	3/31/2031	Groundwater Type I Aquifer	Spray Irrigation	41,930	N/A	See Note 1
Major Community	Edgewater (Sussex County, DE)	See Note 3		Atlantic Ocean	Point (Outfall)	60,750		See Note 1
Owned & operated by National Park Service	Federal Assateague Park	14DP2530	10/31/2024	Sinepuxent Bay	Point (Outfall)	12,000	110	11
Major Community	The Landings	See Note 3			Injection Well	100,000		
Major Community	Ocean Landings II	18DP3401	12/31/2025		Spray Irrigation	30,000	913	See Note 1
Major Community	Lighthouse Sound	20DP3155	2/28/2029	Groundwater Type I Aquifer	Spray Irrigation	37,950	1,386	See Note 1
Major Community	Mystic Harbour	10DP273	4/30/2022	Groundwater Type II Aquifer	Injection Well	250,000	2,283	See Note 1
Major Community	Mystic Harbour	10DP273	5/1/2022	Groundwater Type II Aquifer	Spray Irrigation	81,000	740	See Note 1
Major Community	Newark	24DP3851	6/30/2030	Groundwater Type I Aquifer	Spray Irrigation	57,000	1,735	See Note 1

Major Community	Ocean Pines	22DP0708	12/31/2029	St. Martin's River	Point (Outfall)	2,600,000	31,926	4566
Major Community	Riddle Farm	20DP2710	4/30/2029	Groundwater Type I Aquifer - Columbia	Spray Irrigation	277,750	4,227	See Note 1
Major Community	River Run	20DP2394	11/30/2027	Groundwater Type I Aquifer - Beaverdam Formation	Spray Irrigation	112,000	3,409	See Note 1
Industrial	Village of Showell[(4)]	See Note 4						
Municipal	City of Pocomoke	19DP0674	5/31/2028	Pocomoke River	Point (Outfall)	1,470,000	17,908	1,343
Municipal	Town of Berlin	See Note 3			Spray Irrigation	343,000		
Municipal	Town of Ocean City	19DP0596	4/30/2029	Atlantic Ocean	Point (Outfall)	14,000,000	333,150	10,047
Municipal	Town of Snow Hill	20DP0717	12/31/2028	Pocomoke River	Point (Outfall)	500,000	6,091	457
Municipal	West Ocean City	See Note 3				1,000,000		
Municipal	Riverview Mobile Home Park	24DP3885	7/31/2028	St. Martin's River (Bishopville Prong)	Point (Outfall)	30,000	27	0

Notes:
(1) Per DEP permit concentration is to be monitored without limitation
(2) The spray irrigation limits are not assigned allocations to the receiving waters because the permits assume vegetation uptake and other natural processes reduce the amount of nitrogen reaching the receiving waters i.e. these are monitoring limits
(3) Permit and/or permit documents not available on MDE Waterwater Public Interface Tool (https://mes-mde.mde.state.md.us/WastewaterPermitPortal/ last accessed 8/19/2022)
(4) Planned facility not built or permitted

The County has the benefit of a no-new point discharge requirement in the *Water and Sewer Plan*, save for a permitted discharge for an upgrade of a conventional large flow septic system in the Critical Area to be upgraded with an advanced treatment package plant. This is why all new plants in the County utilize spray irrigation. The spray irrigation limits are not assigned allocations to the receiving waters because there is an assumption that vegetation uptake and other natural processes reduce the amount of nitrogen reaching the receiving waters.

Some nutrient increases will result from meeting future growth via existing WWTPs but only in those that have a significant amount of capacity left of new development. Snow Hill and Pocomoke City's WWTPs flows will be limited by the Chesapeake Bay Tributary Strategy point source caps. Action on the Chesapeake Bay TMDL could possibly lower those caps in the future and therefore lower their nutrient contributions to the Bay. The performance of those treatment plants to reduce nutrient loading by optimal operation can also contribute to lower impacts as will connection of existing septics to those plants that exist in adjacent sewer planning areas.

Most of the new growth in point source inputs will be mitigated by the elimination of point source discharges and transition to spray irrigation or other alternative discharges.

TMDLs

Another measure of assimilative capacity is the Total Maximum Daily Load (TMDL), the maximum amount of pollutant that a water body, such as a river or a lake, can receive without impairing water quality.

Point Source Caps

To address nutrient loads from point sources such as WWTPs, the State has established Chesapeake Bay Tributary Strategy point source caps. These caps are numerical limits on the amount of nitrogen and phosphorus that WWTPs can discharge to the Bay and their tributaries (expressed as pounds per year of nitrogen and phosphorus). Point source caps have been established for the Pocomoke and Snow Hill WWTPs and are reflected in their permits.

Future Wastewater Services

Future wastewater demand is expected to increase by nearly 2 MGD by 2035. To meet this demand without worsening nutrient loads, Worcester County will require all new growth areas to utilize spray irrigation or subsurface discharge systems. A nutrient neutrality requirement will be adopted, ensuring that no net increase in nitrogen or phosphorus results from new growth. The County will also evaluate regional treatment opportunities to reduce costs and environmental risks.

This section discusses future upgrades to existing wastewater service areas within the County as well as those growth areas designated in **Chapter 4** of the *Comprehensive Plan*. In general, if an area is not associated with a growth area the existing service areas will rely on infill development of similar character to the existing community. For those existing service areas not designated for growth by the *Comprehensive Plan*, expansion of the service areas is not planned. To begin this discussion, the following highlights upgrades planned in the sewer service areas.

Growth Area Wastewater Service

Chapter 4 of the *Comprehensive Plan* designates 29 growth areas.

The number of potential Residential and Non Residential EDU's for each growth area is identified in **Table 11-4.** If the County's population projection is realized then an additional wastewater service demand of nearly 2 million GPD by 2035 is expected and can be used for long-range planning purposes.

Table 11-12. Anticipated Wastewater Service Demand

Facility Name	Average Current Flow (GPD)	Current Committed Capacity (GPD)	Current Permitted Capacity (GPD)	Estimated Remaining Capacity (GPD)	Current Percent Remaining Capacity	Growth EDUs Generated	Growth Gallons (GPD)	Future Remaining Capacity
Assateague Pointe	34,500	37,640	41,930	4,290	10%			10%
Edgewater (Sussex County, DE)	60,750	60,750	60,750	0	0%			0%
The Landings	32,000	32,000	100,000	68,000	68%			68%
Lighthouse Sound	27,750	27,750	34,350	6,600	19%			19%
Mystic Harbour	187,000	187,000	400,000	213,000	53%			53%
Newark	45,500	45,500	50,250	4,750	9%			9%
Ocean Pines	1,010,000	1,010,000	2,125,000	1,115,000	52%	138	34,560	51%
Riddle Farm	54,000	54,000	237,000	183,000	77%	35	8,792	74%
River Run	55,000	55,000	100,000	45,000	45%			45%
Village of Showell	**Planned Growth Area**							
The City of Pocomoke	707,000	707,000	688,000	-19,000	0%			0%
Town of Berlin	407,000	407,000	343,000	-64,000	0%			0%
Town of Ocean City	8,688,000	11,200,000	14,000,000	2,800,000	20%	6,961	1,740,165	8%
West Ocean City[4]	653,000	1,205,120	1,000,000	-205,120	0%			0%
Town of Snow Hill[5]	303,000	330,500	500,000	169,500	34%			34%

Assumes that the Lower Pocomoke Growth will not be served by the Ocean City WWTP

11. WATER RESOURCES

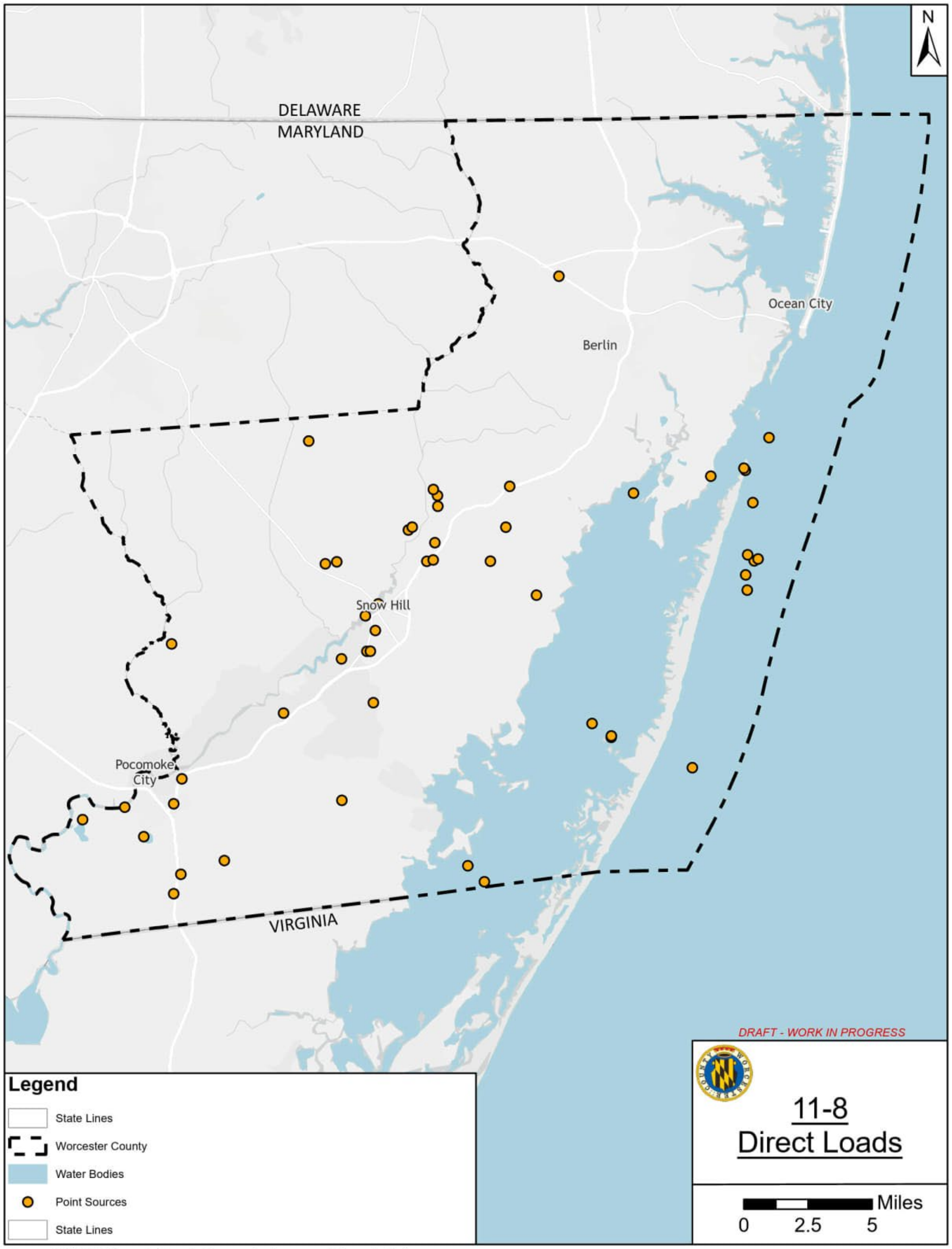
Septic and Point Source Pollution Assessment

Septic system nitrogen loads remain a major contributor to nonpoint source pollution. Worcester County will adopt a goal of reducing septic nitrogen loads by 20% by 2035. All Critical Area septic systems must be upgraded to BAT by 2030. To further improve efficiency in rural development, the County will incentivize cluster and shared BAT systems to reduce nutrient leaching from dispersed rural lots.

Point sources in Worcester County are comprised of the WWTPs that discharge directly to surface waters. In the Coastal Bays Watershed, point sources are found in the Isle of Wight Bay, and Sinepuxent Bay Watersheds. There are two point-sources located in the Chesapeake Bay; both are located in the Lower Pocomoke River drainage basin.

Overall, total nitrogen (TN) and total phosphorus (TP) from WWTP may decrease in the future in the Coastal Bays Watershed. However, a closer look at the overall reduction shows that the Ocean Pines WWTP may increase its TN contribution to their respective watersheds. In the Chesapeake Bay Watershed, TN may increase in the future by 2,517 lbs largely because of the Lower Pocomoke growth areas.

Figure 11-8. Point Source Locations of Direct Loads in Worcester County



Source: MD iMAP, Worcester County, Chesapeake Assessment Scenario Tool

11. WATER RESOURCES

Stormwater Management and Nonpoint Source Assessments

Stormwater runoff remains one of the largest contributors to water quality degradation. Worcester County will require all new development greater than one acre to implement green infrastructure best management practices such as bioretention, permeable pavement, and green roofs. A retrofit program will be established with the goal of converting at least 25 percent of existing stormwater facilities to enhanced BMPs by 2035. A stormwater utility fee will be created to fund these retrofits and long-term maintenance. Developers will be required to meet nutrient reduction standards through either on-site BMPs or participation in a nutrient trading program.

This section provides an assessment of (1) programmatic aspects of effective stormwater management, (2) how nonpoint source pollution could impact water quality and wildlife habitat, and (3) the total potential nutrient impact based on nonpoint and point sources.

Stormwater Management Assessment

Stormwater runoff is generated when the ground's natural ability to infiltrate and hold rainwater is exceeded. This is primarily caused by impervious surfaces that do not allow the rainwater to infiltrate into the ground. Development activities can affect the ability of the ground to absorb the rainfall by compaction, removal of vegetation and the installation of impervious surfaces, such as roads, parking lots, buildings, and houses. When rainwater's ability to infiltrate is lessened, stormwater runoff is directed to the nearest rivers, streams, and bays. This increased runoff also contributes to the erosion of stream banks, more rapid introduction of pollutants to the water bodies, and reduced infiltration, which results in decreases in groundwater recharge.

Research conducted by the Center for Watershed Protection has shown that stream degradation occurs when its watershed is at least 10 percent impervious. Imperviousness is one of the few variables that can be explicitly quantified, managed, and controlled at each stage of land development. It is also a management practice that can be remedied by the homeowner simply by choosing to install pervious products to create driveways or sidewalks, maintaining more forests rather than lawns, and creating more gardens that allow stormwater to soak into the ground. Redirecting runoff from impervious surfaces towards areas that can absorb stormwater also reduces the amount of polluted runoff flowing into our storm drains that ultimately empty into our local waterways.

The Assawoman Bay and Isle of Wight Bay Watersheds have the highest percentage of impervious surfaces in the County, roughly 10 percent and 9 percent respectively,[7] mainly due to the Town of Ocean City (**Table 11-13**). Streets alone occupy 25 percent of the town's land area. These percentages have increased by 11 and 57 percent, respectively since 2014. County wide the increase in impervious surfaces has been approximately 49 percent. Additional efforts are required to create and/preserve more open space, increased pervious land coverage, and improved stormwater management (SWM),

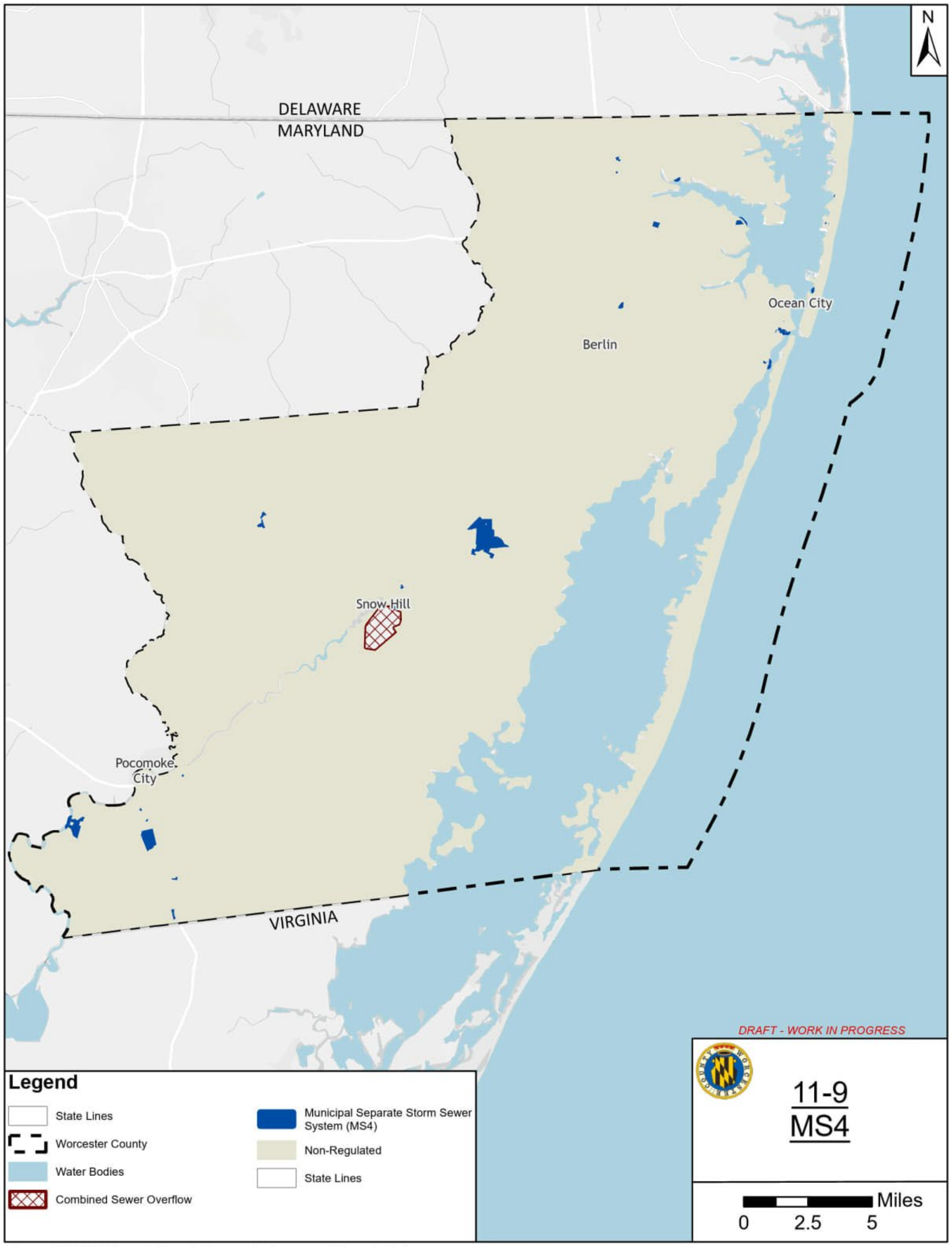
[7] A GIS-based landcover file, digitized based on the 2025 aerial imagery, was used to calculate the acreage amount of buildings, paved and unpaved roads, paved and unpaved driveways, parking lots, sidewalks, trails, tennis courts, and dirt roads.

together with the Coastal Bays Critical Areas Program restrictions on future redevelopment projects to reduce nutrient loading in the future.

Stormwater runoff can carry a whole host of pollutants, including sediments, heavy metals, phosphorus, and nitrogen. If left untreated, these pollutants have a serious impact on the receiving water bodies, leading to diminished water quality and less than desirable habitat.

Since 1982, the State of Maryland has had a SWM program in effect. Initially this program was primarily intended to provide abatement to flooding issues by capturing and storing stormwater. However, although not particularly planned for at the onset, regulators noticed a water quality benefit from capturing and storing stormwater before ultimate discharge to local rivers, streams and bays.

Figure 11-9. Municipal Separate Storm Sewer System (MS4) and Combined Sewer Overflow in Worcester County



Source: MD iMAP, Worcester County, Chesapeake Assessment Scenario Tool

Figure 11-10. The Sediment at the Edge of Stream (lbs/yr) with No Action in 2010 and ongoing progress in 2023

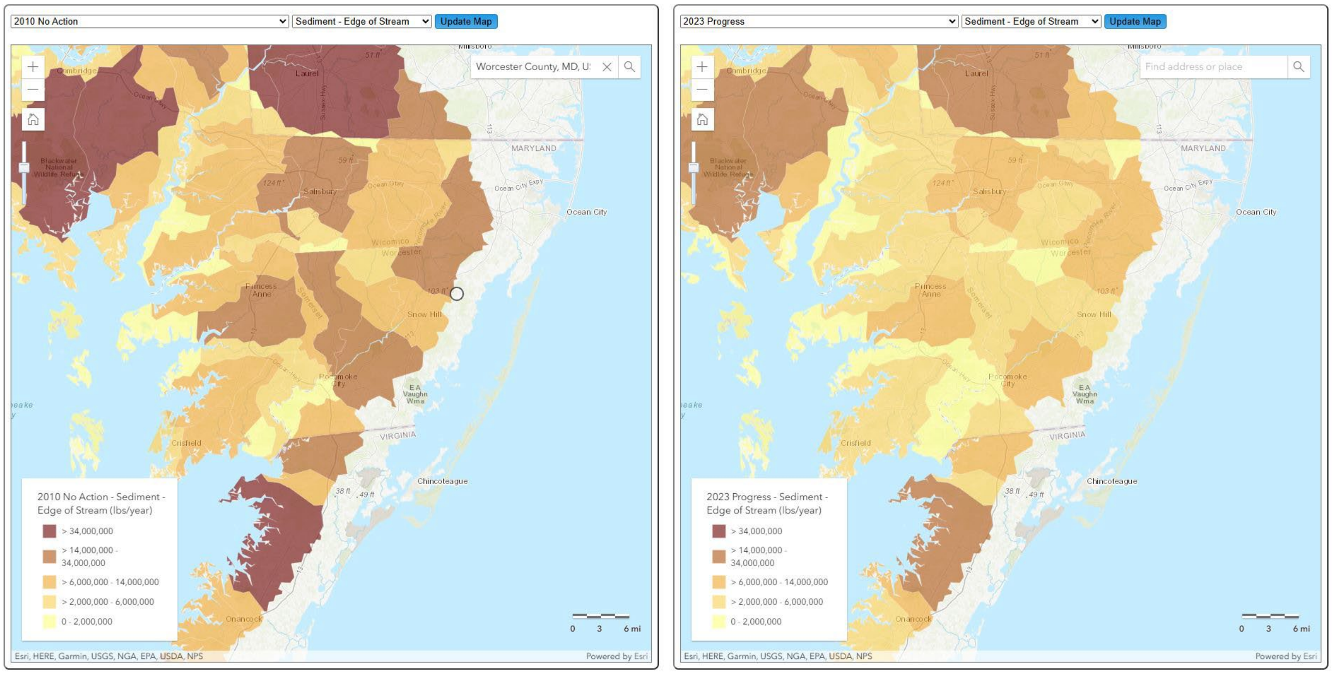


Figure 11-11. The Sediment at the Edge of Tide (lbs/yr) with No Action In 2010 and ongoing progress in 2023

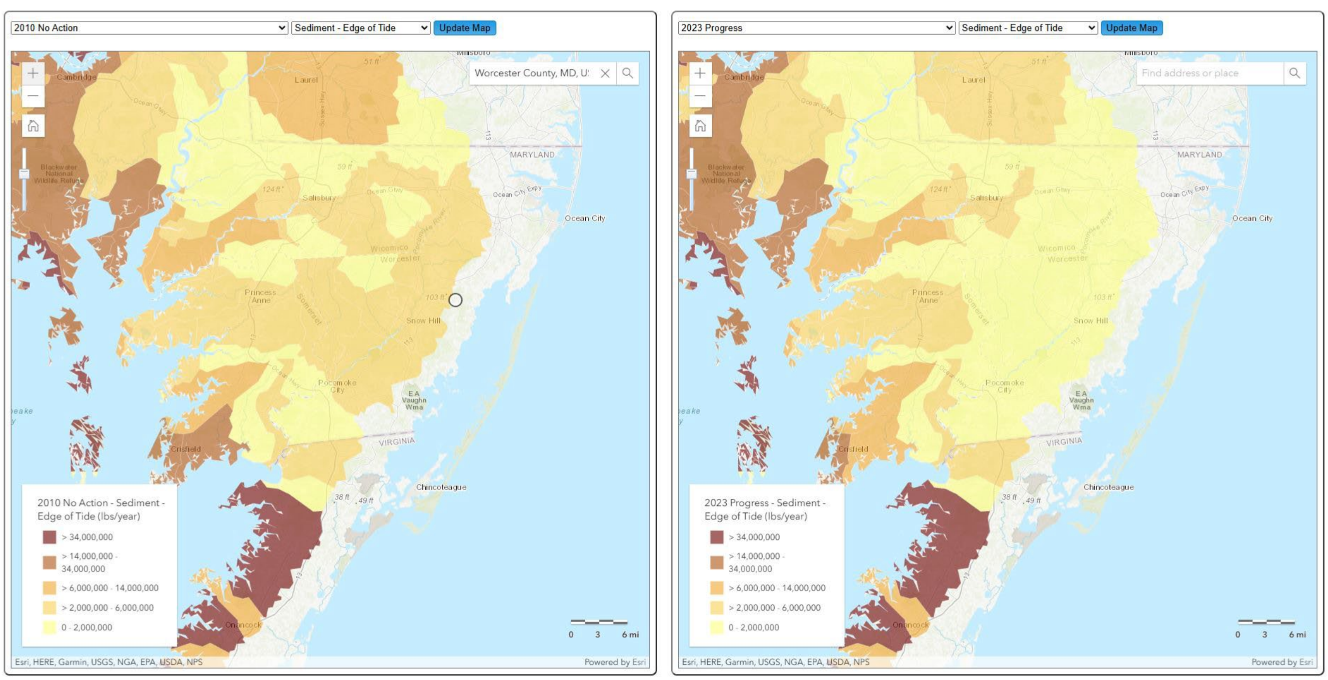


Figure 11-12. Phosphorus at Edge of Stream (lbs/yr) with No Action in 2010 and ongoing progress in 2023

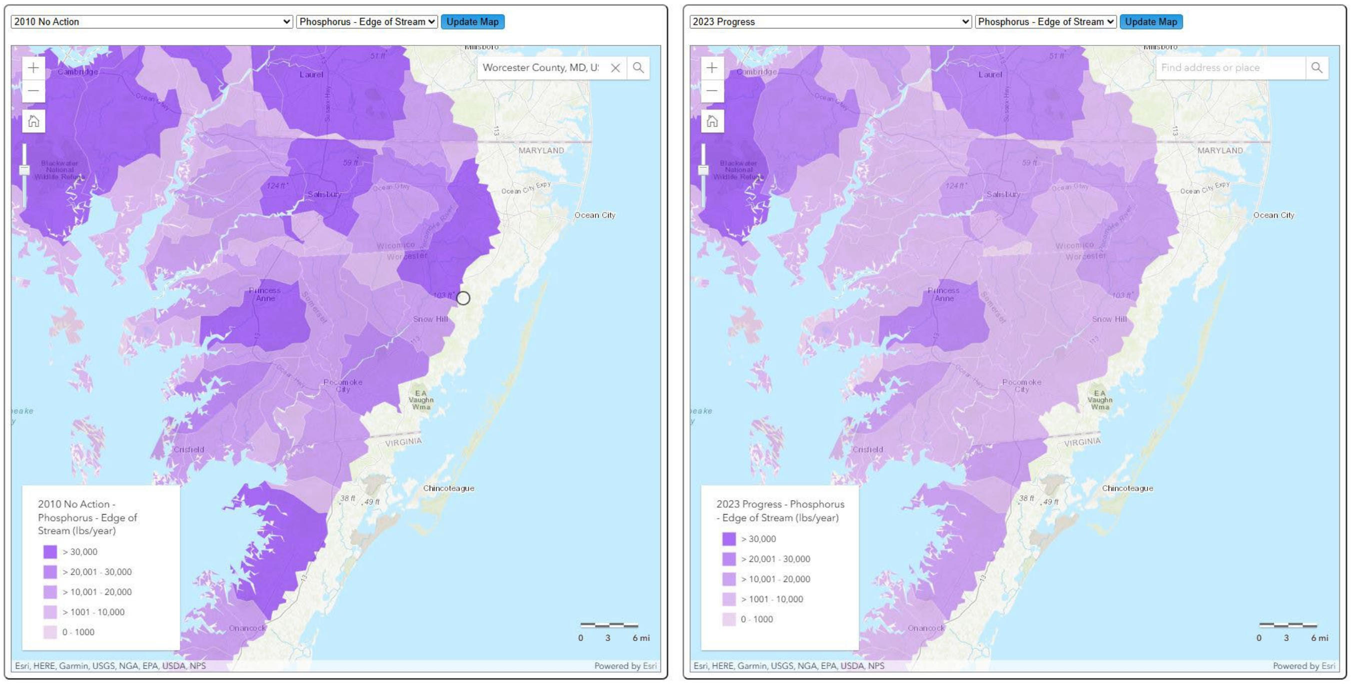


Figure 11-13. Phosphorus at Edge of Tide (lbs/yr) with No Action in 2010 and ongoing progress in 2023

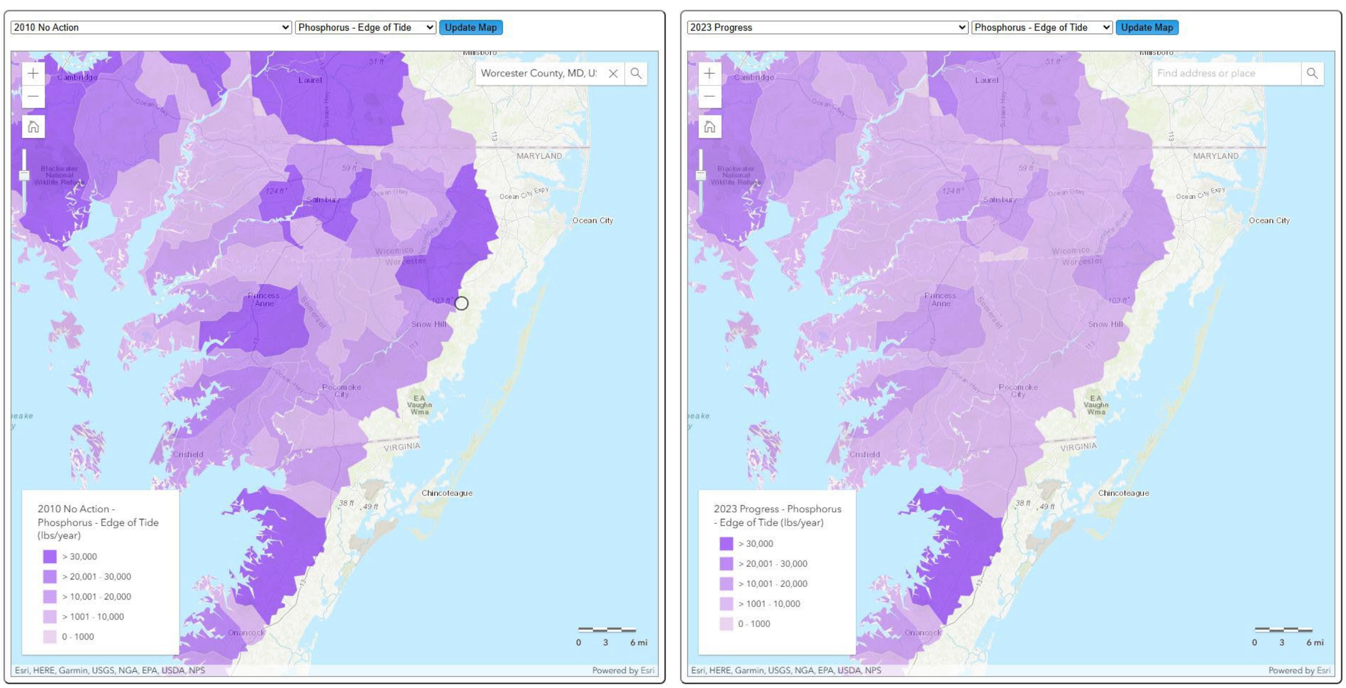


Figure 11-14. Nitrogen at Edge of Stream (lbs/yr) with No Action in 2010 and ongoing progress in 2023

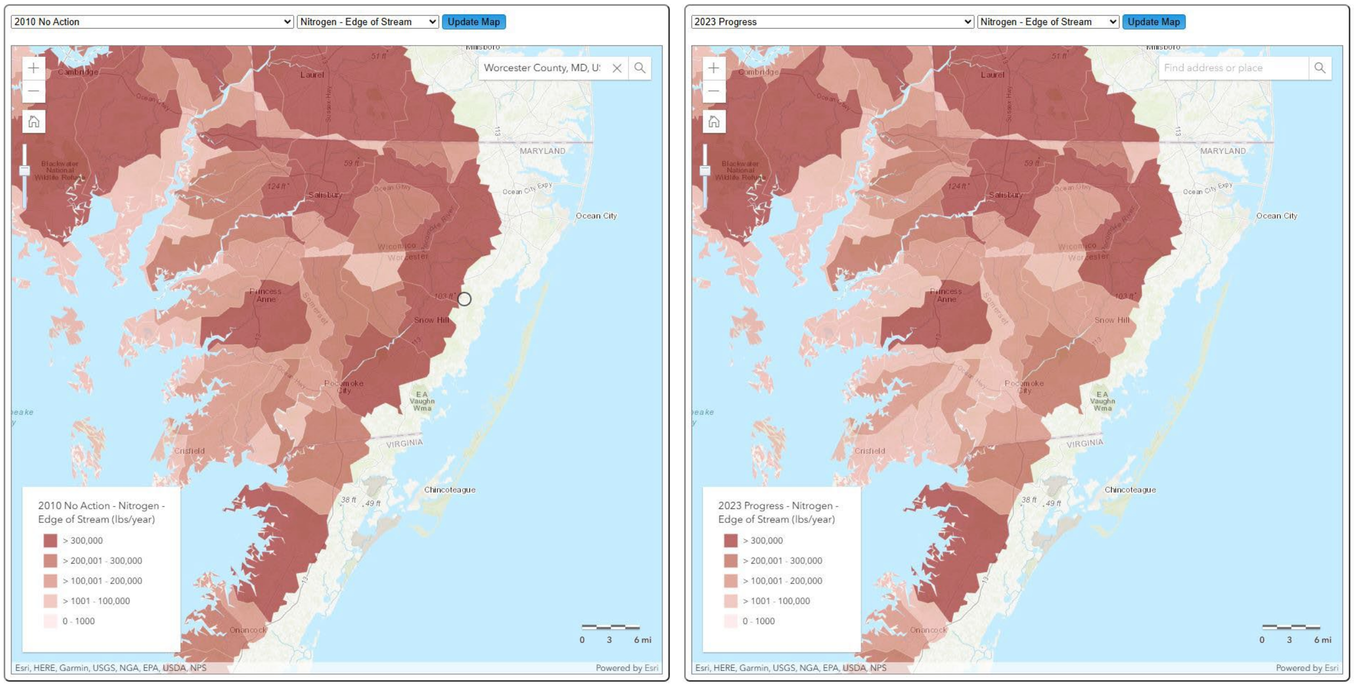


Figure 11-15. Nitrogen at Edge of Tide (lbs/yr) with No Action in 2010 and ongoing progress in 2023

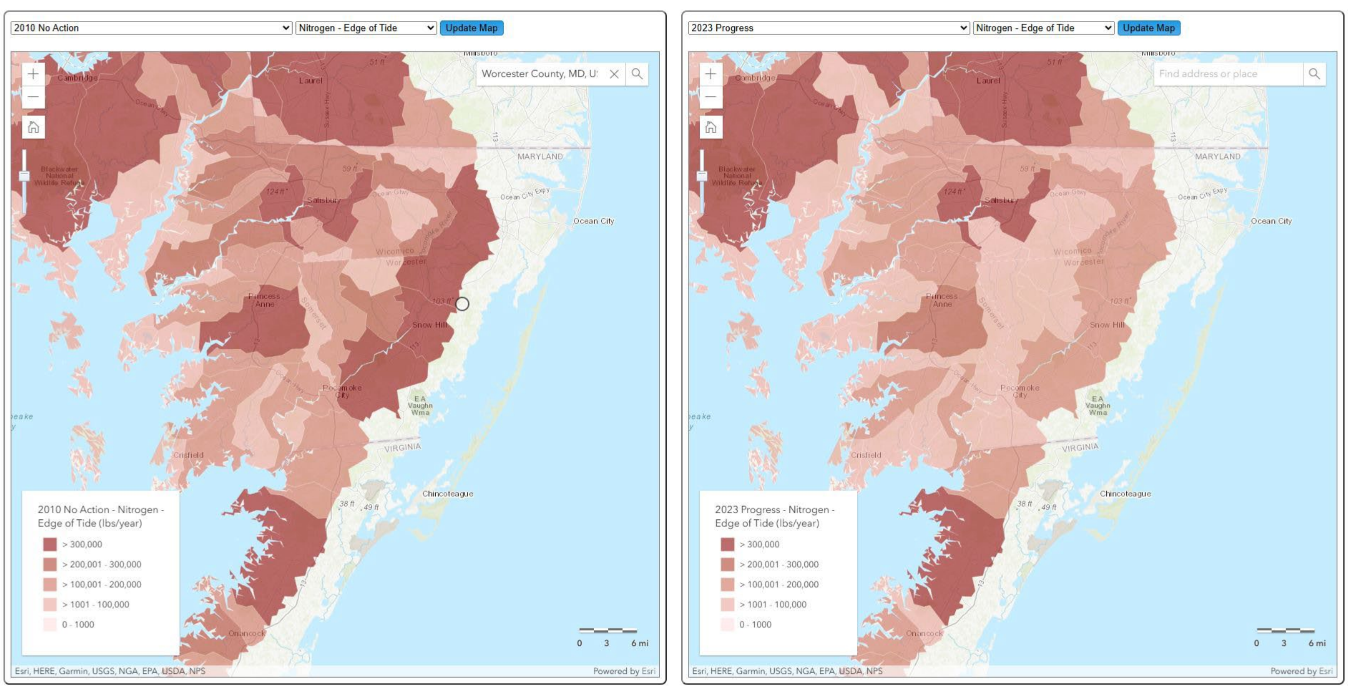


Table 11-13. Impervious Surfaces by Watershed

Watershed Name	Watershed Area (acres)	2014 Impervious Area (acres)	2025 Impervious Area (acres)	Percentage Increase in Impervious	Percentage of Watershed Area Impervious
Coastal Bays Watershed					
Assawoman Bay	12,802	1,195	1,329	11.2%	10.4%
Chincoteague Bay	89,293	300	573	91.0%	0.6%
Isle of Wight Bay	41,121	2,369	3,734	57.6%	9.1%
Newport Bay	32,492	813	1,244	53.0%	3.8%
Sinepuxent Bay	13,710	409	642	57.0%	4.7%
Chesapeake Bay Watershed					
Dividing Creek	26,320	208	303	45.5%	1.1%
Lower Pocomoke River	81,443	1,723	2,526	46.6%	3.1%
Nassawango Creek	25,997	259	332	28.2%	1.3%
Upper Pocomoke River	51,204	687	1,169	70.2%	2.3%
Wicomico Creek	70	1	1	11.9%	1.6%
Grand Total	**374,452**	**7,964**	**11,853**	48.8%	

Source: 2025 Aerial Imagery, GIS-based building footprints and streets layer.

The County's current SWM Ordinance, adopted in 2014 by Bill No. 13-1, incorporates changes mandated by the State and referenced in the *2000 Maryland Stormwater Design Manual* and subsequent changes in Maryland regulations and outlined in MDE's model ordinance. One of the significant changes outlined in this manual is a menu of non-structural best management practices (BMPs) that allowed for a more environmentally sensitive approach to site development.

Unlike other areas of the State, Worcester County has little to no relief in its topography, thus allowing for easier and more successful use of non-structural BMPs. These practices incorporate existing site conditions along with vegetative filtering practices to provide water quality on sites. Once approved and implemented they provide a profound impact on water quality. The relatively flat topography lengthens the amount of time stormwater runoff takes to reach receiving waters, thus allowing for more natural nutrient uptake from existing vegetation.

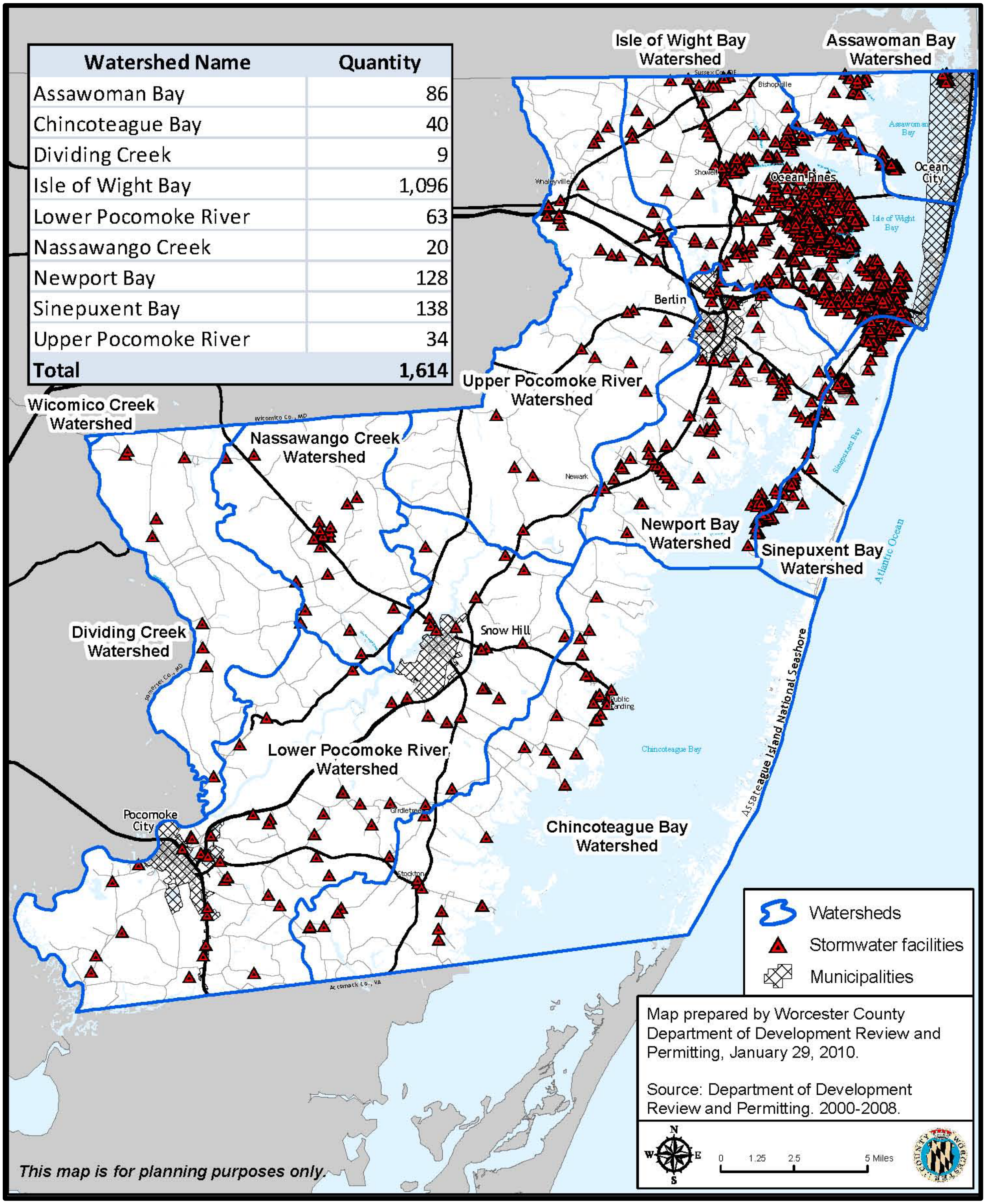
In July 2024 Worcester County adopted the County Critical Area Law to protect the Chesapeake Bay and Atlantic Coastal bays from the adverse impacts of development on water quality and natural habitats. The law establishes buffer requirements from tidal waters, wetlands and streams, limits forest clearing, requires mitigation for deforesting, and otherwise restricts development activities in certain areas.

Currently, Worcester County has more than 1,600 permitted and approved SWM facilities as shown in **Figure 11-16** After final approval and associated inspections, these facilities are inspected once every three years to ensure the functionality of the sites. Of the approved stormwater management facilities, almost 85 percent incorporate non-structural BMPs.

Enforcement procedures in place in the local ordinance require developers and subsequent property owners to enter into inspection and maintenance agreements which bind properties to perpetual compliance with the approved stormwater management plan. This, along with strong oversight during construction, ensures the continued functionality of onsite SWM facilities.

In the next discussion, nutrient pollutant loads from urban stormwater and other nonpoint sources including agricultural and forests designated areas are assessed to determine its potential water quality impact.

Figure 11-16. Stormwater Facilities in Worcester County



Watershed Name	Quantity
Assawoman Bay	86
Chincoteague Bay	40
Dividing Creek	9
Isle of Wight Bay	1,096
Lower Pocomoke River	63
Nassawango Creek	20
Newport Bay	128
Sinepuxent Bay	138
Upper Pocomoke River	34
Total	**1,614**

11. WATER RESOURCES

Nonpoint Source Assessment

This assessment focused on two sources of nonpoint pollution: land use activities and septic systems. To understand the potential impact of septic systems, the County projected the future number of septic systems while considering their location, possibility of connecting systems to nearby WWTPs, and potential for upgrading systems to denitrification technologies.

Through this nonpoint source (NPS) assessment, the County quantified the potential nutrient load, specifically total nitrogen (TN) and total phosphorus (TP), each land use scenario and septic system could contribute at a watershed scale. This initial NPS assessment could supplement existing planning decision-making tools that help to identify appropriate places for future growth and development while protecting our natural resources.

This NPS assessment's methodology is based on nutrient loading rates provided by the Chesapeake Bay Program as well as land use acreages and the number of septic systems in the County (**Tables 11-8** and **9-9**). These three variables are applied in the equations shown in **Table 11-15**. Based on this methodology and generalizations of the land, the County recognizes that the results described in this WRE NPS assessment do not reflect the *actual* amount of nutrients in the watershed, but demonstrate how different land use activities, given its size, location and nutrient loading potential, could impact a watershed's water quality and wildlife habitat.

Additionally, for the purposes of this WRE, the County does not provide additional recommendations regarding air deposition but recognizes that it can contribute nutrients to water resources. EPA has committed to reducing air deposition of nitrogen to the tidal waters of the Chesapeake Bay and these reductions will be achieved through implementation of the Clean Air Act during the coming years (TMDL Implementation Letter dated 11-4-09, p. 34). The County will continue to work with federal and state agencies and assist where needed to comply with regulations. Following is a discussion focused on the land use scenarios. Then a quantitative assessment of septic systems is provided.

Table 11-14. Nutrient Loading Rates (lbs/ac/yr)

					Septic System (lbs/system/yr)	
Nutrient loading rate	**Forest**	**Agriculture**	**Urban**	**Pasture/Hay**	**Outside Critical Area**	**Inside Critical Area**
Total Nitrogen Load	1.7	13.5	8.0	4.0	6.0	12.0
Total Phosphorus Load	0.1	1.5	1.2	0.5	0.0	0.0

Source: Chesapeake Bay Program, 2024. Chesapeake Assessment and Scenario Tool (CAST) Version 2023, Phase 6-[7.14.1]. Chesapeake Bay Program Office, Last accessed [May, 2025].

For this NPS assessment the change in nutrient loadings were determined by taking the existing unconstrained A2 agricultural land (assuming a 30 percent conservation assumption) and assuming 50% of the unconstrained land is agriculture and 50 percent is pasture/hay. Although this assessment was conducted at a county-level and not a site-level, this broad-based planning exercise gave the County insight on how land use changes impact the environment. For this WRE, this assessment level is deemed appropriate and can translate into improving the implementation of environmental site design standards, assisting others with voluntary approaches that can help reduce nutrient loads, and informing the land use element of the *Comprehensive Plan*.

The land use scenarios used in this NPS assessment are based on land use maps that can be found in **Chapter 4 – Land Use**. A land use map generally shows where the County anticipates growth and development, identifies the natural resources that should be protected, and the preservation of agricultural landscapes. Its purpose is to help guide over-arching planning principles. Following is a discussion about how land use changes affected nutrient loads in each watershed.

Table 11-15. Nonpoint Source Assessment Equations

Equation ID	Result	Equation	Variable	Definition	Units
Eq. 1	Total nitrogen load	$TN = LR_n * LU$	TN	Total nitrogen load	lbs/yr
			LR_n	Nitrogen loading rate	lbs/ac/yr
			LU	Land use	acres
Eq. 2	Total phosphorus load	$TP = LR_p * LU$	TP	Total phosphorus load	lbs/yr
			LR_p	Phosphorus loading rate	lbs/ac/yr
			LU	Land use	acres
Eq. 3	Septic nitrogen load	$S_n = LR_{sn} * S_a$	S_n	Septic nitrogen load	lbs/yr
			LR_{sn}	Septic nitrogen load per system	lbs/sys/yr
			S_a	Number of septic systems	n/a
Eq. 4	Total nitrogen NPS load	$TNPS_n = S + TN$ or	$TNPS_n$	Total Nitrogen nonpoint source load	lbs/yr
Eq. 5	Total pollution load	$TPL_n = TNPS_n + TPS_n$	TPL_x	Total N or P pollution load	lbs/yr
		$TPL_p = TP + TPS_p$	TPS_x	Total N or P point source load	lbs/yr

Table 11-16. Nutrient Loads Due to Change in Land Use

	Isle of Wight	Lower Pocomoke	Newport
Area Agriculture to Urban (acre)	209.4	410.4	15.3
Nitrogen Load Decrease (lb/yr)	-1152	-2257	-84
Phosphorus Load Decrease (lb/yr)	-63	-123	-5
Area Pasture/Hay to Urban (acre)	209	410	15
Nitrogen Load Increase (lb/yr)	837	1641	61
Phosphorus Load Decrease (lb/yr)	147	287	11

Change in Nitrogen (lbs/yer)	-314	-616	-23
Change in Phosphorus (lbs/yr)	84	164	6

Septic System Contribution

This assessment examines the contribution from septic systems during the planning period 2026-2036.

Location and technology choices are regulated by State and local requirements. Some older septic systems, especially when located near the water, pose significant water quality problems. They contribute nutrients and pathogens to the nearby surface waters and groundwater. In the Critical Area, current standards require best available technology for new development and certain specific cases. State grants are now useful in converting existing outdated on-site septic systems to less damaging nutrient reduction technologies, but the continued availability of such funding is questionable.

Depending on the location of septic systems, each system may contribute 6 or 12 lbs of TN annually. There are no significant amounts of phosphorus leaching from septic systems. In Worcester County, septic systems within the Critical Area contribute 12 lbs/sys/yr of TN whereas septic systems outside of the Critical Area contribute 6 lbs/sys/yr of TN. Less nitrogen will enter the bays because of the distance traveled by groundwater which allows nitrogen removal processes to occur. Septic systems outside of the Critical Area were upgraded to enhance overall performance, not for denitrification. The following section quantifies the amount of nitrogen potentially leaching from septic systems in the Coastal Bays Watershed.

Table 11-17. Septic System Updates

Watershed Name	**2011-2025**		**2026-2036**	
	Outside Critical Area	**Inside Critical Area**	**Outside Critical Area**	**Inside Critical Area**
Coastal Bays Watershed				
Assawoman Bay	122	258	722	858
Chincoteague Bay	0	182	600	782
Isle of Wight Bay	1,059	618	1,659	1,218
Newport Bay	759	331	1,359	931
Sinepuxent Bay	74	173	674	773
Grand Total	**2,014**	**1,562**	**5,014**	**4,562**
Chesapeake Bay Watershed				
Dividing Creek	212	4	812	604
Lower Pocomoke River	1,476	171	2,076	771
Nassawango Creek	365	16	965	616
Upper Pocomoke River	781	11	1,381	611

Wicomico Creek	1	0	601	600
Grand Total	**2,835**	**202**	**5,835**	**3,202**

Total Nonpoint Source Pollution Assessment: Stormwater and Septic Systems

This section discusses the cumulative amount of total nitrogen and total phosphorus entering local waterways from nonpoint sources if future growth patterns mirrored land use designations and projected contributions from septic systems were realized. To begin, this section first addresses total nitrogen (TN) followed by a discussion on total phosphorus (TP).

Table 11-18. Septic System Nitrogen Loads, Chesapeake Bay Watershed

Watershed Name	No. Septic (2025)	Potential Lots	Expected No. Septic (2035)	Change in no. of septic systems	Change in Nitrogen Loads
Lower Pocomoke River Watershed	**1,647**	**1,425**	**1,700**	53	-10
Inside Critical Area	171	0	104	-67	-804
Outside Critical Area	1,476	1,425	**1,608**	132	794
Upper Pocomoke River Watershed	**792**	**763**	863	71	425
Inside Critical Area	11	0	**11**	0	0
Outside Critical Area	781	763	852	71	425
Nassawango Creek Watershed	**381**	**365**	**415**	34	203
Inside Critical Area	16	0	16	0	0
Outside Critical Area	365	365	**399**	34	203
Dividing Creek Watershed	**216**	**211**	236	20	118
Inside Critical Area	4	0	**4**	0	0
Outside Critical Area	212	211	232	20	118
Wicomico Creek Watershed	**1**	**1**	**1**	0	1
Inside Critical Area	0	0	0	0	0
Outside Critical Area	1	1	**1**	0	1
Total Inside CA	**202**	**0**	**135**	**-67**	**-804**
Total Outside CA	**2,835**	**2,765**	**3,092**	**257**	**1,541**
Grand Total	**3,037**	**2,765**	**3,215**	**178**	**737**

Table 11-19. Septic System Nitrogen Loads, Coastal Bay Watershed

Watershed Name	No. Septic (2025)	Potential Lots	Expected No. Septic (2035)	Change in no. of septic systems	Change in Nitrogen Loads
Assawoman Bay	**380**	**372**	**415**	35	349
Inside Critical Area	258	254	282	24	283
Outside Critical Area	122	118	**133**	11	66
Chincoteague Bay	**182**	**717**	249	67	501
Inside Critical Area	182	182	**199**	17	203
Outside Critical Area	0	535	50	50	298
Isle of Wight Bay	**1,677**	**1,476**	**1,739**	62	406
Inside Critical Area	618	599	624	6	68
Outside Critical Area	1,059	877	**1,115**	56	339
Newport Bay	**1,090**	**919**	1,095	5	-171
Inside Critical Area	331	282	**297**	-34	-406
Outside Critical Area	759	637	798	39	235
Sinepuxent Bay	**247**	**211**	**262**	15	150
Inside Critical Area	173	165	183	10	124
Outside Critical Area	74	46	**78**	4	26
Total Inside CA	**1,562**	**1,482**	1,585	23	272
Total Outside CA	**2,014**	**2,213**	**2,175**	161	963
Grand Total	**3,576**	**3,695**	3,759	183	1,235

Cumulative Recommendations

The WRE commits Worcester County to integrating climate resilience throughout its water management framework, requiring annual monitoring and public reporting of water and wastewater performance, and establishing measurable targets for nutrient reduction, water conservation, and infrastructure resilience. New funding mechanisms, including impact fees, stormwater utilities, and state/federal grants, will be pursued to support these goals. Together, these policies will ensure that Worcester County's water resources remain resilient, sustainable, and capable of supporting both community and ecological needs well into the future.