Charles County Maryland
Where Eagles Fly™

Charles County
Water Resources Element

Draft

Prepared by ERM

July 2010

Table of Contents

I. Introduction

A. Purpose and Background of the WRE

The Water Resources Element of the Charles County Comprehensive Plan creates a 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. It complies with the requirements of Article 66B of the Annotated Code of Maryland—as modified by Maryland House Bill 1141, passed in 2006.

The Water Resources Element 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, including the growth projected for the County's municipalities. In this way, the Water Resources Element helps to protect the local and regional ecosystem while ensuring clean drinking water for future generations of Charles County residents.

B. Interjurisdictional Coordination

The County recognizes the importance of interjurisdictional water resources planning. The Towns of Indian Head and La Plata (the County's two incorporated municipalities) own and operate their own public water systems, wastewater treatment plants, and most wastewater collection systems.

This Countywide Water Resources Element compiles, to the greatest degree possible, up-to-date data from the municipalities in order to coordinate water resources, growth, and land use planning. The Towns of Indian Head and La Plata are preparing their own Water Resources Elements as part of updates to their Comprehensive Plans. This document will provide the nonpoint source modeling data and impervious surface data to be used by the County and its municipalities in their respective WREs. The WRE and Municipal Growth Elements (MGE) from the Town of La Plata and the Town of Indian Head were each reviewed in preparing this County WRE.

Where possible, the County has also obtained data and information on water resources from adjoining Counties in order to paint the fullest possible picture of future impacts to the Potomac, Patuxent, Wicomico and other rivers and streams that form Charles County's eastern, southern, and western boundaries. In preparing its own WRE, the County has reviewed the WREs from Calvert, St. Mary's, and Prince George's Counties.

C. Changes since the 2006 Comprehensive Plan

The Water Resources Element updates, compiles and expands upon many of the data, goals and policies contained in the 2006 Comprehensive Plan. In particular, this Element contains updated information on demand and capacity for public water and wastewater systems in the County. Since the 2006 Comprehensive Plan, the following major changes have impacted public water and sewer infrastructure in the County.

1. In 2006, the County adopted a new Comprehensive Water and Sewer Plan. This document addresses water resources, water and wastewater facilities, needs projections, new and updated policies, and corrective approaches to problem areas.

2. The Waldorf and Bensville water systems were interconnected, providing system redundancy and accomplishing one of the major water goals in the County Water and Sewer Plan.
3. The permit for the Swan Point water system was renewed, with a permitted capacity of 0.5 million gallons per day (MGD).
4. The La Plata water system's permitted capacity was increased from an average daily use of 1.10 MGD to 1.234 MGD, and from 1.335 MGD up to 1.715 MGD in the month of maximum use (peak use). The Town has requested an increase in their NPDES (wastewater discharge) permit to 2.0 MGD.
5. The Mattawoman Wastewater Treatment Plant (WWTP) was upgraded to Enhanced Nutrient Removal (ENR) technology in 2007. This facility upgrade enabled the plant's permitted discharge capacity to be rated at 20 MGD in November 2009.
6. The County's Swan Point WWTP and the Town of Indian Head WWTP were upgraded to ENR technology in 2007 and 2008, respectively.
7. The College of Southern Maryland and Mt. Carmel Woods WWTPs are scheduled to be retired in 2011 and converted to pumping stations, conveying effluent to the Mattawoman WWTP; an Enhanced Nutrient Reduction (ENR) facility.
8. The County initiated use of the Washington Suburban Sanitary Commission (WSSC) water line connection at MD 228 (Berry Road) and Bealle Hill Road on March 31, 2009 to supplement the Waldorf and Bensville water systems with surface water.

II. Goals for Water Resources

The following goals address water resources in Charles County.

Water Resources Goal 1: *In cooperation with the County's municipalities, the County will maintain safe and adequate drinking water supplies for existing and projected population and non-residential uses.*

Water Resources Goal 2: *In cooperation with the County's municipalities, the County will ensure that adequate wastewater treatment capacity exists in public systems for existing and projected population and non-residential uses.*

Water Resources Goal 3: *Take steps to meet regulatory requirements by protecting and restoring water quality in the County's rivers and streams.*

Water Resources Goal 4: *Water resources planning shall be a tool to direct the location, amount, and type of development in Charles County.*

III. County Projections and Scenarios

This section describes the population and housing projections and future growth scenarios used in the Water Resources Element. All projections and scenarios in this section are developed to support the analyses in the Water Resources Element and are intended for use in this Element only. The County's official population projections will be updated as part of a full revision to the 2006 Comprehensive Plan.

A. Watersheds

This Element takes a watershed-based approach in analyzing the impact of future growth on Charles County's water resources—particularly in relation to nutrients discharged to the County's streams. Land in Charles County drains to one of ten major watersheds (or "8-digit watersheds,"

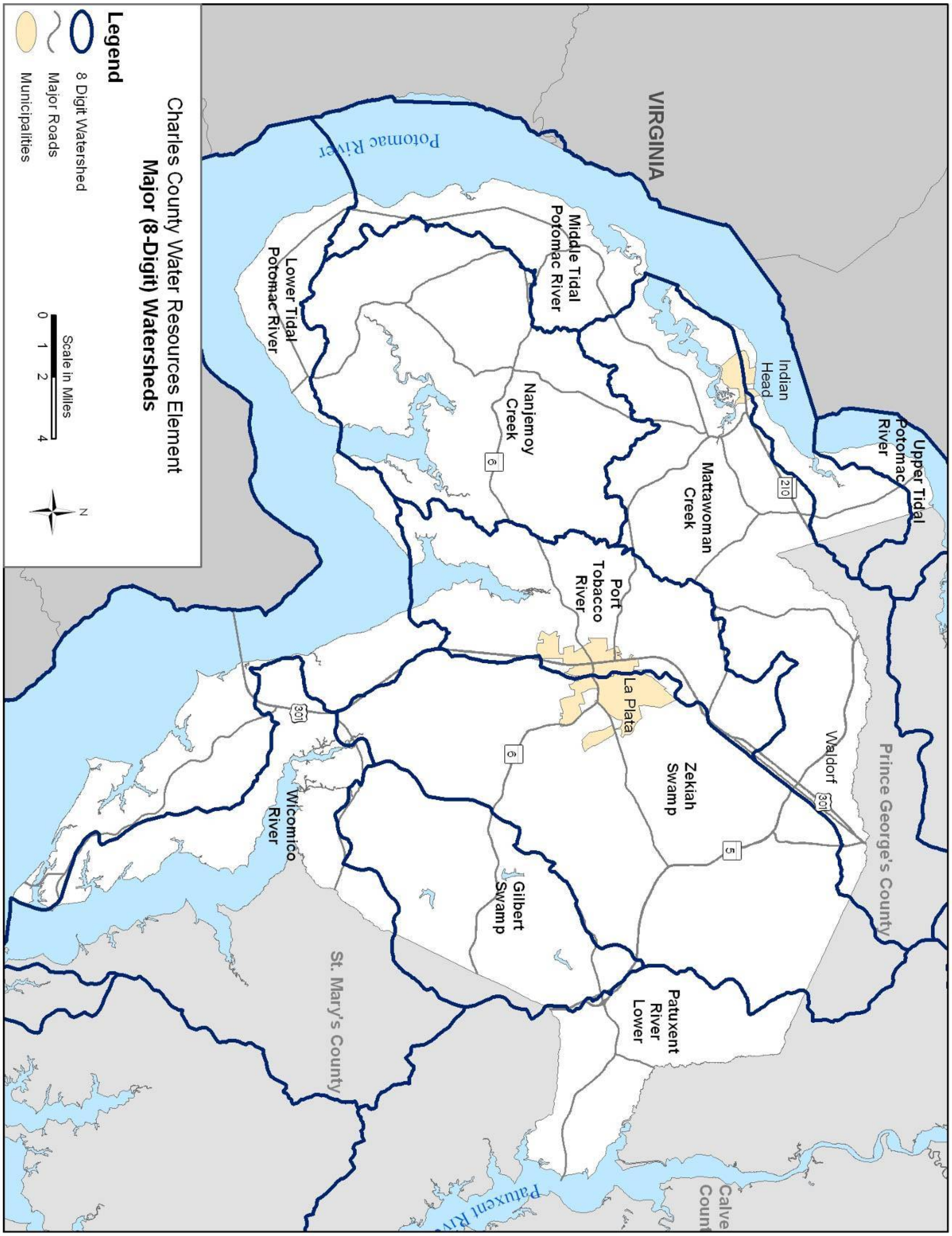


Figure 1: Major Watersheds

referring to the numeric classification system used by the Maryland Department of the Environment). These watersheds, shown on Figure 1, are; the Lower Patuxent River, Gilbert Swamp, Mattawoman Creek, Port Tobacco River, Nanjemoy Creek, Lower Tidal Potomac River, Middle Tidal Potomac River, Upper Tidal Potomac River, Wicomico River, and Zekiah Swamp.

B. Population Projections

The Water Resources Element uses Countywide population projections developed by the Maryland Department of Planning (MDP) in 2008, shown in Table 1. These projections indicate that County population will reach approximately 204,200 by the year 2030, an annual increase of approximately 1.7 percent per year, or 45 percent overall between 2008 and 2030. Projections from the 2006 Comprehensive Plan are included *for reference only*, and are not the basis for the analyses in this WRE. The MDP projections in Table 1 differ slightly from, but are generally consistent with projections in the 2006 Comprehensive Plan (which only projected population through 2025).

Table 1. Population Projections for the Water Resources Element

	Year						*Change, 2008-2030*		
Source	**2008[1]**	**2010**	**2015**	**2020**	**2025**	**2030**	**Number**	**Percent**	**Annual Increase**
MDP	140,764	144,950	160,950	177,200	193,100	204,200	63,436	45%	1.7%
2006 Comp. Plan		*147,400*	*162,293*	*177,181*	*193,914*				

Notes:
1: 2008 is the most recent available population estimate. For other data, such as land use/land cover, the most recent available information dates from 2007. For purposes of this WRE, 2007 and 2008 are considered to be "current" or "baseline" conditions.
Sources:
2008: MDP, 2008 Estimates for Maryland's Jurisdictions
All Other Years: MDP, Projected Total Population for Maryland's Jurisdictions (Revisions, December 2008).

C. Scenarios

To gauge the impacts of alternative land use and water resources policies, this Water Resources Element uses three scenarios for the distribution of future growth. Each scenario assumed the same total amount of growth (e.g., new housing units and nonresidential development), distributed differently as described below. Table 2 shows the projected watershed-level distribution of housing units in each of these scenarios.

- **A. Baseline**. This scenario reflects the 2006 Comprehensive Plan, as implemented by zoning. It will test the water resources impacts of implementing the current Comprehensive Plan, and will serve as a "baseline" for comparing other scenarios.

- **B. Waldorf Area Focus.** This scenario assumes that higher-density development will occur in the Waldorf area[1] and in the Bryans Road area. The Deferred Development District (outside of the DDD) would be subject to restrictions similar to those in the DDD. The County's Priority Preservation Area (PPA) would be part of this scenario, reducing

[1] Base densities in TOD district of the US 301 corridor in Waldorf are 15 units per acre, reflecting the recommendations of the Waldorf Urban Design Study and ordinance, and MTA's Southern Maryland Transit Corridor Preservation Study. Assumed yields (the achieved gross residential density) throughout Waldorf are assumed to be 5 units per acre, taking into account environmental and other limitations that may prevent each parcel in the corridor from achieving its maximum theoretical density. This is compared to current assumed yields of 3.5 units per acre for RH (high density) zoning, and progressively lower yields for other districts.

Table 2. Charles County Water Resources Element Growth Scenarios Through 2030 (Housing Units)

Watersheds	Housing Units, 2008[1]	*2030 Scenarios*					
		A. Baseline		B. Waldorf Area Focus		C. DDD Focus	
		Increment	*Total*	*Increment*	*Total*	*Increment*	*Total*
Patuxent River	2,124	435	2,559	511	2,635	496	2,620
Gilbert Swamp	1,758	828	2,586	317	2,075	309	2,067
Mattawoman Creek							
Waldorf	12,168	2,852	15,020	4,019	16,187	3,026	15,194
Bryans Road	1,007	1,863	2,870	2,126	3,133	1,499	2,506
Indian Head	1,615	598	2,213	598	2,213	598	2,213
Remainder of Matttawoman Creek	5,775	1,622	7,397	1,288	7,063	4,814	10,589
Nanjemoy Creek	1,802	1,324	3,126	378	2,180	418	2,220
Port Tobacco River							
La Plata	1,706	748	2,454	637	2,343	731	2,437
Waldorf	2,422	1,013	3,435	1,747	4,169	1,778	4,200
Remainder of Port Tobacco River	2,934	884	3,818	945	3,879	984	3,918
Lower Tidal Potomac River	2,111	1,128	3,239	648	2,759	630	2,741
Middle Tidal Potomac River							
Indian Head	411	120	531	120	531	120	531
Bryans Road	955	1,310	2,265	1,381	2,336	508	1,463
Remainder of Middle Tidal Potomac	584	362	946	130	714	127	711
Upper Tidal Potomac River	114	62	176	77	191	75	189
Wicomico River	533	635	1,168	210	743	205	738
Zekiah Swamp							
Waldorf	9,808	1,915	11,723	3,958	13,766	2,256	12,064
La Plata	1,718	4,373	6,091	3,723	5,441	4,275	5,993
Remainder of Zekiah Swamp	3,782	2,101	5,883	1,360	5,142	1,324	5,106
Total	**53,327**	**24,173**	**77,500**	**24,173**	**77,500**	**24,173**	**77,500**

Notes:
1: Source: Maryland Property View 2008.
Please see the Water Resources Element Appendix for projection methodology.

(DDD) would remain deferred (with permitted densities of one unit per ten acres) through 2030. New development in the portion of the Old Woman's Run Tier II catchment area development capacity in rural areas. This scenario will test the water resources impacts of concentrating a greater share of development in the County's major Priority Funding Areas (PFA).

- **C. Deferred Development District Focus**. This scenario would test the water resources impacts of immediately opening the entire DDD for development under its base zoning (Low Density Residential).[2] This scenario assumes that all new development in the DDD and a share of existing development would be connected to the Waldorf public water system and the Mattawoman WWTP. The County's policy, as stated in the 2006 Comprehensive Plan, is that there is adequate development capacity in the Development District (not the DDD) through at least 2020. This WRE scenario is a theoretical exercise only, and does not reflect a change in County policy. The PPA would also be included in this scenario. All other parts of the County would remain unchanged from the Baseline.

Because water and sewer service is often measured in terms of Equivalent Dwelling Units, or EDU (see below), the Water Resources Element's projections of water and sewer system demand is based on housing units. The projected increase of 24,173 housing units in all scenarios represents an annual increase of approximately 1.7 percent per year between 2008-2030, or 45 percent overall. A more detailed account of how these projections were developed is included in the Water Resources Element Appendix.

D. Equivalent Dwelling Units

An EDU represents the average amount of water used by one household, and is also used to calculate residential and non-residential (e.g., businesses) water demand. The Water Resources Element makes separate assumptions for an EDU. For water use, one EDU equals 208 gallons per day (gpd). While the typical statewide assumption for one EDU is 250 gpd, Charles County's assumption of 208 gpd is based on water billing data since approximately 2000 (which equates to approximately 180 gpd), plus a factor to account for system water loss and other inefficiencies. The factor of 208 gpd per EDU for water use is the basis for water calculations in the County's 2006 Comprehensive Water and Sewer Plan.[3] A recently completed County water rate study indicates that actual residential use may be as low as 170-180 gpd per housing unit.

For sewer flows, the County does not have detailed metering. Accordingly, the sewer EDU is based on the water EDU, plus a factor to account for inflow and infiltration (see Section V) and other inefficiencies. Thus, for the WRE it is assumed that one sewer EDU is equivalent to 250 gpd.

[2] For modeling purposes, the typical residential yield in Low Density Residential areas was assumed to be 1.55 units per acre, as derived by the Department of Planning & Growth Management based on historical data/housing yield in the RL Zone, which includes land used as open spaces and infrastructure. Densities per acre increase when these areas are removed. This assumes the use of Transferrable Development Rights (TDRs) as commonly used in the active Development District

[3] The Town of La Plata uses 222 gpd for water service and approximately 253 gpd (222 gpd plus 14 percent for inflow and infiltration—see Section V) for sewer service.

IV. Drinking Water Assessment

A. Summary and Analysis of Drinking Water Data

This section describes existing conditions and projected future demand for drinking water.

1. Drinking Water Sources

Although Charles County is bordered by both the Patuxent and Potomac River systems, groundwater is the primary source of water for nearly all of the County's public and private water systems. The major groundwater resources of Charles County are the aquifers of the Patuxent, Patapsco, Magothy, and Aquia Formations (see Figure 1). A more detailed description of these aquifers is included in the County's 2006 Comprehensive Water and Sewer Plan. Several studies over the last two decades have determined that the local groundwater supply may be limited in certain areas due to the natural geology and recharge rate of these aquifers.

At the same time, the ability to obtain drinking water supplies from surface water within the County is constrained because of salinity concentrations. The County supplements the groundwater supply to the Waldorf and Bensville areas by purchasing drinking water (surface water) from the Washington Suburban Sanitary Commission (WSSC). WSSC obtains its water from a more northern reach of the Potomac River near Washington, D.C, which has lower salinity concentrations. Surface water treatment may be considered as a long term option for public drinking water systems in Charles County.

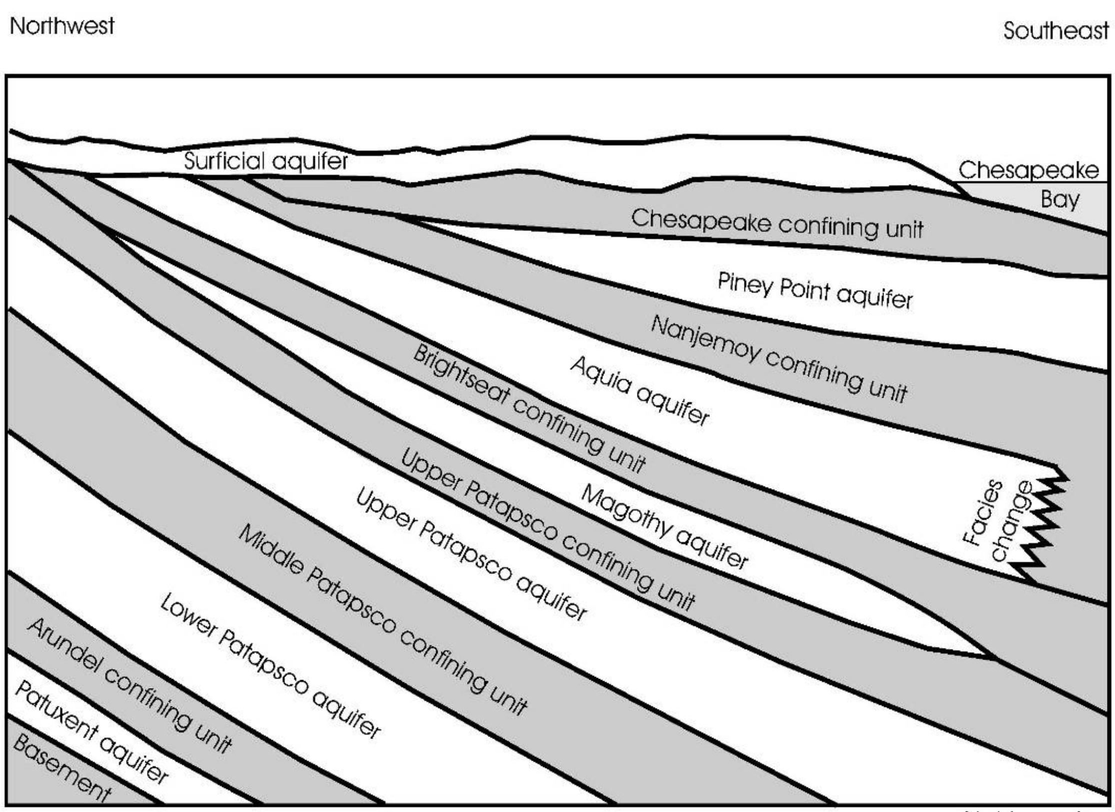


Figure 1: Major Aquifers in Southern Maryland
Source: MGS. 2007. Reports of Investigation #76

2. Public Water Systems

Groundwater is the primary source of potable water for Charles County's public water systems. There are 54 central water supply systems in Charles County that provide potable water service to approximately two-thirds of the County's housing units (or approximately 35,000 housing units).[4] Of these systems, 20 are operated by the County. The Towns of Indian Head and La Plata each operate their own water system. Table 3 shows the sources and characteristics of the 12 existing "major" drinking water systems—those with a permitted withdrawal of more than 50,000 gpd.

Table 3. Drinking Water System Characteristics

Water System[1]	Source Aquifer (number of wells)	Source Concerns/System Issues
Avon Crest	Patapsco (1)	
Benedict	Aquia (2)	
Bryan's Road	Patapsco (5), Patuxent (2)	New Patuxent aquifer well and extension of the Waldorf/Bensville system for support and flow redundancy.
Cliffton	Patapsco (2)	Replace one existing well
Hunter's Brook	Patuxent (2)	
Indian Head	Patapsco (4)	System water loss at 24 percent[2]
La Plata	Patapsco (5)	Increased water appropriation needed to support projected growth.
Strawberry Hills Estates	Patapsco (2)	Planned interconnection to Bryans Road water system/shut down Patapsco wells
Swan Point	Patapsco (2)	
Waldorf	Magothy (9), Patapsco (7)	Additional WSSC appropriation as needed
College of Southern MD	2 wells	
Naval Surface Warfare Center	Patuxent (3), Patapsco (3)	Some saltwater intrusion in the past; future additional Patuxent aquifer well planned.
Mirant Morgantown	Surface Water, Potomac River	

Notes:
1: Source: Charles County Department of Planning and Growth Management, and Department of Public Utilities. Only lists systems with capacities greater than 50,000 gallons per day (gpd)
2: Source: 2009 Indian Head Comprehensive Plan, Water Resources Element.

Figure 2 shows the location of the County's water service areas. Table 4 shows the existing and projected water supplies, demands, surpluses, and deficits for these water systems under each of the three scenarios described in Section 3.

The County's public water systems rely on four primary water-bearing formations. From the deepest to shallowest they are the Patuxent, Patapsco, Magothy, and Aquia aquifers. The County's public systems primarily use the Magothy and Lower Patapsco aquifers. The Patuxent Aquifer is, for the most part, an unused water resource except in the western sections of the County.

a. Waldorf

The Waldorf water system is the largest and most significant system in the County. It serves much of the Development District, including Waldorf, St. Charles, Bensville, and portions of White Plains. The Bensville system, formerly a separate service area, was interconnected to the Waldorf system in 2008. Charles County owns, operates, and maintains the extensive Waldorf

[4] 2006 Charles County Comprehensive Water and Sewer Plan

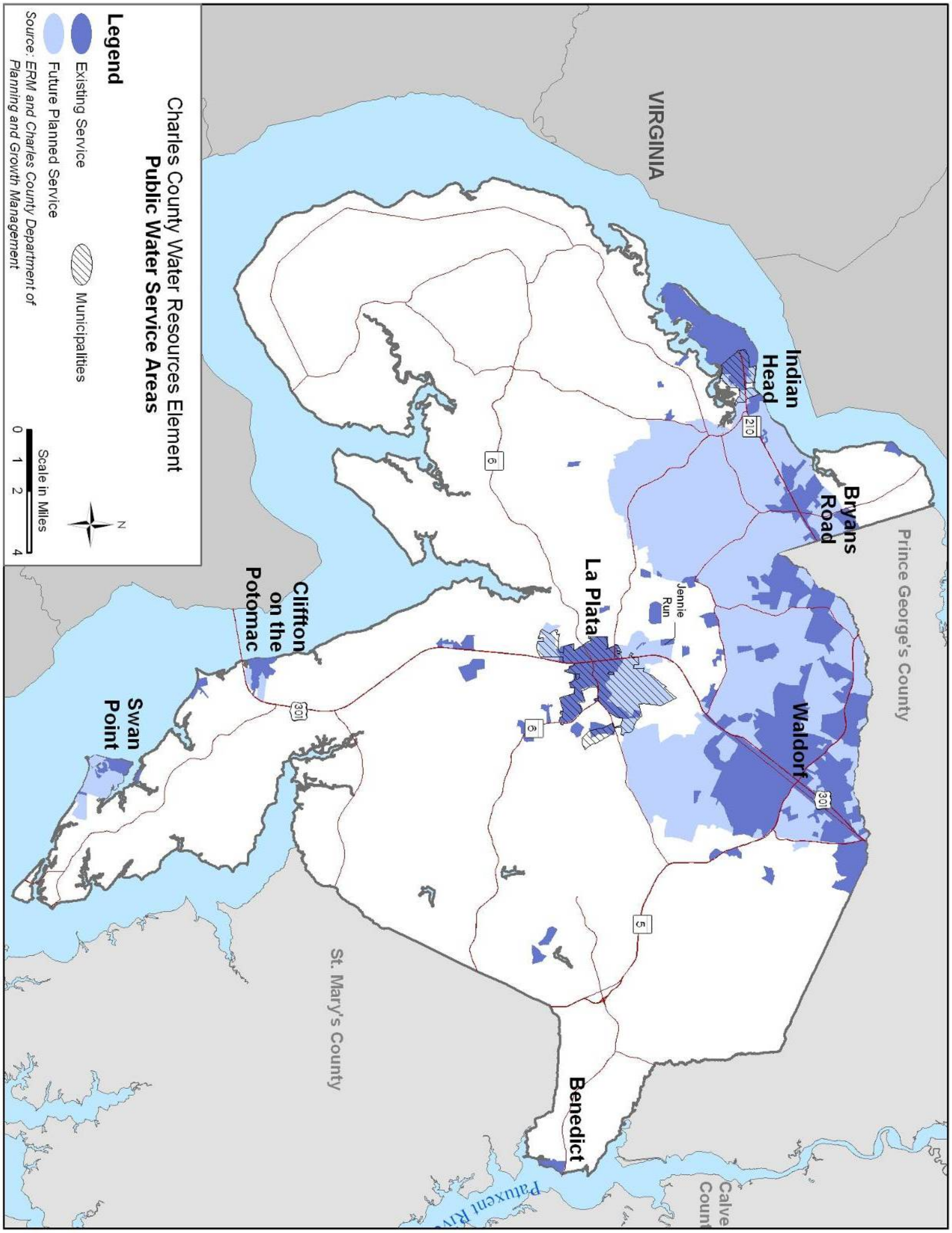


Figure 2: Public Water Service Areas

Table 4. Drinking Water System Demand and Capacity, 2030

		Benedict (St. Francis)			Bryans Road			Cliffton-on-Potomac			Hunter's Brooke	Town of Indian Head
	Scenario[1]	A	B	C	A	B	C	A	B	C	All Scenarios	All Scenarios
Existing Permitted Water Production [2]	gpd[3]			56,000			513,000			90,000	116,000	338,000
	EDU[3]			269			2,466			433	558	1,625
Demand, 2008	gpd			20,225			272,559			49,000	46,827	279,957
	EDU			97			1,310			236	225	1,346
Net Available Capacity, 2008	gpd			35,775			240,441			41,000	69,173	58,043
	EDU			172			1,156			197	333	279
Total Projected New Demand, 2008-2030[4]	gpd	4,992	5,824	5,824	824,304	907,504	533,104	4,853	4,262	4,060	-	184,080
	EDU	24	28	28	3,963	4,363	2,563	23	20	20	-	885
Grand Total Projected Demand, 2030	gpd	25,217	26,049	26,049	1,096,863	1,180,063	805,663	53,853	53,262	53,060	-	464,037
	EDU	121	125	125	5,273	5,673	3,873	259	256	255	-	2,231
System Capacity, 2030[5]	gpd			56,000			513,000			90,000	116,000	588,000
	EDU			269			2,446			433	446	2,262
Net Available Capacity, 2030	**gpd**	**30,783**	**29,951**	**69,173**	**(583,863)**	**(667,063)**	**(292,663)**	36,147	36,738	36,940	**69,173**	**123,963**
	EDU	**148**	**144**	**333**	**(2,807)**	**(3,207)**	**(1,407)**	174	177	178	**333**	**596**

		Town of La Plata			Strawberry Hills Estates	Swan Point			Waldorf System			Indian Head NSWC
	Scenario[1]	A	B	C	All Scenarios	A	B	C	A	B	C	All Scenarios
Existing Permitted Water Production [2]	gpd[3]			1,234,000	120,000			500,000			9,647,000	1,890,000
	EDU[3]			5,559	577			2,404			46,380	9,087
Demand, 2008	gpd			916,308	106,800			56,394			5,822,000	1,106,000
	EDU			4,128	513			271			27,990	5,317
Net Available Capacity, 2008	gpd			317,692	13,200			443,606			3,825,000	784,000
	EDU			1,431	63			2,133			18,389	3,769
Total Projected New Demand, 2008-2030[4]	gpd	1,485,846	1,283,160	1,455,210	7,696	328,324	191,962	186,658	1,598,480	2,583,152	2,910,294	-
	EDU	6,693	5,780	6,555	37	1,578	923	897	7,685	12,419	13,992	-
Grand Total Projected Demand, 2030	gpd	2,402,154	2,199,468	2,371,518	114,496	384,718	248,356	243,052	7,420,480	8,405,152	8,732,294	1,106,000
	EDU	10,821	9,908	10,683	550	1,850	1,194	1,169	35,675	40,409	41,982	5,317
System Capacity, 2030[5]	gpd			1,234,000	120,000			500,000			9,647,000	1,890,000
	EDU			5,559	462			2,404			46,380	7,269
Net Available Capacity, 2030	**gpd**	**(1,168,154)**	**(965,468)**	**(1,137,518)**	**5,504**	**115,282**	**251,644**	**256,948**	**2,226,520**	**1,241,848**	**914,706**	**784,000**
	EDU	**(5,262)**	**(4,349)**	**(5,124)**	**26**	**554**	**1,210**	**1,235**	**10,704**	**5,970**	**4,398**	**3,769**

Notes:
1: A =Baseline Scenario; B = Waldorf Area Focus Scenario; C = DDD Focus Scenario
2: Incorporates all planned upgrades and expansions. La Plata has requested up to 2.0 MGD.
3: gpd = Million gallons per day; EDU = An Equivalent Dwelling Unit (EDU) is 208 gallons per day (gpd) for County systems and the Town of Indian Head. For La Plata, the Town's planning estimate of 222 gpd is used.
4: Includes projected new residential and non-residential demand, as well as new demand from system extensions. Assumes that new non-residential system demand is approximately 20 percent of total new residential demand.
5: Incorporates ongoing, planned, and recommended upgrades and expansions.
Sources: Maryland Property View 2007; Charles County Water and Sewer Master Plan, and Charles County Department of Planning and Growth Management, and Department of Public Utilities. Data for the Towns of La Plata and Indian Head based on draft Municipal Growth Elements and Water Resources Elements for those jurisdictions.

water distribution system, as well as the sixteen production wells that provide water to the system. Nine of these wells tap the Magothy Aquifer, while another seven wells are in the Patapsco aquifers.

In addition, the Waldorf system is interconnected to the Washington Suburban Sanitary Commission (WSSC). WSSC's water is drawn from the Potomac River in the Washington, D.C. area. Through an agreement with WSSC, Charles County can purchase up to 1.4 MGD of water from WSSC. The County is also exploring options to expand the WSSC agreement to allow the County to purchase up to an additional 5 MGD of water. Such expanded water purchases will involve coordination with Prince George's County, the "upstream" user of WSSC water. Other future plans for the Waldorf system include interconnection with the Bryans Road water system, which will complete the interconnection goal for the Development District as stated in the Comprehensive Water and Sewer Plan.

b. Other Major Systems

Other major water systems in Charles County include the municipally-owned systems serving La Plata and Indian Head, as well as County-operated systems in Bryans Road, Benedict, Swan Point, and other locations. More detailed information on existing and proposed future County water service areas can be found in the County's Comprehensive Water and Sewer Plan. The Water Resources Elements of the Indian Head and La Plata Comprehensive Plans include detailed information about these municipal water systems.

c. Minor Systems

Smaller public systems in the County (those with average permitted withdrawals of less than 50,000 gpd) account for nearly 1.55 MGD of permitted withdrawals from a variety of aquifers and an annual average of 0.66 MGD of demand. Collectively, these systems—which typically serve individual subdivisions, mobile home parks, or schools throughout the County—have nearly 0.89 MGD of unused capacity.

d. Water System Capacity

The County's major public water systems all have available capacity to support some additional growth and development. With no changes to current permitted water supplies, the Waldorf system would have adequate capacity to support projected demand in all future scenarios, while the Bryans Road system would need additional water supplies under all scenarios under the current permits. The County's long-term intent is to combine these two systems.

The resulting combined Bryans Road-Waldorf system would have surplus water capacity under the Baseline scenario (1.64 MGD), Waldorf Area Focus scenario (0.57 MGD) and the DDD Focus scenario (0.62 MGD). All other County-operated water systems would also have adequate capacity to support projected demand in all scenarios.

The Town of Indian Head's water system has adequate supply to support the growth identified in its Comprehensive Plan. The La Plata water system, operated by the Town, will need additional water supplies—nearly 0.7 MGD under the Baseline and DDD Focus scenarios—to support projected demand. The Town of La Plata has a pending request to MDE to increase permitted withdrawals to 2.0 MGD to serve the Town's future demand through 2020 (demand through 2030 could require as much as 2.5 MGD[5]).

[5] Source: La Plata Comprehensive Plan.

3. Other Water Use

All residential units and businesses in Charles County outside of public water systems rely on individual or community wells. These wells are drilled in a variety of water-bearing formations, including (from deepest to shallowest) the confined Patuxent, Patapsco (Upper and Lower), Magothy, and Aquia aquifers, and unconfined surficial aquifers.

Table 5 shows the distribution of countywide water use in 2005 (the most recent available data for Countywide water usage). Power generation is clearly the largest single user, reflecting the process water from the Potomac River that is used and discharged by the Mirant Morgantown power generation station (adjacent to the Charles County terminus of the Harry Nice Bridge over the Potomac River).

Table 5. Freshwater Withdrawals in Charles County, 2005

Type of Withdrawal	Groundwater (MGD)[1]	Surface Water (MGD)	Total (MGD)	Share of Total[2]
Domestic (public and individual wells)	9.00	0	**9.00**	**74%**
Commercial	2.57	0	**2.57**	**21%**
Industrial	0.02	0	**0.02**	**>1%**
Mining	0.10	0.08	**0.18**	**>1%**
Agriculture/Irrigation	0.24	0.09	**0.33**	**3%**
Livestock	0.04	0.04	**0.08**	**>1%**
Total (Excluding Power Generation)	**11.97**	**0.21**	**12.18**	**100%**
Power Generation	0.57	1,166.55	1,167.12	

Notes:
1: MGD = millions of gallons per day
2: Excludes Power Generation
Source: 2005 Maryland Water Use Report (MDE)

Excluding the Mirant plant, domestic users (public systems and individual wells) are the largest category of potable water consumption in the County, accounting for nearly three-quarters of all water demand. Commercial uses outside of public systems account for more than one-fifth of water use.

a. Private/Individual Residential Wells

Approximately one-third of the housing units in the County (approximately 18,000 households) are served by individual wells.[6] These wells draw water from several different aquifers. The Aquia aquifer is primarily used in the eastern and southern portion of the County; the Magothy is used by individual wells in the north-central portion of the County; and the Upper and Lower Patapsco aquifers are used in the western portion of the County. Of these major aquifers, the Aquia and Lower Patapsco are the most frequently used for individual wells.

b. Major Commercial and Industrial Users Outside of Public Systems

Two major industries—the Mirant power plant at Morgantown and the Naval Surface Warfare Center (NSWC) at Indian Head—account for substantial water usage in Charles County.[7] NSWC withdraws groundwater primarily for domestic use, while the Mirant plant uses groundwater and a very large amount of surface water (used as a coolant) from the Potomac River.

[6] Based on 2006 Charles County Water and Sewer Plan and MD Property View.

[7] 2006 Charles County Water and Sewer Plan, 3-2.

Mirant's Chalk Point facility, at the extreme southern tip of Prince George's County (across the Patuxent River from the Benedict area in Charles County) also withdraws substantial amounts of groundwater—an average of approximately 0.45 MGD from the Magothy aquifer and 0.50 MGD from the Upper Patapsco aquifer. Beginning in 2010, the Chalk Point facility will switch to the Patuxent aquifer, withdrawing approximately 1 MGD.[8]

c. Agricultural Users

As shown in Table 5, agriculture, irrigation, and livestock, largely in the eastern portion of the County, account for approximately two percent of the County's overall groundwater use and about two/thirds of surface water withdrawal (excluding power plants). The groundwater source for irrigation is typically the surficial aquifer.

B. Discussion of Water Concerns and Issues and Options

1. Water Quality

A limited number of homes and businesses in rural areas of Charles County obtain groundwater from shallow wells drilled into the surficial aquifer. These wells are at risk of bacterial contamination from individual septic systems, agricultural fertilizers, and other pollutants. Attrition of these shallow wells generally prompts these homeowners and businesses to drill a new well into a confined aquifer.

MGS has documented river-water intrusion into the Lower Patapsco aquifer from the Potomac River in the Indian Head area.[9] Such intrusion is most likely to occur when very high volume groundwater pumping causes a reduction in underground pressure, allowing water from the Potomac riverbed (which may be unsuitable for human consumption) to intrude. There have never been documented instances of river water intrusion in public water systems operated by Charles County.

The County's Chapel Point community well was discovered to have traces of radioactivity due to the presence of trace amounts of Polonium. The County has installed Reverse Osmosis (RO) filtration on the existing well, and successfully drilled a new well to mitigate for this water quality problem. Completion of the new well and the associated water line is anticipated in 2010.

2. Groundwater Recharge

The primary goal for Charles County's major public water systems is to ensure the adequacy of available supplies to support existing users and projected growth. County-owned water systems obtain approximately half of their drinking water (approximately 2.8 MGD) from the Lower Patapsco aquifer, which has shown evidence of water level decline from increased use[10]. Other commonly used aquifers, such as the Magothy and Aquia, are heavily used across the state, particularly on the Eastern Shore, and are subject to withdrawal limitations.

The Water Balance methodology recommended by *Models and Guidelines #26* (the state's official guidance for preparation of the Water Resources Element) is not applicable for the Coastal Plain. However, groundwater supplies in Southern Maryland, and particularly in Charles

---

[8] Source: Maryland DNR (PPRP). 2007. Environmental Review of the Proposed Flue Gas Desulfurization (FGD) Project at the Chalk Point Generating Station.

[9] Source: MGS. 2007. Report of Investigations No. 76: Water-Supply Potential of the Coastal Plain Aquifers in Calvert, Charles, and St. Mary's Counties…

[10] 2006 Charles County Water Resource Advisory Committee Report, 6.

County, have been the subject of considerable study by the Maryland Geological Survey (MGS) and other state agencies.

The most recent MGS study, *Report of Investigations #76* (2007) discusses how, in 2002, the Magothy aquifer was near its "80 percent management level," the minimum acceptable level for which MDE will allow withdrawals. The County has been aware of the Magothy's limitations for many years, and has taken steps to sustain the aquifer. Beginning in the 1980s, the County shifted water production to the Lower Patapsco aquifer to preserve the Magothy. This action stopped the decline in the aquifer; and levels have generally been maintained since that time.

At the same time, the Lower Patapsco aquifer in the western portion of Charles County has a relatively limited production capability and a somewhat shallow depth. Given these limitations and the proximity of some of the County's production wells to this area, water levels in the Lower Patapsco tend to have greater fluctuation based on the activities occurring in the vicinity. MGS studies of area aquifers have also suggested that lowered water tables in shallow portions of the Patapsco aquifers could also reduce base flow to streams. In 2007, MDE approached the County with concerns that the water levels observed in the Potomac Heights area were nearing the 80% management level in the Lower Patapsco aquifer. The County immediately took action by shifting nearly all well pumping in the Bryans Road water system to the deeper Patuxent wells already in place. This shift immediately resulted in a rebound of the Lower Patapsco water levels and alleviated the concerns in the Potomac Heights area wells.

At the request of Charles County (Spring 2009), MGS performed another model of the Waldorf water system to evaluate the effect of significantly reducing or even stopping production from five of the County's Lower Patapsco aquifer wells in the Bensville area, and replacing this production with surface water purchased from WSSC. The results of this model projected a substantial rebound in the Patapsco aquifer, with the greatest improvements seen in the Bryans Road area.

These studies of the County's groundwater resources are important inputs into MDE's decision process for approving and altering renewed groundwater withdrawal permits for water systems in Charles County (including systems operated by the County, municipalities, and private entities). In particular, MDE adjusts withdrawal permits in response to aquifer behavior. For example, increased or stabilized aquifer recharge rates could justify increased permit values. Conversely, a permit may be reduced at the time of renewal if there is concern over the aquifer. Generally, such changes are negotiated or worked out between MDE and the local government. An example is when MDE adjusted the County's groundwater permits for the Magothy wells in Waldorf in 2002. While there was no decline in the Magothy aquifer that was being addressed, the County was not using all of its permitted capacity under the permit. Therefore, MDE reduced the permitted capacity in the Magothy to the level of use at that time in exchange for increased appropriation in the Lower Patapsco aquifer.

An additional concern is the impact that continual pumpage increases may have on overall water levels in aquifers. As demand continues to increase, the County is seeking alternatives to the increased withdrawal from the Lower Patapsco in the current scenario. In order to reduce or eliminate the impacts on private well users, alternative water sources or pumping strategies are needed. Such measures have been implemented in Bryans Road by shifting the majority of public water withdrawals to the deeper Patuxent Aquifer, which has little to no private homeowner use due to its great depth and expense to reach.

The pending interconnection of the Strawberry Hills water system[11] to the Bryans Road water system is another example of stopping the impacts of public system consumption on private well users. The County has a contract with MGS to perform annual groundwater monitoring from 23 observation wells in various aquifers located all across the County. The County works with MGS to ensure water levels are maintained above 80 percent management levels (or other designated management levels, as appropriate). An example is the discussion listed above regarding water levels near Potomac Heights and the subsequent actions taken.

The County has studied groundwater levels with the assistance of the State agencies and specialized consultants for over 25 years. These efforts have resulted in over 15 detailed studies, a widespread groundwater monitoring network, a capital program to build needed distribution infrastructure, and a local Water Resources Advisory Committee to continue the evolution of water supply techniques and sources.

3. Municipal Water Systems

a. <u>La Plata Water System</u>

Whereas the Waldorf water system has several potential water sources (including groundwater aquifers and surface water sources via WSSC), the La Plata system is currently limited to withdraw water from the Lower Patapsco aquifer. The Town will need an increase in permitted supply to meet water demand from future development planned through 2030.

One potential approach is interconnection of the La Plata and Waldorf water systems. Interconnection could address the Town's water supply concerns and provide water supply redundancy. However, such an option involves engineering considerations and potential inter-jurisdictional agreements. Approximately two to four miles of distribution lines would need to be constructed to connect the two systems, and any interconnection agreement would need to address the different fee structures of the two systems.

b. <u>Indian Head Water System</u>

The Indian Head water system is similarly limited, in that it relies entirely on groundwater from the Lower Patapsco aquifer. In order to meet the needs of planned growth, and knowing the limitations of groundwater availability in north-western Charles County, the Town recently drilled a new Patuxent well for water supply. Under the Town's current groundwater appropriation permits, adequate capacity exists to accommodate projected growth.

C. Options and Recommendations to Address Drinking Water Issues

1. Potential New Water Supplies[12]

a. <u>Alternate Well Locations</u>

As described above, MGS' modeling efforts have demonstrated limitations of the production wells in the Lower Patapsco aquifer—particularly in the Indian Head and Bryans Road area. One option for addressing this concern is to relocate production wells to portions of the Patapsco Aquifer located farther southeast where the aquifer has greater capabilities and capacity. This

[11] The County has an approved Capital project to construct a 12-inch waterline along MD 227 to interconnect the Bryans Road water System to the County's stand-alone Strawberry Hills water system. The interconnection will allow the County to supply water from the deeper Patuxent aquifer to Strawberry Hills and eliminate the two current wells withdrawing water from the Lower Patapsco. MGS projects that this interconnection will provide additional rebound of water levels in the Lower Patapsco aquifer.

[12] 2006 Charles County Water Resource Advisory Committee Report, 22.

could reduce the amount of drawdown near the Lower Patapsco's most constrained area, making this a more sustainable water supply source.

b. Wellfield Management

Another recommendation of the 2006 WRAC, based on studies conducted by MGS, is to implement a Wellfield Management system. Such a system can make the most sustainable use of the County's groundwater resources. Interconnection of the Waldorf and Bryans Road systems is one aspect of wellfield management. Other key components would include the construction of new wellfields and the automation of pumping from those wells to better balance production and to avoid imbalanced drawdowns of the County's aquifers. Locating wells further south and east—where aquifers have greater production capability—could enable the system to deliver a more sustainable supply with reduced overall impacts on the aquifer.

By rotating the withdrawals among the wells in the network, adequate water can be produced for the Waldorf system, while greatly minimizing impacts to the aquifer. This plan was derived based on MGS's 2003 Bryans Road Optimization Study and 2004 Waldorf Optimization Study, which both determined a series of measures to maximize pumping efficiency, while minimizing drawdown in the aquifers. The studies also suggested the locations of new wells in areas where they do not affect each other or other area users. Finally, in order to distribute water from the "down-dip" area (the southwest) to the more limited or "up-dip" aquifer areas, the County conducted the Waldorf Water Distribution Study in 2008-2009. That study determined the infrastructure needs to transmit water from Waldorf to Bryans Road, including water source needs; the system needs to move water between different hydraulic gradients, and water pressure needs and adjustments.

c. Patuxent Aquifer Wells

The Patuxent aquifer is the deepest aquifer in Charles County. This aquifer is relatively untapped and lies just above the coastal plain bedrock. While little is known about the production capabilities of the Patuxent aquifer in north-central and northeast Charles County, the Bryans Road water system uses two wells into this aquifer, the Indian Head NSWC also has several recently drilled Patuxent aquifer wells, and the Town of Indian Head is currently completing its first Patuxent aquifer well. The 1999 MGS Patuxent Aquifer Study in the Bryans Road-Indian Head area showed that there was approximately 500 feet of available drawdown in this area of the aquifer. The Patuxent aquifer has shown to be a viable source of water for the western portion of the County, making it a valuable resource in combination with the other actions described in this section. Therefore, the County is focusing on the Patuxent aquifer as a potential future source of drinking water.

In 2008, the County initiated a process to use the two production wells in Chapman State Park, for which the County had negotiated during the land transfer of the Chapman's property to DNR in 1998. During their initial pump tests in the mid-1990's, these were shown to have good water quality and a substantial water yield from the Patuxent aquifer. However, in 2008, the Maryland General Assembly passed a law prohibiting the use of potable water from state lands for users outside of the state property. As a result, the General Assembly appropriated funding during the 2010 legislative session to compensate the Charles County for the loss of the previously-committed Chapman Park wells.

Additional wells in the Patuxent aquifers in the northwestern portion of the County will assist the Bryans Road Water System and reduce the impacts to local private well users. The use of these wells would have very little, if any, negative impact on the wells of private individual homeowners, since they are significantly deeper than the average well in the area. Based on the results of the pump test completed when the Chapman's wells and the other more recent production wells were drilled, the Patuxent aquifer water source should yield a sustainable water supply for the Bryans Road Water System. Costs associated with infrastructure to connect a new Patuxent well to the Bryans Road Water System has been evaluated and budgeted in the County's Capital Budget for construction. Therefore, installing this new well is viewed as a priority project to address the issues related to private water use in the area.

d. Purchased Water from WSSC

The County has an existing allocation from the Washington Suburban Sanitary Commission (WSSC) for up to 1.4 million MGD. WSSC water is drawn from the Potomac River before being treated and distributed to customers. To address future water needs, particularly in the Waldorf system, the County is working with WSSC to evaluate the possibility of increasing that allocation to further reduce local dependence on groundwater, thus preserving water levels in the County's aquifers.

e. Surface Water

The County should investigate withdrawals of surface water from the Potomac River to increase potable water supplies. Such an option would require the construction of a water intake station, a water treatment facility, and associated transmission main and distribution lines. Because of the Potomac's tidal characteristics adjacent to Charles County, water treatment may require desalinization, which is a costly process. However, because surface water production would enable the County to preserve aquifer supplies, the establishment of a surface water source should be further evaluated to fully understand the feasibility of this option.

The location of a water treatment plant would have a great bearing on the costs associated with this option. A plant located in close proximity to the existing distribution lines (likely in the northwestern portion of the County) would minimize the length of new distribution lines. However, co-location of the water treatment facility with the Mirant Morgantown power station's existing intake facility could reduce other infrastructure costs.

In 2006, the County's Water Resources Advisory Committee (WRAC) reported on options to ensure sustainable water supplies for Charles County. The WRAC Report recognized the results of previous studies that evaluated options for surface water reservoirs in Charles County. As stated in the WRAC Report, while some potential sites were identified, these studies concluded that reservoirs were not a feasible option in Charles County due to concerns about water quality, environmental impacts, and cost.[13]

f. Water Reuse

Water reuse refers to the process of redirecting treated effluent water from Wastewater Treatment Plants (WWTP) to an industrial or other use such as coolant at a power plant or irrigation for agriculture. This use of effluent not only diverts this water from being discharged into a water body, but also takes the place of potable water that would have been used for the same purpose. MDE currently has strict limitations on water reuse, but has recently begun to relax some of these restrictions.

Charles County currently distributes up to 2.4 MGD of treated effluent from the Brandywine WWTP to the PANDA Brandywine Power Plant in Prince George's County for cooling purposes.

[13] Water Resources Advisory Committee. 2006. Report to the Charles County Commissioners.

The County also has an executed Agreement with the planned Competitive Power Ventures Power Plant (to be built in Charles County) to use additional treated effluent, further diverting discharges from the Potomac River and preserving potable water from unnecessary industrial use, Water reuse is a significant conservation measure, which can be expanded in the future. The County continues to work with MDE to investigate these expanded uses and associated regulations for implementation.

2. Water Conservation

Water conservation is an often-overlooked, but critically important element of water supply. Water conservation is an often-overlooked, but critically important element of water supply. Water-conserving fixtures have been the industry standard in new construction in Charles County since the mid-1980s, and the Maryland Water Conservation Plumbing Fixtures Act (MWCPFA), requires that new plumbing fixtures sold or installed as part of new construction are designed to conserve water. All development in Charles County since 1986 has used water-conserving fixtures and appliances. As a result, the County's water allocations based on average use have dropped from approximately 260 gpd in the 1980s to 208 gpd today. In fact, the County recently completed a Water Rate Study, which found that the 5-year average per EDU was 179.9 GPD.

One of the County's goals with regard to water supply is to increase the public's awareness of water supply limitations, and to encourage citizens and businesses to help the County reach its conservation goals. The County promotes water conservation through media and educational seminars and publications, gives guidance to homeowners interested in water conservation, and has provided water-conserving fixtures to some homeowners. Nationwide and within the County, there is also a growing emphasis on incorporating energy savings and water conservation into new building design, most notably through LEED certification and the National Association of Home Builders'(NAHB) Green Building Program. If such education, retrofit, and design efforts could reduce average water use in the County to 180 gpd per household (including allowances for system water loss), the County's Year 2030 water demand in major public systems could be reduced by approximately 1.7 MGD (more than ten percent of the projected 2030 demand shown in Table 4).

A graduated/inclining water rate structure is another way to encourage water conservation. The County recently replaced its uniform unit rate structure with an inclining block rate structure that defines tiers by quarterly usage. Through this rate structure, the unit price for water increases as the volume consumed increases, which helps to incentivize water conservation. Customers who use low or average volumes of water are charged a modest unit price and rewarded for conservation; those using significantly higher volumes pay higher unit prices.

3. Source water protection

The County protects public water sources primarily through wellhead protection efforts. These include fencing around all wellheads, enclosure of wellheads within buildings where possible and installation of wellhead covers for outdoor wells. For surface water obtained from WSSC, the County performs additional water treatment at the connection point at the Prince George's County line to ensure adequate water quality.

V. Wastewater Assessment

A. Summary and Analysis of Wastewater System Data

This section describes existing conditions and projected future wastewater system needs.

1. Public Sewer Systems

Approximately 33,600 housing units in Charles County (63 percent of the County total) and a considerable share of businesses discharge wastewater to one of the seven County, municipal, or private (community) wastewater treatment plants (WWTP).[14] Indian Head Naval Surface Warfare Center (NSWC) also operates a WWTP.[15] Figure 3 shows the location of the County's public sewer service areas (including industrial systems not described in this chapter) and WWTPs. Table 6 describes these facilities, sorted by the watershed into which effluent is discharged. Table 7 shows the existing and projected water supplies, demands, surpluses, and deficits for these wastewater systems under each of the three scenarios described in Section 3.

Table 6. Public Sewer System Characteristics

Wastewater Treatment Plant (by Watershed)[1]	Discharge Location	Treatment Technology	Planned/Potential Upgrades/Expansions
Patuxent River			
Benedict	Spray irrigation system.	Biological Nutrient Removal (BNR)[2]	Under design. Online by 2013.
Mattawoman Creek			
Indian Head	Ginny Creek	Enhanced Nutrient Removal (ENR)[2]	
Potomac River Middle Tidal			
Mattawoman	Potomac River	ENR. Effluent used as process water at PANDA Brandywine power plant.	Re-rated to 20 MGD based on ENR.
Clifton on the Potomac	Potomac River	Secondary	BNR/ENR upgrade
NSWC	Potomac River	Secondary	ENR upgrade
Port Tobacco River			
La Plata	Tributary of Port Tobacco River	BNR[2]	ENR upgrade by 2011.
Mt. Carmel Woods	Jennie Run	Secondary	Plants to be retired, effluent pumped to Mattawoman.
College of Southern MD	Port Tobacco R.	Secondary	
Lower Tidal Potomac River			
Swan Point	Cuckold Creek	ENR	None
Cuckold Creek (Swan Point)	Spray irrigation system.	Lagoon System, with spray irrigation.	Planned interconnection to Swan Point WWTP (ENR)

Notes:
1: Source: Charles County Department of Planning and Growth Management, and Department of Public Utilities. Only lists systems with capacities greater than 50,000 gallons per day (gpd)
2: ENR is the best available wastewater treatment technology, resulting in loading as low as 3 mg of Nitrogen and 0.3 mg of Phosphorus per liter of effluent, compared to 8 and 2 mg/L, respectively for BNR.

[14] 2006 Charles County Water and Sewer Plan, 4-32.

[15] There are also several small (<0.1 MGD) privately-owned WWTPs scattered throughout the County. Because of their small size and private ownership, these facilities are not discussed in the WRE. However, estimates of their discharges are included in the nutrient modeling described in Section VII.

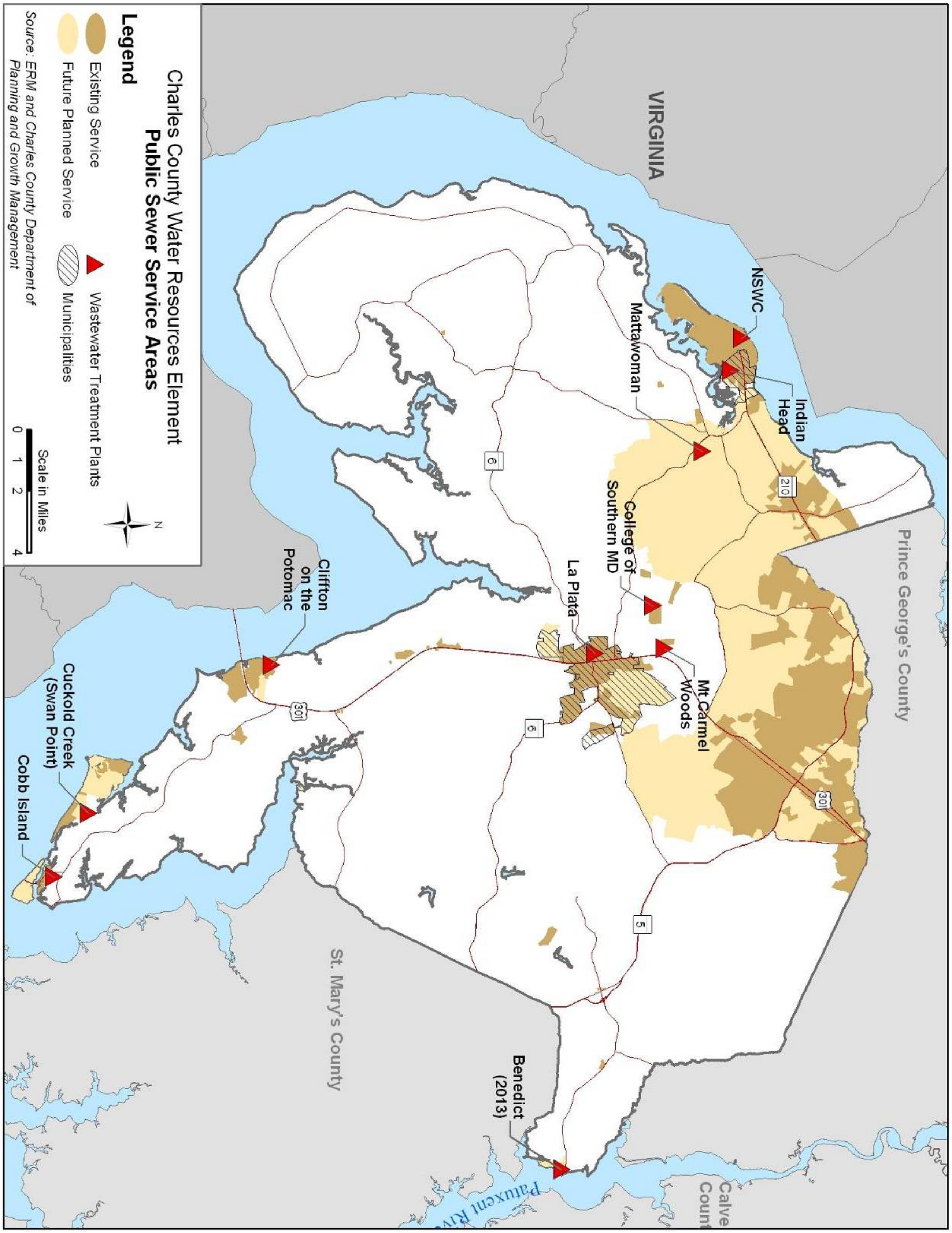


Figure 3: Public Wastewater Service Areas

The Mattawoman WWTP is the County's largest WWTP. Its current capacity is 20 MGD, of which 3 MGD is set aside for WSSC use in Prince George's County. The existing flows to this facility in Table 7 include approximately 0.4 MGD from WSSC, while future flows assume that WSSC will utilize its entire 3 MGD capacity by 2030.16 A more detailed description of the County's public wastewater systems can be found in the 2006 Comprehensive Water and Sewer Plan. The Town of Indian Head and the Town of La Plata provide public sewer services for properties within their corporate limits. The Water Resources Elements of the Indian Head and La Plata Comprehensive Plans include detailed information about these municipal wastewater systems.

Charles County owns and operates the remaining WWTPs in the County. All of the County's public sewer systems have adequate capacity to serve projected development through 2030. The Mt. Carmel Woods and College of Southern Maryland WWTPs are in the process of being decommissioned, with effluent to be pumped to the Mattawoman WWTP. The Benedict WWTP is under design, and is expected to be operational by 2013. Discharge from the Benedict WWTP would be disposed via spray irrigation, or another form of land application (see section B.4 below).

The Town of Indian Head WWTP and the Indian Head NSWC WWTP both have adequate capacity to serve projected development through 2030. The La Plata WWTP will be able to expand to 2.0 MGD upon completion of ENR upgrades (in approximately 2012). The La Plata WRE states that the Town plans to ultimately apply for and NPDES discharge permit of 2.5 MGD, which will serve the planned growth through 2030. However, the Town has not yet requested this capacity, and the Town WRE expresses concern about obtaining this capacity based on MDE permitting policies.

2. Nutrient Discharges and Assimilative Capacity

Nitrogen and phosphorus (more generally referred to as "nutrients") from WWTPs and from stormwater and other "non-point sources" are the primary contributors to degraded water quality in the Chesapeake Bay and its tributaries. As a result of Maryland's participation in the Chesapeake Bay 2000 Agreement and resulting state policies designed to help restore the Bay, water and sewer planning must take into account the "assimilative capacity" of a receiving body of water—the mass of nutrients that the stream can receive while still maintaining acceptable water quality. This section describes the key limits on assimilative capacity as they apply to the County's WWTPs.

a. <u>TMDL</u>

One measure of assimilative capacity is the Total Maximum Daily Load (TMDL), a series of calculations required by the Clean Water Act. A TMDL is the maximum amount of pollutant that a water body, such as a river or a lake, can receive without impairing water quality. Water bodies are classified as "impaired" when they are too polluted or otherwise degraded to support their designated and existing uses. The TMDL is typically expressed as separate discharge limits for point sources such as WWTPs, and nonpoint sources such as stormwater or agricultural runoff. The impaired waters list is called the 303(d) list, named after the section in the Clean Water Act that establishes TMDLs. In Maryland, MDE is responsible for identifying impaired waters, developing TMDLs, and coordinating TMDL implementation with local governments and other state agencies.

---

[16] Development plans for southern Prince George's County do not necessarily indicate full use of the 3 MGD allocation. However, this WRE assumes maximum use of the 3 MGD allocation is assumed for modeling purposes.

Table 7. Public (and Major Private) Sewer System Flows and Capacity, 2030

Watershed		*Patuxent River*			*Middle Potomac River*							*Mattawoman Creek*	*Port Tobacco River*					*Lower Potomac River*			
System		**Benedict[6]**			**Mattawoman[7]**			**Clifton on the Potomac**			**NSWC**	**Town of Indian Head**	**Town of La Plata[8]**			**Mt. Carmel Woods**	**College of Southern MD**	**Swan Point**			**Cobb Island**
Scenario[1]		**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**All Scenarios**	**All Scenarios**	**A**	**B**	**C**	**All Scenarios**	**All Scenarios**	**A**	**B**	**C**	**All Scenarios**
Existing Treatment Capacity[2]	MGD[3]			0			20.000			0.070	0.500	0.500			2.000	0.021	0.060			0.600	0.158
	EDU[3]			0			80,000			280	2,000	2,000			7,905	84	240			2,400	632
Average Daily Flow, 2008	MGD			0			10.612			0.028	0.350	0.332			1.134	0.008	0.030			0.083	0.051
	EDU			0			42,449			112	1,400	1,328			4,482	32	120			333	205
Net Available Capacity, 2008	MGD			0			9.388			0.042	0.150	0.168			0.866	0.013	0.030			0.517	0.107
	EDU			0			37,551			168	600	672			3,423	52	120			2,067	427
Total projected new demand, 2030[4]	MGD	0.082	0.083	0.083	5.986	7.270	7.213	0.006	0.005	0.005	0	0.259	1.757	1.526	1.722	Retired. Transferred to Mattawoman WWTP.	Retired. Transferred to Mattawoman WWTP	0.395	0.231	0.224	-
	EDU	328	332	332	23,943	29,078	28,851	23	21	20	0	1,038	6,943	6,030	6,805			1,578	922	898	-
Grand Total Projected Demand, 2030	MGD	0.082	0.083	0.083	16.598	17.882	17.825	0.034	0.033	0.033	0.350	0.591	2.891	2.660	2.856			0.478	0.314	0.308	0.051
	EDU	328	332	332	66,392	71,527	71,300	135	133	132	1,400	2,366	11,425	10,512	11,287			1,911	1,255	1,230	205
Future Capacity, 2030[5]	MGD			0.165			20.000			0.070	0.500	1			2.000					0.600	0
	EDU			660			80,000			280	1,923	1,923			7,905					2,400	608
Net Available Projected Capacity, 2030	**MGD**	**0.083**	**0.082**	**0.082**	**3.402**	**2.118**	**2.175**	**0.036**	**0.037**	**0.037**	**0.150**	**(0.091)**	**(0.891)**	**(0.660)**	**(0.856)**			**0.122**	**0.286**	**0.292**	**0.107**
	EDU	**332**	**328**	**328**	**13,608**	**8,473**	**8,700**	**145**	**147**	**148**	**600**	**(366)**	**(3,520)**	**(2,607)**	**(3,382)**			**489**	**1,145**	**1,170**	**427**

Notes:
1: A = Baseline Scenario; B = Waldorf Area Focus Scenario; C = DDD Focus Scenario
2: Indicates the more restrictive of either MDE's discharge permit or the system's design capacity.
3: MGD = Million Gallons per Day; EDU = Equivalent Dwelling Unit, 250 gallons per day for County systems and the Town of Indian Head. For La Plata, the Town's estimate of 253 gpd (222 gpd for water, plus 14% for I/I) is used.
4: Includes projected new residential and non-residential demand, as well as new demand from system extensions. Assumes that new non-residential system demand is approximately 20 percent of total new residential demand. Projected new demand for the Mattawoman WWTP includes 3 MGD dedicated to WSSC.
5: Incorporates ongoing, planned, and recommended upgrades.
6: Benedict WWTP was being designed as of 2010, and is expected to be operational by 2013. Initial capacity is 165,000 gpd, with potential ultimate capacity of up to 304,000 gpd.
7: Mattawoman WWTP's permitted capacity is 20 MGD. Of this capacity, 3 MGD is allocated to WSSC. Thus, this table shows the capacity available to support development in Charles County.
8: For La Plata, new demand includes 250 EDU to account for the connection of failing residential and nonresidential septic systems, as described in the Town's Draft WRE (July 2009).
Sources: Maryland Property View 2007; Charles County Water and Sewer Plan, Charles County Department of Planning and Growth Management, and Department of Public Utilities. Data for the Towns of La Plata and Indian Head based on draft Municipal Growth Elements and Water Resources Elements for those jurisdictions.

Failure to achieve the pollutant reductions specified in a TMDL can result in a variety of penalties and other federal actions, such as:[17]

- Expansion of National Pollution Discharge Elimination System (NPDES) permit coverage to currently unregulated sources;
- Federal objections to state-issued NPDES permits, and increased NPDES program oversight;
- Requirement of additional offsets for new or increased point source discharges (beyond replacement of anticipated new/increased loadings);
- Establishment of more geographically-specific TMDLs by the State;
- Requirement of additional reductions of loadings from point sources, such as wastewater treatment plants;
- Increased federal enforcement of air and water regulations in the affected watershed;
- Redirection of EPA grants away from the local jurisdiction, and/or incorporating more stringent criteria into future grants; and
- Federal promulgation of more stringent local nutrient water quality standards.

The following watersheds that are partially or entirely found within Charles County are impaired for nutrients (nitrogen and/or phosphorus): Mattawoman Creek, Nanjemoy Creek, Patuxent River Lower, Port Tobacco River, Potomac River Lower Tidal, and the Potomac River Upper Tidal. [18] MDE has established (and EPA has approved) nutrient TMDLs for the Mattawoman Creek and Port Tobacco River watersheds (see Table 8), while all other nutrient-impaired watersheds in Charles County are awaiting draft TMDLs. Nutrients are generated by a wide variety of sources, such as WWTPs, residential and agricultural fertilizer, waste from livestock and wild animals, and airborne deposition of nitrogen and phosphorus. In addition to nutrients, some watersheds in Charles County are impaired by other substances, such as Bacteria, Fecal Coliform, or excess amounts of sediment.[15]

Table 8. Approved Nutrient TMDLs for Charles County Watersheds

Watershed	Impairing Nutrient	Nonpoint Source TMDL (lbs/year)	Point Source TMDL (lbs/year)
Mattawoman Creek	Nitrogen	116,699	85,784
	Phosphorus	5,304	11,786
Port Tobacco River	Nitrogen	194,750	42,720
	Phosphorus	13,300	1,870

b. 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 its tributaries (expressed as pounds per year of nitrogen and phosphorus). Nitrogen and phosphorus point source caps have been established for the Mattawoman, Indian Head, Swan Point, and La Plata WWTPs. The caps for the Indian Head and La Plata WWTPs are both more stringent than the

[17] Source: US EPA. 2009. Letter to the Chesapeake Executive Council, 29 December. Accessed at http://www.epa.gov/region03/chesapeake/bay_letter_1209.pdf

[18] MDE maintains a full listing of impairments and available TMDLs at http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/index_new.asp

point source caps for the Mattawoman and Port Tobacco River watersheds (respectively), the receiving bodies for these point sources. The receiving bodies of water for other WWTPs in the County do not have final nutrient TMDLs (see Section V.2.a.). Thus, the point source caps determine the allowable nutrient discharges from WWTPs in Charles County.

c. Point Source Discharges

Table 9 lists the nutrient caps, as well as existing and projected future nutrient discharges for the County's WWTPs under each future land use scenario. This Water Resources Element assumes that by 2030, most WWTPs will be upgraded to ENR technology. Because the Cobb Island WWTP discharges effluent via spray irrigation, this WRE assumes that the Cobb Island facility's point source discharges to the Potomac River are minimal; the same assumption is made for the Benedict WWTP and the Patuxent River.[19]

All County-operated WWTPs would meet the requirements of their nutrient caps under all future land use scenarios. The Mattawoman WWTP would have substantial available capacity. If the wastewater from all future development in La Plata were discharged via the Town's existing NPDES permit requirements and design, that facility would exceed its nitrogen and phosphorus caps. However, the Town has asked MDE to permit expansion of the WWTP to 2.0 MGD with ENR, which will meet the Town's wastewater needs through approximately 2020.

d. Antidegradation

Maryland's antidegradation policy significantly limits new or expanded discharge permits that would degrade water quality. The focus of the antidegradation policy is on Tier II (high quality) waters, as defined by the US Environmental Protection Agency (EPA), which are subject to special protections to maintain better-than-necessary water quality. Within Tier II watersheds, new or expanded nutrient discharges can be permitted in limited circumstances, frequently involving pollutant offsets.

Charles County has 31 segments of Tier II waters. The Mount Carmel Woods WWTP currently discharges to Jennie Run, a Tier II stream. However, this discharge is in the process of being eliminated, with flows transferred to the Mattawoman WWTP via a new pump station. None of the other WWTPs evaluated in this WRE discharge to a Tier II stream segment.

B. Alternative Wastewater Disposal Options

While County-operated WWTPs have sufficient capacity to support projected development through 2030 (and beyond, in most cases), it is nonetheless important to understand options for obtaining additional treatment capacity. Such options may become necessary in the case of unexpected changes in flows, changes to environmental regulations, or other unforeseen factors. This section summarizes key concepts that the County and its municipalities could consider.

1. Wastewater Reuse

Following the full treatment process, effluent from a WWTP can be recollected and returned for a variety of types of reuse, as described in section C(1)(f) of this document. Reclaimed water recipients may employ a variety of methods to apply the returned effluent, including industrial (or process) water reuse, or urban and agricultural irrigation. The County has a strict allocation policy to manage the distribution of treated effluent, and continues to promote the use of the effluent water to reduce discharge into the rivers and streams and reduce unnecessary use of

---

[19] This assumption is consistent with the discussion on page 30 of *Models and Guidelines 26*, the official state guidance on preparing a WRE.

Table 9. Point Source Nutrient Discharges, Public Systems

Watershed		*Middle Potomac River*						*Mattawoman Creek*	*Port Tobacco River*			*Lower Potomac River*		
System		**Mattawoman[6]**			**Clifton on the Potomac**			**Town of Indian Head**	**Town of La Plata**			**Swan Point**		
Scenario[1]		**A**	**B**	**C**	**A**	**B**	**C**	**All Scenarios**	**A**	**B**	**C**	**A**	**B**	**C**
Projected Capacity, 2030	MGD	20.000			0.070			0.500	2.000			0.600		
Existing Nutrient Loads[2]	TN[3]	60,000			1,537			4,000	11,000			2,500		
	TP[3]	2,500			512			400	500			50		
Likely Nutrient Caps, 2030[4]	TN	243,645			2,820			6,091	18,273			7,309		
	TP	10,964			470			457	1,371			548		
Projected ADF, 2030 (from Table 7)	MGD	16.598	17.882	17.716	0.034	0.033	0.033	0.591	2.891	2.660	2.856	0.478	0.314	0.308
Treatment Technology, 2030		ENR			ENR			ENR	ENR			ENR		
Estimated Nutrient Discharges, 2030[5]	TN	151,469	163,184	161,671	309	304	301	5,397	26,379	24,271	26,060	4,360	2,863	2,807
	TP	9,088	9,791	9,700	19	18	18	540	2,638	2,427	2,606	436	286	281
Remaining Discharge Capacity (Overage)	**TN**	**92,176**	**80,461**	**81,974**	**2,511**	**2,516**	**2,519**	**694**	**(8,106)**	**(5,998)**	**(7,787)**	**2,949**	**4,446**	**4,502**
	TP	**1,876**	**1,173**	**1,264**	**451**	**452**	**452**	**(83)**	**(1,267)**	**(1,056)**	**(1,235)**	**112**	**262**	**267**

Notes:
1: A = Baseline Scenario; B = Waldorf Area Focus Scenario; C = DDD Focus Scenario
2: Estimates for Mattawoman, Indian Head, La Plata, and Swan Point based on MDE's ENR Fact Sheets for (http://www.mde.state.md.us/Water/CBWRF/pop_up/enr_status_map.asp). Other estimates calculated, assuming discharges of 18 mg/L TN, 6mg/L TP for non-BNR systems; 8 mg/L TN, 3 mg/L TP for BNR systems.
3: TN = Total Nitrogen (lbs/year); TP = Total Nitrogen (lbs/year)
4: Source: MDE (list of nutrient caps for public systems in Charles County).
5: Assumes discharge concentrations of 3 mg/L TN and 0.3 mg/L TP for ENR; 8 mg/L TN and 2 mg/L TP for BNR
6: Mattawoman discharges assume full use of the 3 MGD allocated to WSSC, as well as flows from the Mt. Carmel Woods and College of Southern MD facilities.

potable water. Three methods are briefly described below; however, more detailed investigation, in conjunction with MDE will be required on a case-by-case basis prior to implementation.

a. Industrial Water Reuse

Charles County is especially familiar with industrial water reuse. The PANDA power plant in the Brandywine area of Prince George's County (within the Mattawoman watershed) uses effluent from the Mattawoman WWTP for cooling purposes. In addition, the County has an executed agreement with the operators of the proposed Competitive Power Ventures (CPV) Power Plant Project in eastern Charles County to reuse treated effluent from the Mattawoman WWTP for turbine cooling purposes, as well as for steam in the power generation process. Together, the two power plants could divert as much as 8.4 MGD of treated effluent that would otherwise be discharged to the Potomac River.

b. Urban Irrigation Reuse

For the purposes of this Water Resources Element, urban irrigation includes providing reclaimed wastewater (or stormwater) to virtually any irrigated land within the developed portion of Charles County. Public access reuse can encompass irrigation of golf courses, parks, playing fields, cemeteries, commercial/industrial areas, multifamily residential lawns, single-family residential lawns, medians, and right-of-ways. Since urban irrigation involves applying reclaimed water to areas accessible to the public, secondary treatment with filtration and high-level disinfection would be required. A MDE-sponsored panel (which includes representatives from Charles County) is evaluating the use of treated effluent, including the restrictions and regulations that would accompany such reuse.

c. Agricultural Reuse

Irrigation of agricultural crops with reclaimed effluent also requires similar levels of treatment. A major restriction with the use of reclaimed water is that it cannot come in direct contact with foods that will not be cooked, peeled, skinned, or thermally processed prior to consumption. This restriction does not prohibit the irrigation of these crops with reclaimed water, but restricts the irrigation method that can be utilized.[20]

d. Potable Reuse

Potable reuse (i.e., drinking water) is not currently permitted in Maryland, but is allowed in other states. Direct potable reuse of treated effluent—e.g., the transmittal of treated effluent directly to water treatment facilities—is not seen as a near-term alternative for Charles County due to current state restrictions. Indirect potable reuse is practiced in other parts of the United States, and may be a long-term (beyond 2030) option. In some cases of indirect reuse, treated wastewater effluent can be used to recharge groundwater aquifers. As with tertiary treatment wetlands (see Section V.B.5), effluent is treated to potable (or better) standards before being injected into the drinking water aquifer.

One large-scale example of such a system is in place in Orange County, California.[21] In that system, treated effluent is used not only to recharge the aquifer (and to provide some drinking water as a result), but also to halt and even reverse saltwater intrusion into the aquifer. Maryland has no regulations permitting this type of activity. However, given the potential benefits to

---

[20] For more information, see http://www.mde.state.md.us/researchcenter/publications/general/emde/vol2no4/spray_irriqation.asp

[21] For more information, see http://www.gwrsystem.com/

aquifers, this approach may have merit for further investigation, and the County should coordinate with MDE in any future investigations.[22]

2. Nutrient Trading

Under the state's Policy for Nutrient Cap Management and Trading, [23] nutrient discharges can be traded between one point source and another within the same trading basin (for Charles County, this includes the entire Potomac River basin from St. Mary's County to Garrett County). In such a scenario, an existing WWTP outside of Charles County (likely in Maryland, but trades from Virginia could also be considered) would agree to forego a certain amount of development in exchange for payment, and then send or "trade" that excess treatment capacity to one of the County's WWTPs. The receiving WWTP would then be allowed to expand beyond its current permitted capacity (as long as its discharges would not exceed the limits set by a TMDL). Conversely, a WWTP in Charles County could act as the "seller" of nutrient credits. Credits can be accrued through other methods, such as:

- Upgrading an existing minor WWTP to Biological Nutrient Removal (BNR) or ENR technology (in Charles County, the Bel Alton, Clifton-on-the-Potomac and Cobb Island facilities are the only publicly-owned WWTPs that would be eligible);
- Retiring an existing minor WWTP after connecting its flow to a BNR or ENR facility, as is the case with the Mt. Carmel Woods and the College of Southern Maryland WWTPs, which will be retired and connected to the Mattawoman sewer system; or
- Retiring an existing On Site Disposal System (OSDS or septic system) by connecting to an ENR facility.

  Under the state policy, a County WWTP could receive the following nutrient credits for each type of septic system retired:

  - Septic systems in the Chesapeake Bay Critical Area: approximately 5.3 EDU per OSDS.
  - Septic systems within 1,000 feet of any perennial surface water: approximately 3.3 EDU per OSDS.
  - Any other OSDS: 2 EDU per OSDS

  As an example, there are approximately 1,700 residential units on septic systems in the Critical Area in Charles County. By connecting half of those units to a WWTP (assuming that the other half are too far from the WWTP to extend service), the County's WWTPs could gain approximately 4,500 EDU (or 1.125 MGD) of capacity.

In addition to these point-to-point trading opportunities, MDE and the Maryland Department of Agriculture (MDA) recently adopted guidelines that allow trades between nonpoint sources (such as agriculture) and point sources.

[22] In addition to California, other states in the Western and Southeastern United States—notably, Florida—also use similar practices. The US EPA website contains information on Aquifer Recharge, including best practices and some of the key technological concerns that would need to be addressed before implementation: http://www.epa.gov/safewater/asr/index.html

[23] Information available at: http://www.mde.state.md.us/Water/nutrientcap.asp

3. Continue System Repairs

Considerable capacity is taken up by Inflow and Infiltration (I/I)[24] in public wastewater collection systems in the County. While the County and its municipalities do not expect to be able to remove all I/I from public sewer systems—since it is impossible to police every property to ensure disconnection of roof drains and sump pumps—repairing the worst I/I problems is the most efficient means of securing additional capacity for public systems.

4. Land Application of Treated Wastewater

Land treatment of wastewater may involve a wide variety (or combination) of techniques such as spray irrigation, drip irrigation, rapid infiltration basins, and overland flow. In a land application system, the soil and vegetative cover purify and dissipate the effluent as it percolates into the ground. In addition to the primary benefit of keeping harmful pollutants from watercourses, land application can also serve to recharge groundwater supplies, allow recovery and reuse of nutrients, and may provide an economic return if used for some agricultural purposes.

Major design parameters for land application systems include topography, permeability of the soils, depth to groundwater, and the location of nearby residences. Disposal of effluent via spray irrigation requires large amounts of land that are sprayed with effluent at very low application rates (1 to 2 inches per week). Seasonal limitations on spray irrigation are also a factor. State requirements mandate the provision of three months of effluent storage capacity, to account for times when the ground may be frozen or have limited permeability. Suitable spray irrigation areas are characterized by permeable to highly permeable soils.

On dedicated lands, spray irrigation would be considered a non-public-access method of effluent disposal. Secondary (or better) treatment, with some nutrient removal, is typically required for land application systems. The Cobb Island wastewater system disposes of treated effluent via spray irrigation on the Breeze Farm property.

5. Tertiary Treatment Wetlands

Wetland application is rapidly gaining recognition as a viable alternative for effluent disposal. It represents an extension of the land application and reuse concepts, and has been encouraged by the U.S. Environmental Protection Agency (EPA). In this system, effluent is treated at a WWTP (using either BNR or ENR) and then discharged into a series of constructed, vegetated (typically, forested) wetlands. These wetlands purify the effluent to the point where the eventual discharge meets water quality standards with regard to nutrients and other pollutants. The best-known large-scale application of this technology occurs in Clayton County, Georgia.[25] In this system (which treats 9.3 million gallons of wastewater per day on a 4,000 acre site), the wetland-treated effluent is pure enough to be used for drinking water. Other smaller applications of tertiary treatment wetlands—typically at schools or other institutional facilities—can be found in Maryland.

Implementation of a large-scale tertiary treatment wetland facility in Charles County would depend heavily on soil characteristics and other site conditions. Considerable permitting and monitoring requirements are also associated with tertiary treatment wetlands.

---

[24] Inflow is water from storm events entering the system through roof drains sump pumps, and similar sources. Infiltration is groundwater entering the system through leaking pipes, manholes, and other elements. I/I takes up sewer capacity that should be reserved only for wastewater, effectively limiting the system's overall capacity.

[25] For more information, see http://www.ccwa1.com/operations/water.reclamation.aspx

VI. Assessment of Nonpoint Source / Stormwater Policies

Nonpoint sources of nutrient pollution include agricultural runoff, erosion and sediment from development, stormwater runoff from roads, parking lots, and rooftops, as well as atmospheric deposition and any source other than an outfall pipe. These sources are called nonpoint because they involve widely dispersed activities, and hence are difficult to measure. All non-point sources of pollution eventually reach the waters of the Chesapeake Bay unless filtered or retained by some structural system or non-structural techniques.

Various technologies reduce nutrients from agricultural and developed lands. Nutrient reduction technologies for nonpoint source pollution are generally referred to as "Best Management Practices" (BMPs). Examples of these technologies include agricultural nutrient management planning, stormwater settling ponds, and erosion controls. Non-structural controls are extremely effective in reducing the amount of pollutants that reach waterways. Woodlands and wetlands release fewer nutrients into the Bay than any other land use. For these reasons, forests, grasslands, and wetlands are critical to restoring and maintaining the health of the aquatic environment.

This section characterizes the policies and procedures in place to manage nonpoint source pollution in Charles County.

A. Maryland Stormwater Design Manual

The 2000 Maryland Stormwater Design Manual, Volumes I & II, is incorporated by reference into the Charles County Code and serves as the official guide for stormwater principles, methods, and practices.

The 2007 Maryland Stormwater Management Act, passed by the General Assembly, mandates substantial revision of the Stormwater Design Manual. The most notable provision of the 2007 Act is the requirement that new development and redevelopment use Environmental Site Design (ESD) techniques (to the most practicable extent possible), which are intended to "maintain pre-development runoff characteristics" on the site. ESD techniques are based on the premise that stormwater management should not be seen as stormwater disposal. Instead of conveying and treating stormwater in large, costly end-of-pipe facilities located at the bottom of drainage areas, ESD addresses stormwater through the use of small, cost-effective landscape features that are frequently located onsite. It is an effective means of managing both stormwater quality and quantity.

As of June 2010, the County was in the process of finalizing its Stormwater Management Ordinance (incorporating ESD and other stormwater management policies contained in the Stormwater Management Act of 2007) based on MDE review comments. These revisions include implementation of an ESD compliance program.

B. Other Nonpoint Source Management Policies and Considerations

1. Failing Septic Systems

Individual systems are prone to failure or malfunction due to the surrounding soil conditions and high water tables due to improper installation, maintenance, or unsuitable soils characteristics. Objectives of the Comprehensive Water and Sewer Plan included the provision of opportunities for residents in identified failing septic areas or with failing wells to correct existing supply, health and environmental problems, education regarding the proper maintenance of home septic systems, and, where possible, provisions for financial assistance or grant opportunities to homeowners in areas of failing septic systems. Charles County is working with the Maryland Department of the Environment and local citizen groups to seek grant funding through the state's Bay Restoration Fund to assist in the repair and enhancement of the existing systems.

The Water and Sewer Master Plan lists numerous areas of failing septic systems throughout the County, totaling approximately 1,200 homes with failing septic tanks. The vast majority (more than 1,000 homes) are in the Mattawoman Sewer Service Area, while the remaining homes are in other parts of the County.

The County has established a failing septic tank area petition process; whereby failing areas can appeal to the County for assistance in mitigating their failing systems[26]. Approximately 150 homeowners have received grants to rehabilitate failing septic systems.

2. Septic Denitrification Systems

Denitrification units can reduce the nitrogen loading from septic systems by approximately 50 percent. A small number of Charles County's existing septic systems (approximately 40 homes) utilize denitrification units, and the County does not currently require denitrification units for new septic systems.

Maryland Senate Bill 554 (from the 2009 legislative session) now requires all new development on septic systems in the Chesapeake Bay Critical Area to include Best Available Technology (BAT) for nitrogen removal, as defined by MDE.[27] Septic denitrification (in any location—not just the Critical Area) can be one approach to meeting TMDL requirements. Denitrification systems are encouraged throughout the remainder of the County to encourage nitrogen reductions. Bay Restoration Funds have been used to install some denitrification systems in the Port Tobacco River watershed and other areas.

The nonpoint source analysis (Section 7) assumes that one-quarter of all new residential and non-residential development outside of public sewer systems will utilize denitrification units, and that ten percent of existing septic systems will be retrofitted with BAT for nitrogen removal. Although not explicitly a goal of the County's existing Comprehensive Plan, this level of implementation is reasonably foreseeable in the next two decades.

3. Stormwater Retrofits and Maintenance

Since 1997, the stormwater discharge from Charles County's Development District has been regulated by a National Pollutant Discharge Elimination System (NPDES) permit. The need for such a permit is based on population thresholds established under the Clean Water Act. Its purpose is to eliminate non-stormwater discharges and reduce the discharge of pollutants to the maximum extent possible. The NPDES permit requires significant monitoring, maintenance and improvements of the stormwater system.

Maintaining existing stormwater management (SWM) facilities to function properly helps reduce pollutants entering the County's streams and waterways. Additionally, providing new or improved stormwater management facilities where none exist, or where existing facilities provide minimal benefit, can help to reduce nonpoint source pollution. The need for additional and improved urban SWM and for increased maintenance of existing SWM facilities is of particular

[26] Charles County Health Department, 2006

[27] More information is available at: http://www.mde.state.md.us/Water/CBWRF/osds/brf_bat.asp. County regulations requiring denitrification in the Critical Area were being reviewed as of early 2010.

concern to the County, especially in the Development District where much development occurred prior to the establishment of SWM requirements in the State and County codes.

a. Retrofits

Two SWM retrofit studies—the 2004 and the 2007 Watershed Restoration Studies—have been completed for Charles County's Development District. Together, these Studies identified nearly 765 acres of impervious surface (see VII.C below) that lacks adequate (or, in some cases, any) SWM facilities, and recommends improvements reduce stormwater-borne pollutants from entering streams and waterways. Recommended improvements include upgrading existing SWM facilities, construction of new facilities in areas developed prior to SWM regulations, installing rain gardens and pervious paving, stream channel restoration, and educational outreach activities such as rain barrel distribution events and trash removal from streams. As of 2010, the County has completed construction of new stormwater management facilities for 45 acres that previously lacked appropriate SWM. Several additional projects are in the engineering phase.

b. Maintenance

To function properly and provide the most environmental benefits, stormwater facilities must be regularly maintained and inspected. State and local codes require Charles County to inspect the 1,075 SWM facilities located within its boundaries every three years. Charles County owns approximately 240 of these SWM facilities. Homeowners associations and private property owners own—and shoulder the maintenance burden of—the vast majority of the remaining SWM facilities.

The Charles County Homeowners' Association Task Force reported in 2001 that in many cases, the owners of properties containing SWM facilities are responsible for maintenance that benefits other private or public users. Yet, these owners have no practical recourse to collect a proportionate share of the maintenance expense from these other parties. Dealing with these issues involves a gray area between public and private ownership interests and rights of access. The County is working with affected parties to attempt to resolve these issues to meet public health, safety, and natural resource objectives.

c. Monitoring

The County monitors the stormwater system as required by the NPDES permit. This includes monitoring nutrients, other contaminants, and physical condition of the streams. The monitoring is the basis for status and progress assessments. In addition to stream monitoring, the County inspects large storm drain outfall pipes for stormwater flow during dry weather. If water is observed flowing from a pipe when there hasn't been a storm event, the water is tested to see whether it contains pollutants. This test helps determine if there has been an illicit discharge into the system. Discharges into the County's stormwater system are not allowed unless individually permitted by MDE.

4. Watershed Management Planning

Watershed management planning is important for maintaining water quality. Several County watersheds have management plans and commissions to support their implementation. These include the Wicomico River and Zekiah Swamp, the Patuxent River, and the Potomac River. The most recently completed watershed plans include the Mattawoman Creek Watershed Management Plan and the Port Tobacco River Watershed Restoration Action Strategy.

a. Mattawoman Creek Watershed Management Plan

In 2003, the U.S. Army Corps of Engineers completed a watershed management plan for Mattawoman Creek in Charles County. The plan was developed in response to concerns that development within the Development District had the potential to significantly affect Mattawoman Creek, with water quality and biota (plants and animals) the primary concerns. The purpose of the plan was to balance the protection of the Mattawoman Creek's natural resources and water quality with the development plans of the County. A computer model was developed to assess the future pollutant loads within the watershed in a variety of land use scenarios and time scales. Based on the model results, and consideration of natural resources protection and the County's development plans, the Corps made three recommendations to minimize pollutant loads in the Mattawoman Creek's waterways:

- Delineate and protect the stream valley – defined as the top of the slope to the stream.
- Future development should implement low impact design techniques, minimizing the amount of impervious surfaces and promoting stormwater disconnects.
- Examine existing developments for stormwater retrofit opportunities.

b. Port Tobacco Watershed Restoration Action Strategy

The Port Tobacco River watershed is fully contained within the County, but overlaps a portion of the Town of La Plata. In 2007, the County prepared a Watershed Restoration Action Strategy (WRAS). The WRAS was adopted for implementation by the Charles County Commissioners in 2007[28] and by the Town of La Plata in 2008. The WRAS includes a plan to achieve the residents' visions for restoration of the Port Tobacco River watershed. These include:

- Reduce bacteria levels below the State limits for contact recreation.
- Prevent summer algal blooms by reducing summer nutrient levels from non-point sources to the low-flow load allocation as specified by the TMDL.
- Reduce sedimentation rates.
- Mitigate future changes to watershed hydrology.

Based on extensive fieldwork, data review, discussion, and computer pollutant modeling, nine recommendations were made to achieve these goals:

- Eliminate septic system failures.
- Eliminate sanitary sewer overflows.
- Protect a greater percentage of the watershed.
- Reduce the volume of runoff generated at new developments through better site design and well designed and constructed stormwater management.
- Reduce stream bank erosion caused by existing development without stormwater management practices by constructing stormwater retrofits.
- Enforce sediment and erosion control regulations.
- Eliminate illicit discharges to reduce nutrient and bacteria loads and protect the biological functions of streams.

[28] County Commissioners Resolution 07-57.

- Educate the watershed residents about water quality impacts of individual actions.
- Exclude livestock from streams.

Many specific implementation projects were identified to achieve the above recommendations, some of which have been implemented—primarily through the efforts of the Port Tobacco River Conservancy. These include installation of rain gardens, wetland restoration, and education on water quality impacts of individual actions. Additional implementation progress is being pursued by the County and Town of La Plata.

5. Sludge

Most sewage treatment plants in Charles County process sludge via aerobic digestion processes followed by dewatering on sand beds. These plants produce approximately 7 wet tons per year. The Mattawoman WWTP uses gravity thickening, aerobic digestion, and Belt Filter Processing with the County's Land Application Contracts. New State regulations require that all septage gathered by sewage pumping trucks be treated at a sewage treatment plant. According to these regulations, raw septage may not be applied directly to any land surface in the State. The total sludge processed at the Mattawoman WWTP is approximately 93 percent of the sludge generated in Charles County. Beginning in May 1990, Mattawoman sludge was no longer landfilled. The County has recently contracted to have its sludge applied to farmland.

The Town of La Plata currently processes sludge in its aerobic digesters and dewaters it through land application. This facility also has anaerobic digesters, which are not currently in use. Recently, a filter press (pressure filtration) was installed to dewater the sludge. The Town of Indian Head processes sludge in an aerobic digester and dewaters it on sludge drying beds. Currently, the town trucks its sludge to the Mattawoman WWTP. Smaller plants located in the County do not have the facilities to process excess sludge. These plants contract haulers to dispose of excess sludge, either at the Mattawoman WWTP or via land spreading.

6. Land Preservation, Parks, and Recreation Plan

Charles County's 2005 Land Preservation, Parks, and Recreation Plan (LPPRP) was adopted as an amendment to the Comprehensive Plan. While the LPPRP contains few goals, objectives, policies, and implementation actions that directly relate to the analyses in this WRE, its overall emphasis on preservation of rural and agricultural land are consistent with the WRE.

7. Agriculture

Maintaining rural character and agriculture as an industry is a major goal of the County. However, runoff from cropland, feedlots, and pastures can carry nutrients and pollutants from manure, fertilizers, ammonia, pesticides, livestock waste, soil, and sediment into waterways. Across the Chesapeake Bay basin, agriculture is one of the largest contributors of nitrogen and phosphorus to the Bay and its tributaries. However, this impact can be reduced through the application of agricultural Best Management Practices (BMPs) such as planting cover crops, judicious use of fertilizer (especially animal manure), and maintaining appropriate buffers along rivers and streams. The County continues to work with the agricultural community to ensure that agricultural BMPs are implemented to the greatest degree feasible.

8. Sedimentation and Erosion

Sedimentation and other impacts resulting from construction activity, and increased stormwater flows to streams and rivers from development are also a potential threat to water quality. Most new non-agricultural development in Charles County requires a sedimentation and erosion control plan. The County also inspects construction sites to ensure proper sediment and erosion control. The Charles County bureau of the Natural Resources Conservation Service (NRCS) also reviews Erosion and Sediment permits for every construction site that disturbs land.

9. Roads and Stormwater Management

The design of roads can impact nonpoint source nutrient loading. Open section roads (roads without curbs and gutters) can help to reduce impacts on water quality by dispersing runoff from pavement. Such roads are most appropriate outside of towns, urban areas, and populated areas where pedestrian facilities are a priority.

"Green streets" provide similar water quality benefits, but are used in towns and urban areas where pedestrian facilities are priority. Green streets make use of many ESD practices and can be applied to new development or to retrofit existing development. The green street design approach blends natural hydrological features and processes within the designed urban landscape. The key features of green streets are:

- Reduction of impervious surface.
- Improved water quality.
- Use of the public right-of-way for multiple purposes.

Components of green streets may include:

- Landscaped curb extensions,
- Swales that store and promote infiltration of stormwater runoff,
- Lowered or raised planter strips,
- Permeable surfaces, such as porous paver blocks and pervious asphalt or concrete, and
- Street trees.

Where reasonably feasible and fiscally practicable, new roads in such areas of the County are designed with open sections.

VII. Total Nutrient Loads and Assimilative Capacity

Nutrient loads from point sources (WWTPs), stormwater, and other nonpoint sources are major contributors to degraded water quality in the Chesapeake Bay and its tributaries. This section evaluates existing and projected nonpoint source and total nutrient loads.

A. Nonpoint Source Loading

Table 10 shows the estimated existing and future nonpoint source loading (nitrogen and phosphorus) in each 8-digit watershed under each of the three scenarios, while Table 11 shows the nonpoint source loading from septic systems only. Nonpoint source (NPS) nutrient loads (including septic systems) were estimated using methodology developed by the Maryland Department of the Environment, as modified by the County to reflect revised nutrient loading rates. More detail on the nonpoint source evaluation methodology is presented in the Water Resources Element Appendix. The loadings described in Tables 10-12 represent estimates only, and intended only to facilitate comparison between scenarios.

Table 10. Nonpoint Source Nutrient Loading[1]

		(all data in lbs/year)	**Patuxent Lower[3]**	**Gilbert Swamp**	**Mattawoman Creek[3]**	**Nanjemoy Creek[3]**	**Port Tobacco River[3]**	**Potomac Lower[3]**	**Potomac Middle**	**Potomac Upper[3]**	**Wicomico River**	**Zekiah Swamp**	**Total**
Existing	Nonpoint Source Loading	TN[4]	141,903	207,231	304,888	236,498	229,217	272,250	113,415	14,529	139,945	481,630	**2,141,507**
		TP[4]	6,409	13,773	19,046	13,991	13,876	13,296	4,974	616	9,491	31,356	**126,827**
	TMDL Caps	TN			116,699		194,750						
		TP			5,304		13,300						
	Available Capacity (Overage)[2]	TN			(188,189)		(34,467)						
		TP			(13,742)		(576)						
Baseline	Nonpoint Source Loading	TN	106,794	154,924	243,353	199,215	179,478	231,624	100,440	13,229	109,349	375,141	**1,713,547**
		TP	4,905	10,436	14,289	11,598	10,647	10,883	4,172	543	7,805	24,282	**99,561**
	Available Capacity (Overage)	TN			(126,654)		15,272						
		TP			(8,985)		2,653						
Waldorf Focus	Nonpoint Source Loading	TN	107,889	148,757	240,080	181,116	180,969	225,491	95,987	13,557	101,965	366,122	**1,661,853**
		TP	4,925	10,401	14,268	10,868	10,720	10,775	3,977	559	7,606	24,191	**98,290**
	Available Capacity (Overage)	TN			(123,381)		13,781						
		TP			(8,964)		2,580						
DDD Focus	Nonpoint Source Loading	TN	107,700	148,659	283,399	181,880	181,726	225,268	95,369	13,510	101,880	364,269	**1,703,660**
		TP	4,922	10,400	15,157	10,899	10,749	10,771	3,933	556	7,604	24,074	**99,065**
	Available Capacity (Overage)	TN			(166,700)		13,024						
		TP			(9,853)		2,551						

Notes:
1: Includes septic systems. For development outside of public wastewater systems in all future scenarios, assumes that 25% of new development and 10% of existing development (via retrofit) will utilize Best Available Technology for nutrient removal.
2: Reflects Load Allocation (LA) limits set by adopted TMDLs for each watershed. Where no TMDL has been adopted, or where the watershed is not impaired, no numerical standards are shown.
3: Indicates a watershed that is impaired by nutrients.
4: TN = Total Nitrogen; TP = Total Phosphorus

Table 11. Septic System Nutrient Loading, By Land Use Scenario[1]

Watershed	Total Nitrogen (lbs/year)[1]			
	Existing	Baseline	Waldorf Area Focus	DDD Focus
Patuxent River	25,479	25,466	26,162	26,035
Gilbert Swamp	21,249	26,267	21,644	21,571
Mattawoman Creek	33,224	44,208	41,150	73,437
Nanjemoy Creek	22,160	31,598	23,011	23,374
Port Tobacco River	35,711	39,639	40,197	40,554
Potomac Lower Tidal	12,426	21,504	17,025	16,857
Potomac Middle Tidal	7,949	10,373	8,226	8,198
Potomac Upper Tidal	1,445	1,843	1,980	1,962
Wicomico River	5,987	11,114	7,216	7,170
Zekiah Swamp	50,117	63,914	56,990	56,653
Total Septic Loading	**215,747**	**275,927**	**243,601**	**275,814**

Notes:
1: MDE does not consider septic systems to be a significant source of phosphorus.

As shown in Table 10, all three future land use scenarios would result in reduced NPS nutrient loads in all watersheds. This is due largely to the nonpoint source model's assumption[29] that nutrient-reducing Best Management Practices (BMPs) for urban stormwater and agricultural runoff would be more widely implemented by 2030. The Waldorf Area Focus scenario would result in the lowest overall NPS discharges, as well as the lowest NPS discharges in the Mattawoman Creek watershed, due largely to the amount of redevelopment (as opposed to consumption of forest land for development) that could occur if permitted densities were increased to match the recommendations of the Waldorf Urban Design Study. As shown in table 11, the Waldorf Area Focus scenario would also result in the lowest nitrogen loading from septic systems, since development in this scenario would be concentrated in areas served by public sewer systems.

Based on the NPS modeling, all future land use scenarios would meet the nonpoint source TMDLs for nitrogen and phosphorus in the Port Tobacco River watershed, but none of the future land use scenarios would meet the nutrient TMDLs for the Mattawoman Creek watershed by 2030 (although all would reduce NPS nutrient discharges below current levels).

Given the magnitude of the difference between existing/projected nutrient loads and nonpoint source TMDLs, the nonpoint source model used for this Comprehensive Plan may not be the best measure of progress toward TMDLs.[30] The County will continue to work with MDE, MDA, and other appropriate agencies to reduce nonpoint source nutrient loads in impaired watersheds, and to further clarify the actual and projected loadings in these watersheds.

B. Total Nutrient Loading

Table 12 shows the total combined point and nonpoint source discharge in each 8-digit watershed under each of the three scenarios. This table combines data from Tables 9 and 10. The total nutrient loading in Table 12 includes the public-system point sources listed in Table 10, as well as estimates of point source discharges from NSWC, Mirant-Morgantown, and other commercial WWTPs listed in the County Water and Sewer Plan.

[29] The model uses loading rates from the Chesapeake Bay Program Watershed Model, Phase 4.3.

[30] The nonpoint source model used in this WRE is recommended by MDE for use in Comprehensive Plans, but in numerous public meetings, MDE has explicitly cautioned that the NPS modeling should *not* be used to determine TMDL compliance.

Table 12. Total Nutrient Loading, All Scenarios

(all data in lbs/year)			Watershed										
			Patuxent Lower[1]	Gilbert Swamp	Mattawoman Creek[1]	Nanjemoy Creek[1]	Port Tobacco River[1]	Lower Potomac[1]	Middle Potomac	Upper Potomac[1]	Wicomico River	Zekiah Swamp	**Total**
Existing	Nonpoint	TN[1]	141,903	207,231	304,888	236,498	229,217	272,250	113,415	14,529	139,945	481,630	2,141,507
		TP[1]	6,409	13,773	19,046	13,991	13,876	13,296	4,974	616	9,491	31,356	126,828
	Point	TN	0	0	4,000	0	11,602	3,048	74,283	0	0	219	93,152
		TP	0	0	400	0	701	233	15,758	0	0	73	17,165
	Total	**TN**	**141,903**	**207,231**	**308,888**	**236,498**	**240,819**	**275,298**	**187,698**	**14,529**	**139,945**	**481,849**	**2,234,658**
		TP	**6,409**	**13,773**	**19,446**	**13,991**	**14,577**	**13,529**	**20,732**	**616**	**9,491**	**31,429**	**143,993**
Baseline	Nonpoint	TN	106,794	154,924	243,353	199,215	179,478	231,624	100,440	13,229	109,349	375,141	1,713,547
		TP	4,905	10,436	14,289	11,598	10,647	10,883	4,172	543	7,805	24,282	99,560
	Point	TN	0	0	5,497	0	26,981	4,907	156,037	0	0	219	193,641
		TP	0	0	540	0	2,839	618	9,426	0	0	73	13,496
	Total	**TN**	**106,794**	**154,924**	**248,850**	**199,215**	**206,459**	**236,531**	**256,477**	**13,229**	**109,349**	**375,360**	**1,907,188**
		TP	**4,905**	**10,436**	**14,829**	**11,598**	**13,486**	**11,501**	**13,598**	**543**	**7,805**	**24,355**	**113,056**
Waldorf Area Focus	Nonpoint	TN	107,889	148,757	240,080	181,116	180,969	225,491	95,987	13,557	101,965	366,122	1,661,933
		TP	4,925	10,401	14,268	10,868	10,720	10,775	3,977	559	7,606	24,191	98,290
	Point	TN	0	0	5,497	0	24,873	3,411	167,747	0	0	219	201,747
		TP	0	0	540	0	2,628	469	10,129	0	0	73	13,839
	Total	**TN**	**107,889**	**148,757**	**245,577**	**181,116**	**205,842**	**228,902**	**263,734**	**13,557**	**101,965**	**366,341**	**1,863,680**
		TP	**4,925**	**10,401**	**14,808**	**10,868**	**13,348**	**11,244**	**14,106**	**559**	**7,606**	**24,264**	**112,129**
DDD Focus	Nonpoint	TN	107,700	148,659	283,399	181,880	181,726	225,268	95,369	13,510	101,880	364,269	1,703,660
		TP	4,922	10,400	15,157	10,899	10,749	10,771	3,933	556	7,604	24,074	99,065
	Point	TN	0	0	5,497	0	26,663	3,355	166,231	0	0	219	201,965
		TP	0	0	540	0	2,807	463	10,038	0	0	73	13,921
	Total	**TN**	**107,700**	**148,659**	**288,896**	**181,880**	**208,389**	**228,623**	**261,600**	**13,510**	**101,880**	**364,488**	**1,905,625**
		TP	**4,922**	**10,400**	**15,697**	**10,899**	**13,556**	**11,234**	**13,971**	**556**	**7,604**	**24,147**	**112,986**

Notes:
1: Indicates a watershed that is impaired by nutrients.
2: TN = Total Nitrogen; TP = Total Phosphorus.

As with NPS loading, all three future land use scenarios would result in reduced total nutrient loads Countywide, as well as in all watersheds except for the Middle Potomac.[31] This occurs not because of a specific assumption in this WRE, but because the MDE nonpoint source model assumes that, by 2030, substantial progress will be made in the implementation of various nutrient-reducing strategies. These include wider use of cover crops and other agricultural practices that limit nutrient runoff, the use of ESD for new development (as required by law), and stormwater retrofits for areas that do not currently have stormwater management facilities. The increased discharges in the Middle Potomac watershed reflect the increased point source discharges from the Mattawoman WWTP. The Waldorf Area Focus scenario would result in the lowest total nutrient discharges Countywide, as well as the lowest nutrient discharges in the Mattawoman Creek watershed.

C. Impervious Surface

Impervious surfaces are primarily human-made surfaces that do not allow rainwater to enter the ground. Impervious surfaces can create runoff that causes stream bank erosion, sediment deposition into stream channels, increases in stream temperatures, and potentially degradation of water quality and aquatic life. The amount of impervious surface in a watershed—particularly impervious surfaces that are not treated by stormwater management facilities—can be a key indicator of water quality. All other factors being equal, water quality in streams tends to decline as impervious coverage increases in a watershed. Table 13 summarizes existing and potential impervious coverage in Charles County by watershed.

Table 13. Impervious Surface Coverage

Watershed	Total Acreage[1]	Existing		Baseline		Waldorf Area Focus		DDD Focus	
		Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*
Patuxent River	18,030	939	5.2%	985	5.5%	993	5.5%	992	5.5%
Gilbert Swamp	24,756	782	3.2%	884	3.6%	821	3.3%	820	3.3%
Mattawoman Creek	44,662	4,361	9.8%	4,772	10.7%	4,835	10.8%	4,941	11.1%
Nanjemoy Creek	46,692	701	1.5%	871	1.9%	749	1.6%	755	1.6%
Port Tobacco River	28,068	1,890	6.7%	2,195	7.8%	2,246	8.0%	2,267	8.1%
Potomac Lower Tidal	28,312	914	3.2%	1,090	3.9%	1,015	3.6%	1,012	3.6%
Potomac Middle Tidal	19,223	524	2.7%	594	3.1%	569	3.0%	552	2.9%
Potomac Upper Tidal	2,039	44	2.2%	60	2.9%	63	3.1%	63	3.1%
Wicomico River	17,430	221	1.3%	385	2.2%	275	1.6%	274	1.6%
Zekiah Swamp	65,238	3,607	5.5%	4,169	6.4%	4,214	6.5%	4,088	6.3%
Total	**294,450**	**13,981**	**4.7%**	**16,006**	**5.4%**	**15,780**	**5.4%**	**15,763**	**5.4%**

Notes:
1: Acreage excludes areas of open water.
Source: MDE Nonpoint Source Model, based on existing and projected land use/land cover.

[31] The increase in total loading in the Middle Potomac is due to the increased point source nutrient loading from the Mattawoman WWTP

Countywide, 4.8 percent of all land (excluding open water within the County's boundaries) is impervious. On a percentage basis, impervious surface coverage is highest in the Mattawoman and Port Tobacco watersheds, where much of the County's developed land is found (i.e. within the County's Development District and the Town of La Plata). Impervious coverage percentage in most other watersheds is moderate to low.

The use of Environmental Site Design (ESD) for new development, redevelopment, and targeted stormwater retrofits can help to mitigate some of the impacts of impervious surfaces by reducing the amount, velocity, and pollutant content of stormwater entering streams. The MDE-generated NPS model used to estimate existing and future impervious surface coverage for this WRE accounts for some of these benefits, notably in the form of reduced nutrient loading. However, the model's outputs, in the form of impervious acreages and percentages, can be misleading. An acre of untreated or minimally treated impervious surface (i.e., existing conditions) generates more substantial adverse stormwater impacts than an acre of ESD-treated impervious surface. It is therefore most helpful to compare the impervious surface acreages and percentages from the three future land use scenarios against each other—and not against existing conditions.

VIII. Choice of Land Use Plan

A major goal of the Water Resources Element is to more closely link land use and development to water quality. This section describes those linkages, and makes land use recommendations to be considered in the next update of the County's Comprehensive Plan, anticipated in 2012.

A. Identification of Suitable Receiving Waters

Ideally, the Water Resources Element should use measures of assimilative capacity, such as completed TMDLs for nutrients, to guide direction of growth and land use patterns within the County. Article 66B specifically requires the WRE to identify suitable receiving waters for point and nonpoint source nutrient discharges. While nutrient TMDLs have been completed for two of the County's watersheds, the Port Tobacco River and Mattawoman Creek, TMDLs remain incomplete for the County's other impaired watersheds. Lacking such complete information on assimilative capacity, it is not possible for the County to definitively identify "appropriate" receiving waters for nutrients. Instead, this WRE uses the best available information to make land use and water resources infrastructure recommendations.

On one hand, the available TMDLs indicate the need to reduce nutrient flows to Mattawoman Creek and the Port Tobacco River. On the other hand, the lack of TMDLs for other watersheds makes it difficult to understand the relative degree of impairment in each of the County's six nutrient-impaired watershed—a relationship that must be fully understood before definitively linking land use to nutrient discharges. Another consideration is that the majority of the County's Priority Funding Areas (PFAs) fall within impaired watersheds. The state's Smart Growth approach to land use fundamentally encourages the continued concentration of new development within these already-developed areas. The opposite approach—dispersal of development to unimpaired watersheds—could help to improve water quality in Mattawoman Creek and other impaired watersheds, but would encourage inefficient use of water and sewer infrastructure.

Although the relationship between the County's nutrient TMDLs and the nonpoint source model used in this WRE is questionable, it is clear that development in the Mattawoman Creek and Port Tobacco River watershed has the potential to diminish the County's ability to meet nonpoint source TMDLs. However, there is significant potential to concentrate growth in the County's PFAs in these watersheds, in a way that provides opportunities for stormwater management facilities to treat urban runoff more efficiently than currently occurs. Development in the

Mattawoman Creek, Port Tobacco, and other impaired watersheds should proceed carefully, and stormwater management retrofits should be targeted here to reduce nonpoint source nutrient loading.

B. Preferred Land Use Plan

As shown in Tables 10, 11, and 12, there are notable differences in potential nutrient loadings under each of the future land use scenarios. The Waldorf Area Focus scenario would generate the lowest overall nutrient discharges Countywide and in the Mattawoman watershed, and would generate among the lowest nutrient discharges in the County's other impaired watersheds. The Waldorf Area Focus scenario also supports the state's Smart Growth goals by concentrating new development in the County's primary PFA—an area where water and sewer infrastructure is already available or can be more efficiently provided.

Charles County has initiated implementation of the Waldorf Area Focus scenario through the zoning and density provisions from Waldorf Urban Design Study. Using Transferrable Development Rights (TDR) and bonuses for affordable housing, these provisions allow densities of nearly 30 residential units per acre in some parts of the US 301 corridor. The County is also working to identify a Priority Preservation Area (another component of the Waldorf Area Focus Scenario). The 2012 Comprehensive Plan update will integrate all of these initiatives into a holistic land use vision.

C. Relationship to Senate Bill 276

Senate Bill 276 (from the 2009 General Assembly session) amends Article 66B, requiring the establishment of a statewide goal for increasing the amount of development within PFAs and decreasing development outside of PFAs. As part of this law, jurisdictions must also establish (beginning in 2011) local land use goals for the amount of development inside of PFAs. To the degree that its recommendations with regard to land use are followed, the Water Resources Element will result in progress toward the statewide (and eventually the local) land use goals by directing development to PFAs and employment centers.

IX. Objectives, Policies, and Recommendations

The following objectives, policies, and implementation actions address water resources in Charles County.

Water Resources Goal 1: *In cooperation with the County's municipalities, the County will maintain safe and adequate drinking water supplies for existing and projected population and non-residential uses.*

Objective: *Measure supply and demand on an annual basis to determine future public water needs and take other actions needed to ensure adequate supply is available to meet demand.*

Policies and Recommendations

1. *Work with MDE, WSSC, and other agencies, as necessary, to identify, access, and sustainably utilize groundwater resources. Specifically, install an additional Patuxent well through the state-appropriated funds for Western Charles County/Bryans Road.*

2. *Implement a well field management strategy, as recommended by the 2006 WRAC Report to the County Commissioners.*

3. *Continue to pursue expanded purchases of water from WSSC, coordinating with Prince George's County as necessary.*

4. *Consider interconnection between the County-operated Waldorf water system and the Town of La Plata's water system. In addition to engineering challenges, a key concern for such a connection is the fair distribution of system costs.*

5. *Begin to evaluate the feasibility of desalinization. Specific considerations include the location, engineering requirements, and funding of such a facility.*

6. *Work with MDE to investigate the feasibility of an indirect wastewater reuse system.*

7. *County now has regressive tiered water rate structure. No other policies for water conservation.*

Water Resources Goal 2: *In cooperation with the County's municipalities, the County will ensure that adequate wastewater treatment capacity exists in public systems for existing and projected population and non-residential uses.*

Objective: *Measure supply and demand on an annual basis to determine future public wastewater treatment needs and take other actions needed to ensure adequate supply is available to meet demand.*

Policies and Recommendations

1. *Consider extending public sewer service to existing communities identified as failing septic areas in the County's Comprehensive Water and Sewer Plan, and to septic systems in the Chesapeake Bay Critical Area.*

2. *Correct sanitary sewage problems in existing problem areas to provide a safe environment for all of the County's residents.*

Water Resources Goal 3: *In cooperation with the County's municipalities, the County will maintain or improve water quality in its streams and rivers through the establishment and continued use of appropriate development policies and enforcement actions.*

Objective 1: *Continue to monitor point-source discharges to ensure compliance with NPDES permit requirements.*

Policies and Recommendations

1. *Ensure that point source discharges of pollutants are maintained at safe levels of environmental quality through strict enforcement of state water quality standards for sewage effluent.*

2. *Ensure industrial facilities are appropriately permitted under the NPDES industrial discharge program and that the necessary Pollution Prevention Plans are in place and implemented in accordance with the County's NPDES Municipal Stormwater permit.*

Objective 2: *Continue to identify and participate in programs and initiatives that reduce nonpoint source discharges of nutrients and other pollutants.*

Policies and Recommendations

1. *Participate in development of Watershed Implementation Plans to achieve Total Maximum Daily Loads for the County's watersheds, to be established by MDE and US EPA.*

2. *Continue to implement the Mattawoman Creek Watershed Management Plan.*

3. *Continue to implement the Port Tobacco River WRAS per County Commissioner Resolution 07-57.*

4. *Continue to work with MDE and the Department of Natural Resources (DNR) to encourage retrofit of existing septic systems with denitrification units, focusing on septic systems in the Chesapeake Bay Critical Area and in other high priority areas.*

5. *Continue to encourage the installation of septic denitrification systems as part of new development throughout the County.*

6. *Continue to retrofit untreated impervious surface area in the County with stormwater management in accordance with the NPDES Municipal Stormwater permit.*

7. *Identify and map areas of failing septic systems, and reduce nonpoint source nutrient loads from such septic systems through retrofits, replacement, or where appropriate, connection to public sewer systems (ensure that the County receives nutrient credits for any such connections).*

8. *Work with MDE, DNR, and the Maryland Department of Agriculture (MDA) to assist farmers in adopting best management practices to reduce nonpoint source loads of nutrients and other pollutants. As part of this effort, develop an educational program and assistance for farmers to improve or limit their runoff.*

9. *Encourage the establishment of Soil Conservation and Water Quality Plans on all farms in Charles County to reduce sediment and nutrient export from agricultural activities.*

Water Resources Goal 4: *Water resources planning shall be a tool to direct the location, amount, and type of development in Charles County.*

Objective: *Utilize planning and design standards that focus on environmental impacts on a watershed level, to better mitigate the impacts from development within the watershed.*

Policies and Recommendations

1. *Continue to develop and implement regulations that require the use of Environmental Site Design (ESD) stormwater techniques in all new construction and redevelopment to the maximum extent practicable.*

2. *Build on the Port Tobacco WRAS by identifying stormwater "hotspots" in other parts of the County. Through the Capital Improvement Plan (CIP) or other funding mechanisms, design and implement stormwater retrofits and stream restoration projects at these locations.*

3. *Continue and improve programs and policies to assure the functional maintenance of stormwater management systems.*

4. *As part of Comprehensive Plan updates after the 2011-12 update, re-run the nonpoint source loading analysis, incorporating up-to-date land use and any changes to the state's model.*

5. *Plan capital improvements consistent with growth in County areas where development is encouraged to locate, especially in the Mattawoman Sewer Service Area.*

6. *Place special emphasis on management of the Mattawoman Creek and Port Tobacco River watersheds (the location of most existing and planned development in the County) to balance the protection of natural resources and water quality with the County's development plans.*

7. *Limit provisions of facilities and services in rural County areas outside of village boundaries that do not permit efficient investment in services or which might encourage more growth than is desired.*

8. *Continue public education and outreach efforts, such as rain barrel distribution, pet waste education, and drywell installation programs focused in neighborhoods with untreated impervious surfaces.*

9. *Continue to explore and implement new techniques and technologies to reduce the impacts to streams during mass grading for development.*

10. *Encourage the use of open section roads and green streets for new and existing stormwater management.*

11. *Consider develop an urban canopy program to maintain the water quality benefits provided by healthy trees in the Priority Funding Areas.*

Water Resources Element Appendix

Housing Unit Projection Methodology

The following assumptions were used to develop the housing unit projections for each Water Resources Element Scenario. All projections described in the Water Resources Element and this Appendix are intended *only* for the analyses in the Water Resources Element, and do not constitute official County population, housing unit, or nonresidential development projections.

The year 2030 housing unit projections for each scenario rely primarily on a residential Development Capacity Analysis prepared by the Maryland Department of Planning. The Capacity Analysis evaluates each parcel in the County based on the likely yield (in terms of residential units per acre) based on the parcel's zoning, environmental constraints (such as wetlands and floodplains), and the amount of existing development on the parcel.

Other residential units were distributed amongst segments of the County's 8-digit watersheds. Each 8-digit watershed was divided into Priority Funding Area (PFA) and "Rural" areas (areas outside of PFAs). Thus, the 8-digit Mattawoman watershed was divided into four "segments:" Mattawoman (Waldorf PFA); Mattawoman (Bryans Road PFA); Mattawoman (Indian Head PFA); and the Remainder of Mattawoman Creek.

Note Regarding Municipal Growth

In addition to the Development Capacity Analysis, the housing unit projections in Table 2 of the Charles County Water Resources Element reflect information provided in the Municipal Growth Elements (MGE) of the Comprehensive Plans for the Towns of Indian Head and La Plata. The Indian Head MGE projects approximately 718 new households in the Town through 2030.[1] While the Development Capacity Analysis showed capacity for only approximately 200 new housing units in Indian Head, 718 new housing units represent growth of approximately 35 percent, which is consistent with the County's projected 45 percent growth through 2030. Thus, the County WRE uses Indian Head's projections without alteration (except to divide these new units among the two watersheds that the Town straddles).

The same cannot be said of the Town of La Plata's projections. The Draft La Plata MGE (July 2009) indicates that the Town will grow from a population of approximately 9,000 to 24,000 by 2030. This is a growth rate of more than 250 percent, approximately six times faster than the County's overall projected growth rate through 2030. This population growth translates to more than 9,000 additional housing units. Approximately 700 existing housing units are present in the Growth Areas shown in the Draft MGE. While there is almost certainly adequate land *capacity* to support 9,000 new housing units (including more than 5,000 within the Town's existing boundaries), it seems unlikely that *actual development* in La Plata will reach the levels projected by the Draft MGE.

Accordingly, the Charles County WRE uses its own projections for development in La Plata. These projections, based on the Development Capacity Analysis, provide for 4-5,000 new housing units (depending on the scenario). This equates to growth rates of 34 to 56 percent through 2030, a range that is consistent with overall Countywide growth.

[1] Although "households" are different from "housing units" (the basis for the data in the County WRE), these two terms are comparable, and were used interchangeably for purposes of this analysis.

Baseline Scenario

In this scenario, the Development Capacity Analysis was applied without modification. Under the baseline, based on past trends, 60 percent of all projected new residential units outside of the Town of Indian Head (14,073 of 23,455 projected units outside of Indian Head) would be built within the County's Priority Funding Areas, in proportion to the development capacity in each of the watersheds covered by those PFAs.

For example, in 2008, the portion of the Waldorf PFA within the Mattawoman Creek watershed had approximately 20.3 percent of all housing units in Charles County's PFAs. Thus, of the 14,073 units projected to be built in Charles County PFAs by 2030, 2,852 (20.3 percent of the PFA total) would be built in the Mattawoman portion of the Waldorf PFA.

The remaining projected 9,382 housing units (40 percent of the projected new residential units outside of the Town of Indian Head) were distributed amongst the rural (non-PFA) portions of the County's 8-digit watersheds in proportion to the development capacity in each of the watersheds covered by those PFAs.

For example, in 2008, the portion of the Mattawoman Creek watershed not within a PFA (the "Remainder of the Mattawoman Watershed") had approximately 17.3 percent of all housing units in Charles County's rural areas. Thus, of the 9,382 units projected to be built in Charles County's rural areas by 2030, 1,622 (20.3 percent of the rural total) would be built in the Mattawoman watershed.

Mattawoman Focus Scenario

This scenario assumes that 70 percent of all projected new residential units would be built within the County's PFAs, while the remaining 30 percent would be built in rural areas. This assumption is based on increased densities in the Waldorf and Bryans Road PFAs, and reduced development capacity in rural areas as the result of the implementation of Priority Preservation Areas (PPA). To model this assumption, the Development Capacity Analysis was modified to increase densities and assumed yields (units per acre) in the portion of the Waldorf area along US 301 (see Figure A-1).

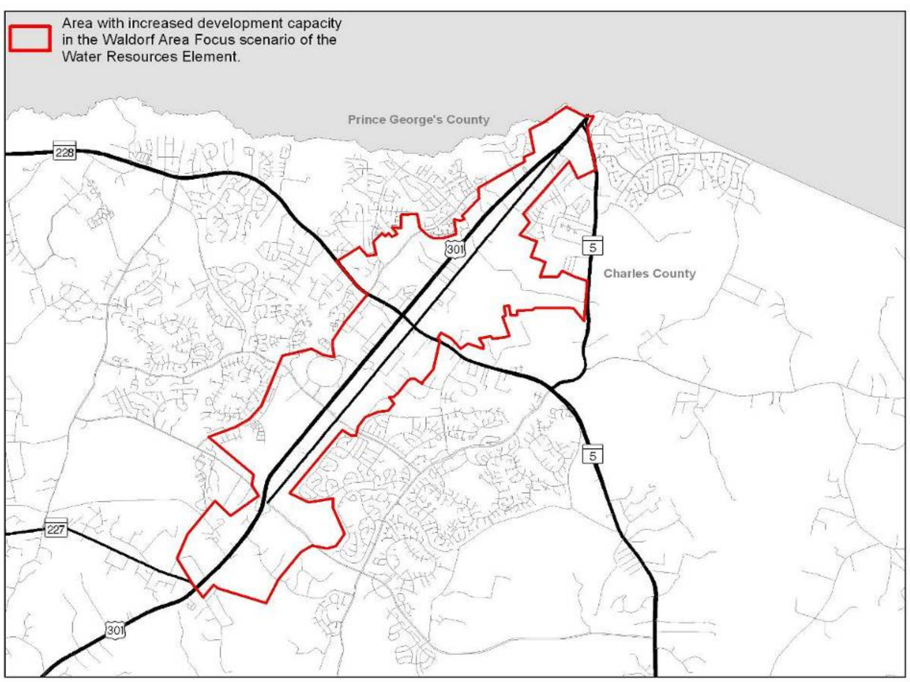


Figure A-1: Area of Increased Development Capacity for Waldorf Scenario

The geography of this “increased density” portion of Waldorf is based on the recommendations of the Waldorf Urban Design Study and the Maryland Transit Administration’s Southern Maryland Transit Corridor Preservation Study.

Priority Preservation Areas are shown in Figure A-2. Within these areas, development capacities were substantially reduced, reflecting an assumed future maximum density of one unit per 20 acres. These assumptions are not based on, nor do they set County policy. Rather, they were used as a “ballpark” assumption for purposes of the WRE only.

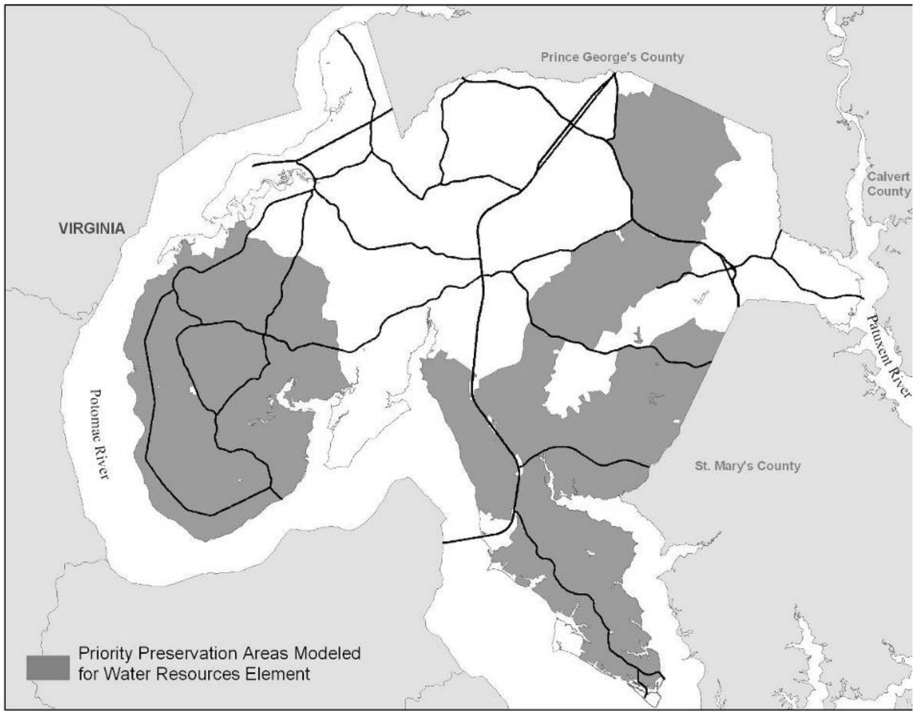


Figure A-2: Priority Preservation Areas

Within each watershed subdivision—e.g., “Mattawoman (Waldorf)”—projected new housing units were distributed in proportion to development capacity (revised for the Waldorf and PPA areas), in the same manner as described for the Baseline scenario.

DDD Focus Scenario

In this scenario, 60 percent of all projected new residential units would be built within the County’s PFAs, while the remaining 40 percent would be built within the County’s rural areas. This scenario assumed implementation of the PPAs as described in the Waldorf scenario, and also assumed that development constraints in the Deferred Development District (DDD) would be removed. To model this assumption, the Development Capacity Analysis was modified to decrease densities and assumed yields in the PPAs. Yields were increased to 1.55 units per acre in the DDD. All other densities and yields in the County were unchanged from the Baseline scenario.

Within each watershed subdivision—e.g., “Mattawoman (Waldorf)”—projected new housing units were distributed in proportion to development capacity (revised for the Waldorf and PPA areas), in the same manner as described for the Baseline scenario.

Assignment of Acreages for Nonpoint Source Model

This section discusses how the Existing Conditions (Year 2007) Land Use/Land Cover (LU/LC) acreages within each 8-digit watershed were altered to reflect projected development under each of the three growth scenarios analyzed in the Water Resources Element. Year 2007 Land Use/Land Cover data and categories were provided by the Maryland Department of Planning.

Residential Development

For the WRE, the New Housing Capacity (NHC—a product of the Development Capacity analysis) was summed for three categories in each watershed segment.

- Urban (LU/LC Codes 11-18, 191, and 192)
- Agricultural (LU/LC Codes 21-25, 241, and 242)
- Forest, Water, and Wetlands (LU/LC Codes 41-44, 50, and 60)

It was assumed that new residential development would occur in the same ratio as existing residential development. For example, in the Mattawoman (Waldorf) watershed segment, 16 percent of existing residential development was within "Low Density" LU/LC areas, 69 percent was within "Medium Density" areas, and 15 percent was within "High" density areas. These percentages were applied to projected residential units assigned to this watershed segment.

The following gross densities were used for all geographies to convert new units into new acreage:

- Rural (LU/LC 191, 192): 0.2 units/acre. Not used within PFAs.
- Low Density (LU/LC 11): 2 units/acre
- Medium Density (LU/LC 12): 5 units/acre
- High Density (LU/LC 13): 10 units/acre

New residential acreage within each watershed segment was then assigned to the Urban, Agricultural, or Forest categories according to the ratio of NHC. For example, in the Mattawoman (Waldorf) watershed segment, 38 percent of all NHC was within the Forest category.

New development assigned to the urban category was deemed to be "infill," and thus would not result in any land use acreage change. In theory, there would be shifts from low density to medium density, and so on. However, because the nonpoint source model's loading rates are the same for all urban development types, there was no need to further parse the urban category.

New development assigned to the agricultural category would result in an equal loss of agricultural land in that watershed segment. Reductions in agricultural land were concentrated in the LU/LC 21 (cropland) category for simplicity (since the nonpoint source model's loading rates do not distinguish among agriculture types).

Similarly, new development assigned to the forest category would result in an equal loss of forest land in that watershed segment. Reductions in agricultural land were concentrated in the LU/LC 41 (deciduous forest) category for simplicity (since the nonpoint source model's loading rates do not distinguish among forest types).

Nonresidential Development

In all scenarios, nonresidential acreage (commercial and industrial land) was projected to grow proportionately with new residential development, within each watershed segment. For example, in 2007, there were 187 acres of commercial land and 6,477 acres of residential land use in the Port Tobacco (Remainder) watershed segment. The ratio of 187 to 6,477 is 0.03. In 2030, the Baseline scenario projected that residential uses in this watershed would account for 1,366 additional acres (excluding infill). Using the 0.03 ratio, this equates to approximately 42 acres of new commercial development in the Port Tobacco (Remainder) watershed segment.

Nonresidential acreage replaced agricultural and forest acreage using the same methodology as described above for residential acreage.

Wastewater Reuse—Spray Irrigation

Option A, Preliminary Spray Irrigation Site Capacity Estimate (from *M&G 26*, page 67) was used to estimate the acreage in Charles County that could be appropriate for future land application (spray irrigation) of treated wastewater effluent. Charles County's GIS soils database was used to identify soil types and permeability classes that most closely matched the drainage categories listed in the state guidelines. Table A-1 shows the results of this analysis. Map A-1 shows areas that, based on this analysis, might be suitable for land application.

Table A-1. Potential Land Application Acreage in Dorchester County

Drainage Category	Estimated Site Capacity for Each 100 Acres	Total Potential Land Area[1]
Excessively drained	640,000 gpd	1,846 acres
Well drained	480,000 gpd	12,061 acres
Moderately well drained	320,000 gpd	22,504 acres
Total		**36,411 acres**

Notes:

1: Limited to Agricultural land (Land Use/Land Cover categories 21, 22, 23, and 24) outside of municipal boundaries. Does not include buffers from streams or developed areas.

Developed areas, bare ground, wetlands, and forests were not considered appropriate for land application. Forests, in particular, should be preserved due to their ability to filter and reduce nonpoint source pollution. Because spray irrigation (with groundwater) is already a common agricultural practice in Maryland, agricultural areas are considered to be the most appropriate locations for future land application of treated wastewater.

It is understood that Option A is a coarse level of analysis, and is preliminary in nature. More detailed evaluations of soil characteristics, water table, and other factors are necessary before identifying specific locations for land application. However, these results indicate that, in some areas, augmenting public wastewater collection and treatment with land application may be appropriate ways to expand system capacity without increasing nutrient loads to receiving bodies of water. For example, a 50-acre plot of "well drained" land (with appropriate depth to bedrock, buffers, and other favorable physical conditions) could add as much as 900 EDU of capacity.

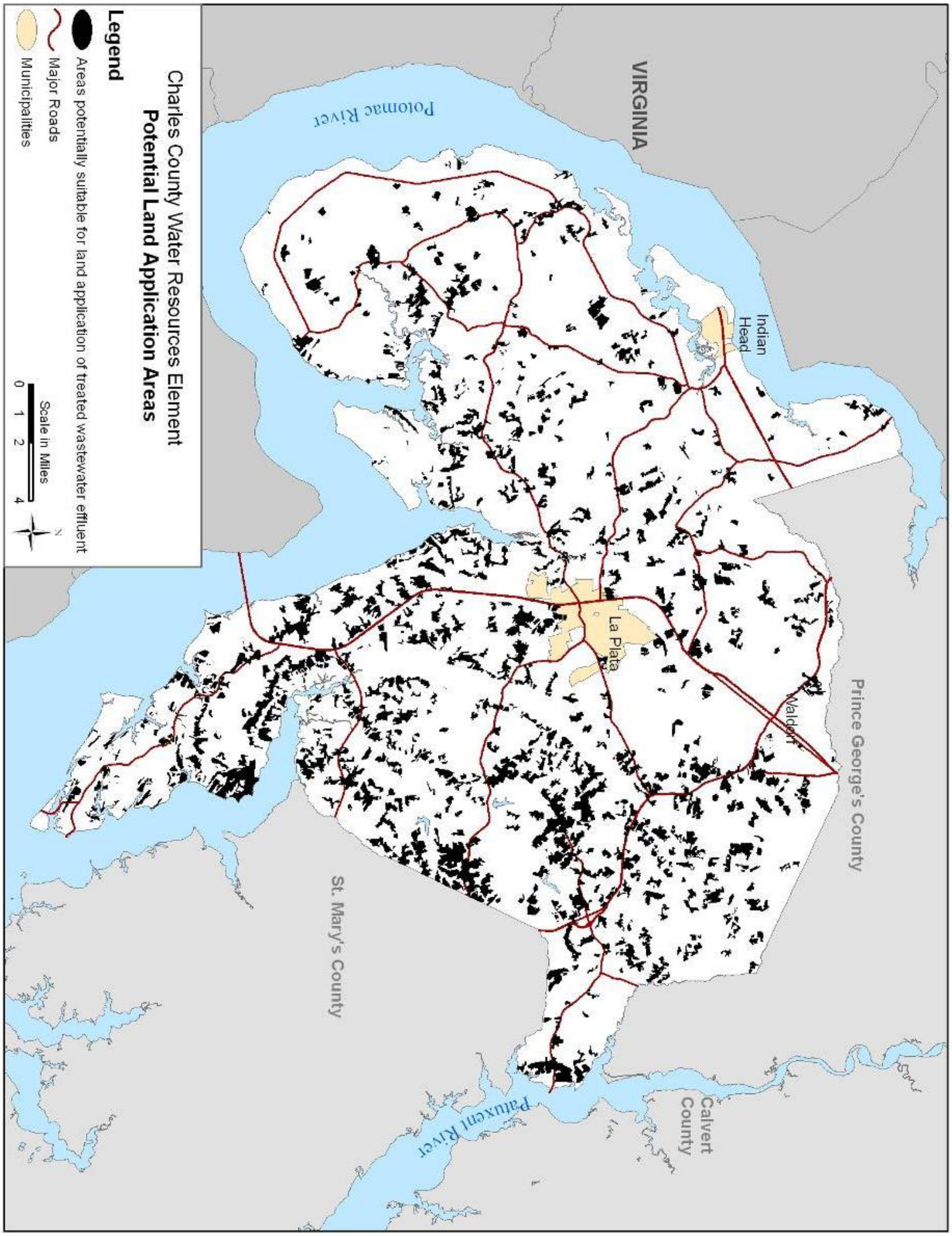


Figure A-3. Areas Potentially Suitable for Land Application of Treated Effluent

Nonpoint Source Modeling Methodology

In conjunction with *Models and Guidelines 26*, the official guidance for preparing the Water Resources Element, MDE developed a spreadsheet-based model for Charles County to use in calculating existing and projected future nitrogen and phosphorus loads from nonpoint sources, based on land use (specifically, GIS layers showing existing and projected future land use).

Modifications to the MDE Model

The County used the MDE default model as a framework for estimating nonpoint source (NPS) nutrient loading for the Water Resources Element. However, in the course of developing the Charles County Water Resources Element and other Water Resources Elements in Maryland, the County and its consultant, Environmental Resources Management, Inc. (ERM), received public comments about the nature of the loading rates contained in the state's default model. In particular, there were concerns that the loading rates (which state the lbs per year of nitrogen or phosphorus that is generated by a given land use) greatly underestimated NPS nutrient loading from agricultural land.

ERM and the County decided to use an alternative set of loading rates and methodology for the NPS model. Loading rates were obtained from the Chesapeake Bay Program Watershed Model, Phase 4.3. Loading rates for Agriculture, Forest, Urban, and Mixed Open Space were amalgamated for all of the segments of the Watershed Model in Charles County. Table A-2 shows the loading rates used for existing and future year projections. Table A-3 shows how the generalized land uses correspond to the Land Use/Land Cover (LU/LC) categories in the default model. A digital version of the NPS model used for this WRE is available from the Planning and Zoning Office upon request (the spreadsheets themselves are difficult to reproduce in print form).

Table A-2. Nonpoint Source Loading Rates (Lbs/Acre/Year)

Generalized Land Use	Existing Conditions (2008)[1]					
	TN (Lbs/Ac/Year)		*TP (Lbs/Acre/Year)*		*Sediments (T/Ac/Year)*	
	Patuxent[3]	*Potomac[3]*	*Patuxent*	*Potomac*	*Patuxent*	*Potomac*
Agriculture	12.2	16.3	0.9	1.3	1.1	0.7
Forest	1.3	1.3	0.0	0.0	0.0	0.0
Mixed Open	4.3	4.4	0.4	0.6	0.2	0.1
Urban	10.3	10.6	0.5	0.8	0.2	0.1
Generalized Land Use	**With Tributary Strategy Implementation[2]**					
	TN (Lbs/Ac/Year)		*TN (Lbs/Ac/Year)*		*TN (Lbs/Ac/Year)*	
	Patuxent	*Patuxent*	*Patuxent*	*Patuxent*	*Patuxent*	*Patuxent*
Agriculture	7.58	7.58	7.58	7.58	7.58	7.58
Forest	1.21	1.21	1.21	1.21	1.21	1.21
Mixed Open	3.32	3.32	3.32	3.32	3.32	3.32
Urban	6.75	6.75	6.75	6.75	6.75	6.75

Notes:

1: Source: Chesapeake Bay Program Watershed Model, Phase 4.3, scenario s65prog08b (2008 Annual Model Assessment), http://www.chesapeakebay.net/data_modeling.aspx

2: Source: Chesapeake Bay Program Watershed Model, Phase 4.3, scenario s66mdts06 (Maryland Tributary Strategy 06 - FINAL). Coefficients represent combined loading for state segments 4500 (Patuxent River), 4910, 4915, and 4920 (Potomac River). http://www.chesapeakebay.net/data_modeling.aspx

3: The Chesapeake Bay Program Watershed Model's loading rates are differentiated by 6-digit watershed. Charles County has two such basins: the Patuxent and Potomac River basins. The Patuxent River basin includes only the Lower Patuxent River 8-digit watershed. All other 8-digit watersheds in Charles County fall within the Potomac basin.

**Table A-3. Correspondence Table:
Chesapeake Bay Model Generalized Land use to MDP LU/LC**

CBP Generalized Land Use	MDP Land Use/Land Cover[1]	
	Category	Code
Agriculture	Cropland	21
	Pasture	22
	Orchards	23
	Row and Garden Crops	25
	Feeding Operations	241
	Agricultural Buildings	242
Forest	Deciduous Forest	41
	Evergreen Forest	42
	Mixed Forest	43
	Brush	44
	Water	50
	Wetlands	60
Mixed Open	Urban Open Space	18
	Bare Ground	73
Urban	Low Density Residential	11
	Medium Density Residential	12
	High Density Residential	13
	Commercial	14
	Industrial	15
	Institutional	16
	Extractive	17
	Transportation	80
	Rural Residential	191, 192

The default state model uses separate loading rates for the pervious and impervious portion of each LU/LC category. Because the Chesapeake Bay Watershed Model's data do not distinguish between pervious and impervious, the Charles County NPS model applied the loading rates in Table A-2 directly to the LU/LC acreage, without segregating pervious and impervious. It should be noted that the Towns of Secretary and East New Market (Dorchester County's "Twin Cities") and Dorchester County used similar data and assumptions for their Water Resources Elements.

Septic Denitrification

For purposes of modeling, it was assumed that half of new development outside of public sewer systems (residential and non-residential) would incorporate Best Available Technology (BAT) for nutrient removal (a.k.a. denitrification), and that one-quarter of existing development would be retrofitted with denitrification technology through 2030.

Other Modifications

The default model was also modified to reflect updated household size data. Year 2000 data were replaced with year 2008 (2.86 persons per household), and year 2030 data (2.66 persons per household) were included.

NPS Model Outputs

The tables and graphs below are the detailed output of the Charles County NPS model described above and in section VII of the Water Resources Element.

Table A-4. Land Use and Septic Systems

	Existing (Acres)	Baseline Scenario (Acres)	Waldorf Area Focus Scenario (Acres)	DDD Focus Scenario (Acres)
Development	68,233	87,595	81,012	83,183
Agriculture	47,978	42,872	44,883	44,563
Forest	170,219	155,964	160,536	158,683
Water	119,837	119,837	119,837	119,837
Other	8,019	8,019	8,019	8,019
Total Area	**414,288**	**414,288**	**414,287**	**414,286**
Residential Septic (EDUs)	16,749	26,039	22,523	26,042
Non-Residential Septic (EDUs)	8,696	9,727	9,338	9,683

Table A-5. Total Nitrogen Loading

	Existing (Lbs/Yr)	**Baseline Scenario** (Lbs/Yr)	**Waldorf Area Focus Scenario** (Lbs/Yr)	**DDD Focus Scenario** (Lbs/Yr)
Development NPS	720,782	612,073	565,894	581,119
Agriculture NPS	772,295	444,637	465,916	462,528
Forest NPS	212,774	188,717	194,248	192,007
Water NPS	149,797	145,003	145,003	145,003
Other Terrestrial NPS	69,713	51,327	51,327	51,327
Total Terrestrial Load	**1,925,361**	**1,441,756**	**1,422,389**	**1,431,983**
Residential Septic (EDUs)	182,028	242,886	211,788	242,912
Non-Residential Septic (EDUs)	33,719	33,042	31,813	32,901
Total Septic Load	215,747	275,927	243,601	275,814
Total NPS Nitrogen Load	**2,141,108**	**1,717,684**	**1,665,990**	**1,707,797**
Total PS Load	93,151	193,542	201,646	202,860
Total Nitrogen Load (NPS+PS)	**2,234,260**	**1,911,225**	**1,867,636**	**1,910,657**

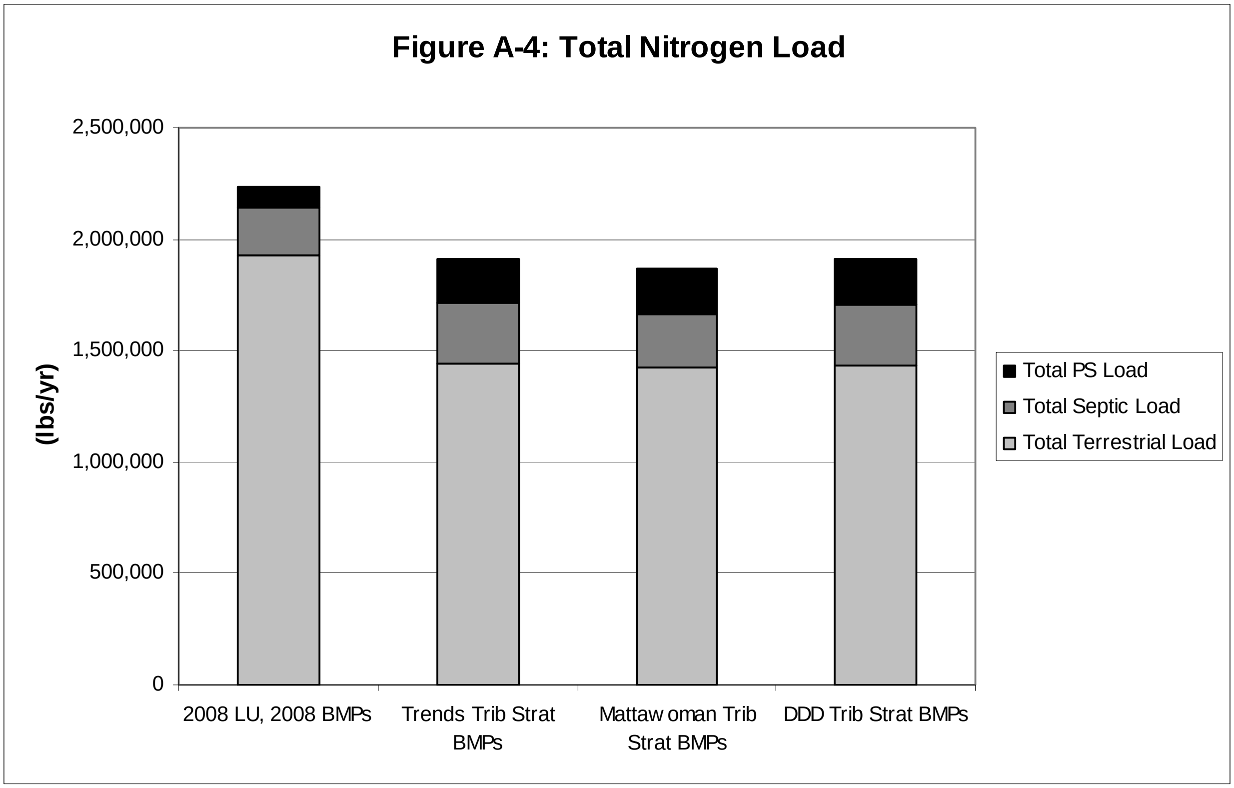


Figure A-4: Total Nitrogen Load
(lbs/yr)
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
2008 LU, 2008 BMPs
Trends Trib Strat BMPs
Mattaw oman Trib Strat BMPs
DDD Trib Strat BMPs
Total PS Load
Total Septic Load
Total Terrestrial Load

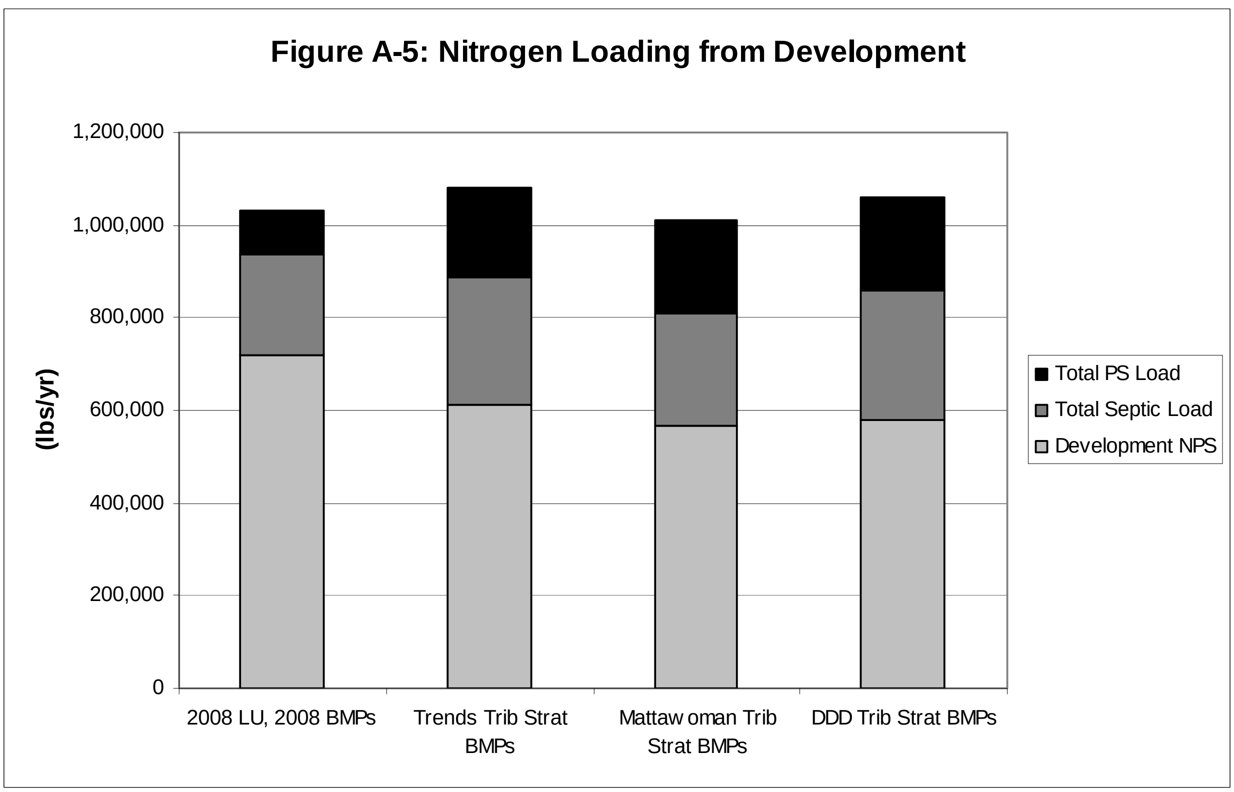
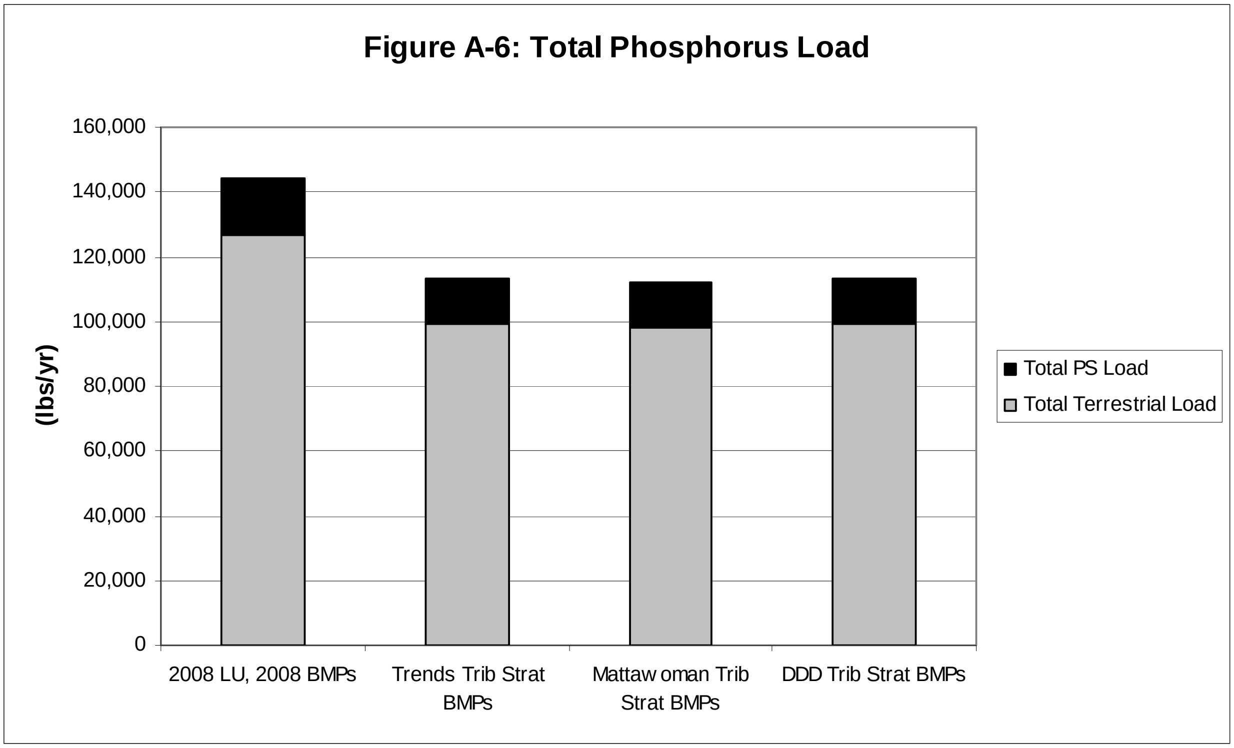


Figure A-5: Nitrogen Loading from Development
(lbs/yr)
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
2008 LU, 2008 BMPs
Trends Trib Strat BMPs
Mattaw oman Trib Strat BMPs
DDD Trib Strat BMPs
Total PS Load
Total Septic Load
Development NPS

Table A-6. Total Phosphorus Loading

	Existing (Lbs/Yr)	Baseline Scenario (Lbs/Yr)	Waldorf Area Focus Scenario (Lbs/Yr)	DDD Focus Scenario (Lbs/Yr)
Development NPS	52,842	45,365	41,861	43,014
Agriculture NPS	62,216	44,662	46,803	46,462
Forest NPS	3,404	3,041	3,133	3,096
Water NPS	2,397	2,385	2,385	2,385
Other Terrestrial NPS	5,968	4,108	4,108	4,108
Total Terrestrial Load	**126,827**	**99,561**	**98,290**	**99,065**
Total PS Load	17,164	13,496	13,838	13,980
Total Phosphorus Load (NPS+PS)	**143,991**	**113,057**	**112,128**	**113,045**



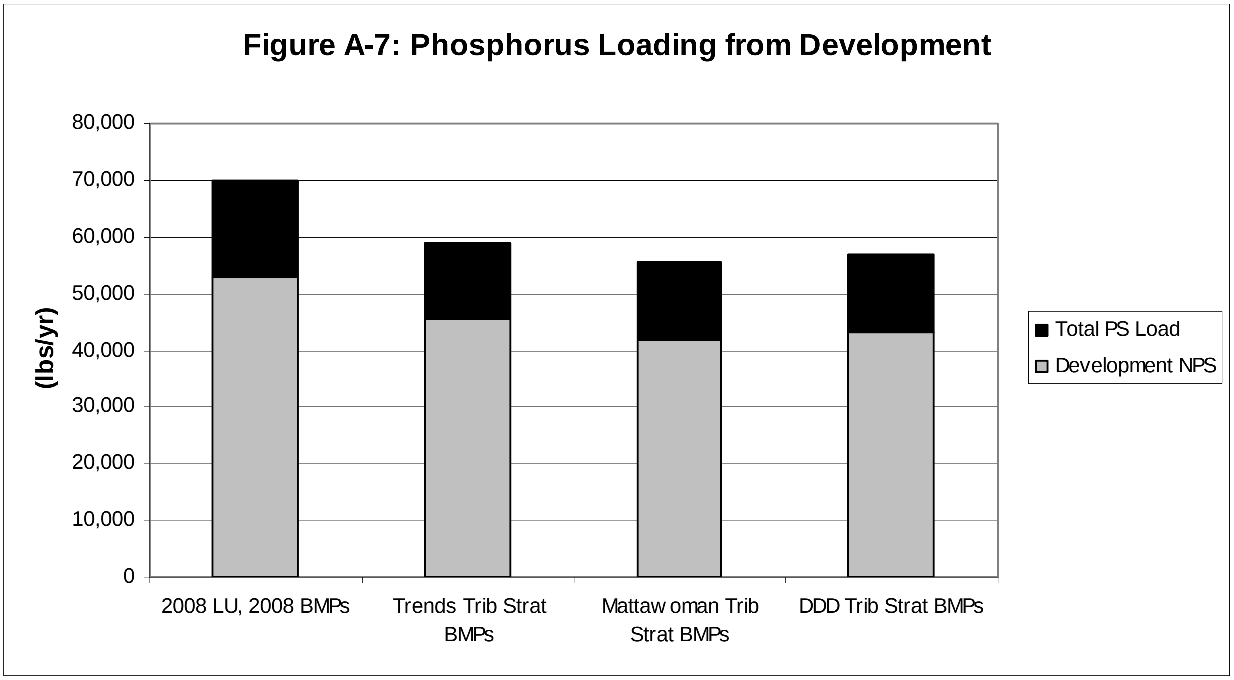
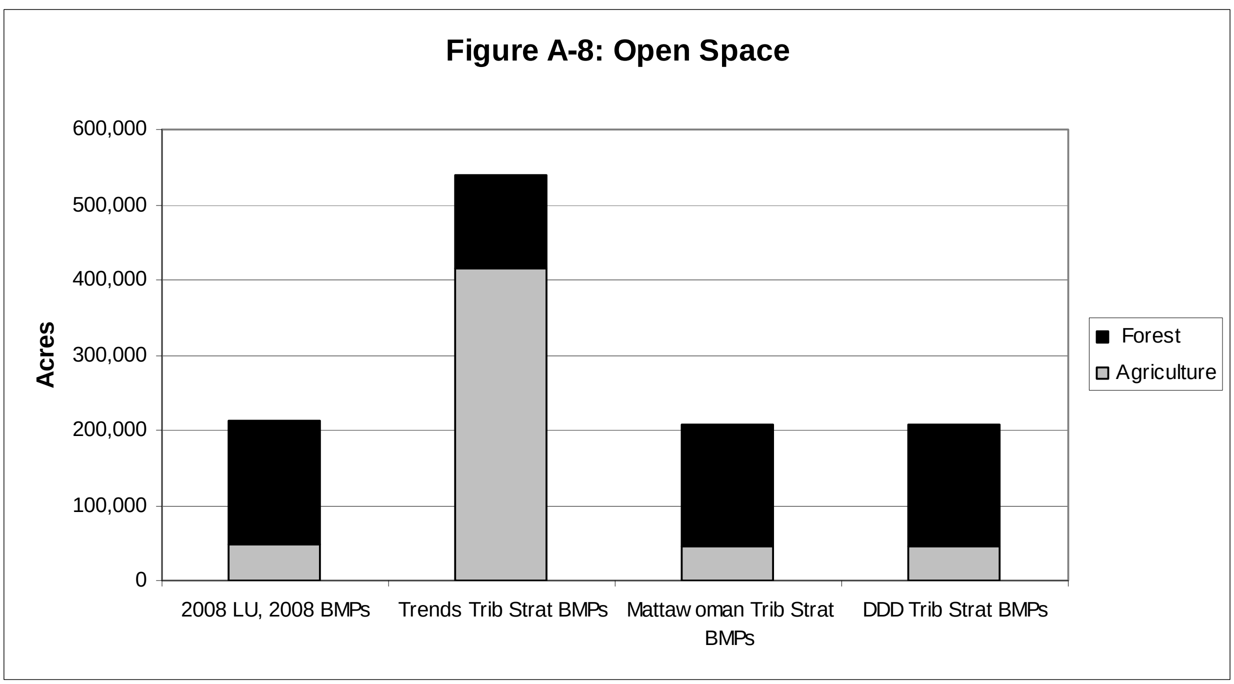


Table A-7. Impervious Cover and Open Space

	Existing	Baseline Scenario	Waldorf Area Focus Scenario	DDD Focus Scenario
Total Impervious Cover	3.4%	3.9%	3.8%	3.8%
Countywide Impervious Percentage	47,978	414,288	44,883	44,563
County Land in Agriculture	163,451	126,153	163,451	163,451
County Land in Forest	3.4%	3.9%	3.8%	3.8%



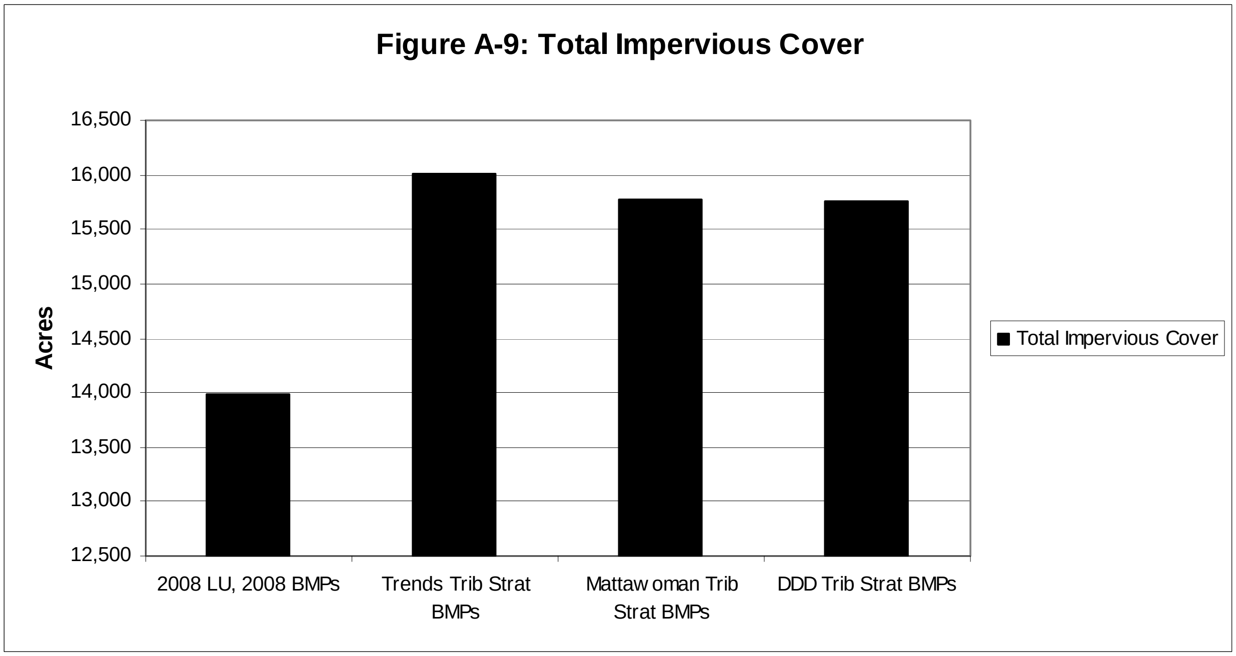


Figure A-9: Total Impervious Cover
16,500
16,000
15,500
15,000
14,500
14,000
13,500
13,000
12,500
Acres
2008 LU, 2008 BMPs
Trends Trib Strat BMPs
Mattaw oman Trib Strat BMPs
DDD Trib Strat BMPs
Total Impervious Cover

Alternative NPS Model

For comparison, the County ran the default state NPS model using the same scenarios, acreages, housing unit totals, and septic system assumptions as in the model described above and in the Water Resources Element. The results of that model are shown in Table A-8. A digital version of the default state NPS model is available from the Planning and Zoning Office upon request.

Table A-8. Total Nutrient Loading, Default MDE Nonpoint Source Model

		Watershed										
(all data in lbs/year)		Patuxent Lower*	Gilbert Swamp	Mattawoman Creek*	Nanjemoy Creek*	Port Tobacco River*	Lower Potomac*	Middle Potomac	Upper Potomac*	Wicomico River	Zekiah Swamp	**Total**
Existing	TN	126,139	191,028	288,136	233,595	233,890	894,306	404,718	44,255	178,282	441,097	**3,035,446**
	TP	6,594	14,018	23,463	15,489	16,224	53,470	35,951	2,560	10,462	34,084	**212,316**
Baseline	TN	99,525	155,071	255,946	213,850	215,041	760,802	443,378	38,523	147,190	377,996	**2,707,322**
	TP	5,343	11,960	18,622	14,802	15,644	52,521	29,042	2,533	10,189	29,288	**189,944**
Waldorf Area Focus	TN	100,433	147,878	251,740	193,610	213,224	752,821	449,955	38,823	138,526	365,967	**2,652,976**
	TP	5,374	11,606	18,573	13,456	15,548	52,125	29,426	2,557	9,594	28,832	**187,092**
DDD Focus	TN	100,270	147,772	269,354	194,439	215,752	752,552	447,924	38,774	138,429	364,185	**2,669,449**
	TP	6,653	15,539	34,057	28,322	26,878	301,344	118,347	15,027	33,359	38,987	**618,513**

** Indicates a watershed that is impaired by nutrients.*