Delaware's Phase I Chesapeake Bay Watershed Implementation Plan

Assembled By:

Delaware's Chesapeake Interagency Workgroup

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DELAWARE CHESAPEAKE WATERSHED IMPLEMENTATION PLAN

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SECTION 1. EXECUTIVE SUMMARY

Delaware has participated in the Chesapeake Bay Program since signing a multi-jurisdictional Memorandum of Understanding in 2000, committing to achieving water quality goals to protect and improve the bay and tributary waters. Since past Chesapeake Bay Program restoration goals have yet to be met, on May 12, 2009, President Obama signed Executive Order 13508, placing increased focus and heightened emphasis on Bay restoration. In addition, draft legislation has reauthorized the Chesapeake Bay Program, calling for increased measures from federal, state, and local governments. Before both of these initiatives began, however, EPA had already begun developing a Total Maximum Daily Load (TMDL) for nitrogen, phosphorus, and sediment for the entire six-state and DC Chesapeake Bay watershed because water quality impairments had been documented for decades. This TMDL will require significant reductions in point and nonpoint pollutant loadings from all jurisdictions within the Chesapeake Bay watershed so that water quality standards can be achieved. As part of the EPA TMDL, each jurisdiction is required to develop a Watershed Implementation Plan (WIP) that details how load allocations will be achieved and maintained now and in the future. Additionally, jurisdictions will have to exhibit accountability by achieving 2-year milestone goals.

If jurisdictions fail to develop their WIP or meet their 2-year milestone goals, EPA has identified a set of potential consequences to impose. These consequences range from EPA taking over responsibility for developing the plans to increasing their regulatory oversight and extending their regulatory authority to additional sources of pollution. EPA may deny National Pollutant Discharge Elimination System (NPDES) permits or require additional reductions from regulated sources, increase and target federal enforcement and compliance, and expand NPDES coverage to currently unregulated sources. Examples of currently unregulated sources in many locations include Concentrated Animal Feeding Operations (CAFOs) in the agriculture community and Municipal Separate Stormwater Systems (MS4s) in the developed community. Additionally, EPA may condition or redirect grant funds needed by the State to implement voluntary cost-share programs.

Considering the potential consequences, jurisdictions must not only identify the actions that are immediately available for them to implement, but also identify contingencies. These contingencies are additional actions that they may resort to if the original actions are not successfully implemented, or do not result in the anticipated nutrient and sediment reductions. With additional regulatory controls looming, stakeholders have been encouraged to participate in the process as soon as possible in order to quickly reach consensuses on proposed actions.

To follow this aggressive schedule and achieve these requirements, the Delaware Department of Natural Resources and Environmental Control (DNREC) has convened the Chesapeake Bay Interagency Workgroup made up of representatives from each DNREC Division, Department of Agriculture, Department of Transportation, Office of State Planning Coordination, County Conservation Districts, US Department of Agriculture, and other stakeholders. Eight subcommittees have been formed to address the issues present in the WIP, and they are: Agriculture; Stormwater; Wastewater; Land Use and Comprehensive Plans; Restoration; Public Lands; Funding; and Information Technology. Subcommittees have been tasked with recommending and reviewing sub-allocating methodologies to the various point and nonpoint sources within the basins, assessing current data tracking and reporting systems, determining maximum implementation goals and methods to fill program and funding gaps, and assisting with writing and providing information for the Watershed Implementation Plan. These subcommittees are also

communicating proposed actions to the respective stakeholder groups, and soliciting their input on WIP elements.

As the largest estuary in the United States, the Chesapeake Bay is essential for the well being of many living things. Not only is it an irreplaceable home for various bay-dwelling organisms, it is also an important resource for thousands of people. The habitats and economical situations of many have been negatively impacted by pollutants entering the rivers and Bay. In particular, nutrient and sediment pollution have been of high concern in Delaware's Chesapeake Bay Tributaries, already causing irreparable damage. Prominent signs of such pollution have included algal blooms and decaying algae. The coordinated effort led by EPA to develop a TMDL for the entire Chesapeake Bay Watershed is the most recent attempt to correct these issues. The TMDL in Delaware will be achieved through the actions and programs outlined in this WIP.

SECTION 2. INTRODUCTION

2.1. The Chesapeake Bay Drainage in Delaware

In 2000, the State of Delaware entered into a Memorandum of Understanding with the Chesapeake Bay Program signatory jurisdictions, Maryland, Pennsylvania, Virginia, District of Columbia, EPA, and the Chesapeake Bay Commission, to encourage participation in the restoration of the Bay from jurisdictions in the entire watershed. The State of Delaware also committed to working cooperatively with the other parties to achieve the nutrient and sediment reduction targets that all agree are necessary to achieve the goals of a clean Chesapeake Bay thereby allowing the Chesapeake and its tidal tributaries to be removed from the list of impaired waters. Representatives from DNREC and the Department of Agriculture participate on Chesapeake Bay Program committees and workgroups, which discuss the science, modeling, and policy decisions that impact this TMDL and restoration efforts. Additionally, because of Delaware's commitment to improve water quality in the Chesapeake watershed, DNREC has been the recipient of an EPA-Chesapeake Bay Program headwater implementation grant, and more recently a regulatory and accountability grant, and these funds have assisted the State with data tracking and reporting and increased the implementation of projects and practices that have resulted in the reduction of nutrients and sediment to receiving waters.

2.1.1. Chesapeake Rivers and Watersheds

The Chesapeake Bay Watershed includes land area within Delaware, the District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia. The portion of the Chesapeake Drainage within Delaware makes up about 1% of the land area within the entire Chesapeake Bay Watershed (Figure 1). The watersheds that make up the Chesapeake Drainage in Delaware encompass a 451,268 acre area of land in all three of Delaware's counties. The Chesapeake makes up approximately 10% of New Castle County, 33% of Kent County, and 50% of Sussex County (Figure 2).

The headwater streams and rivers that originate in Delaware all ultimately drain to the Eastern Shore of the Chesapeake. These streams include, from north to south: Elk Creek, Perch Creek, the C&D Canal, Bohemia Creek, Sassafras River, Chester River, Choptank River, Marshyhope Creek, Nanticoke River, Gum Branch, Gravelly Branch, Deep Creek, Broad Creek, Wicomico River, and Pocomoke River. The modeling undertaken by EPA has grouped these streams into three minor basins, 11 303(d) segments, and 26 land river segments (Table 1; Figures 3 and 4).

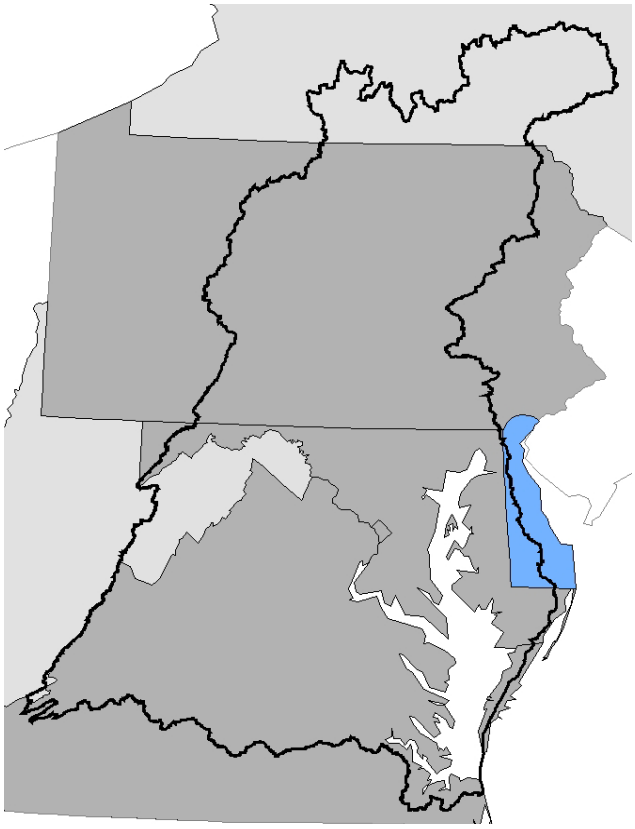


Figure 1: The Chesapeake Bay Watershed

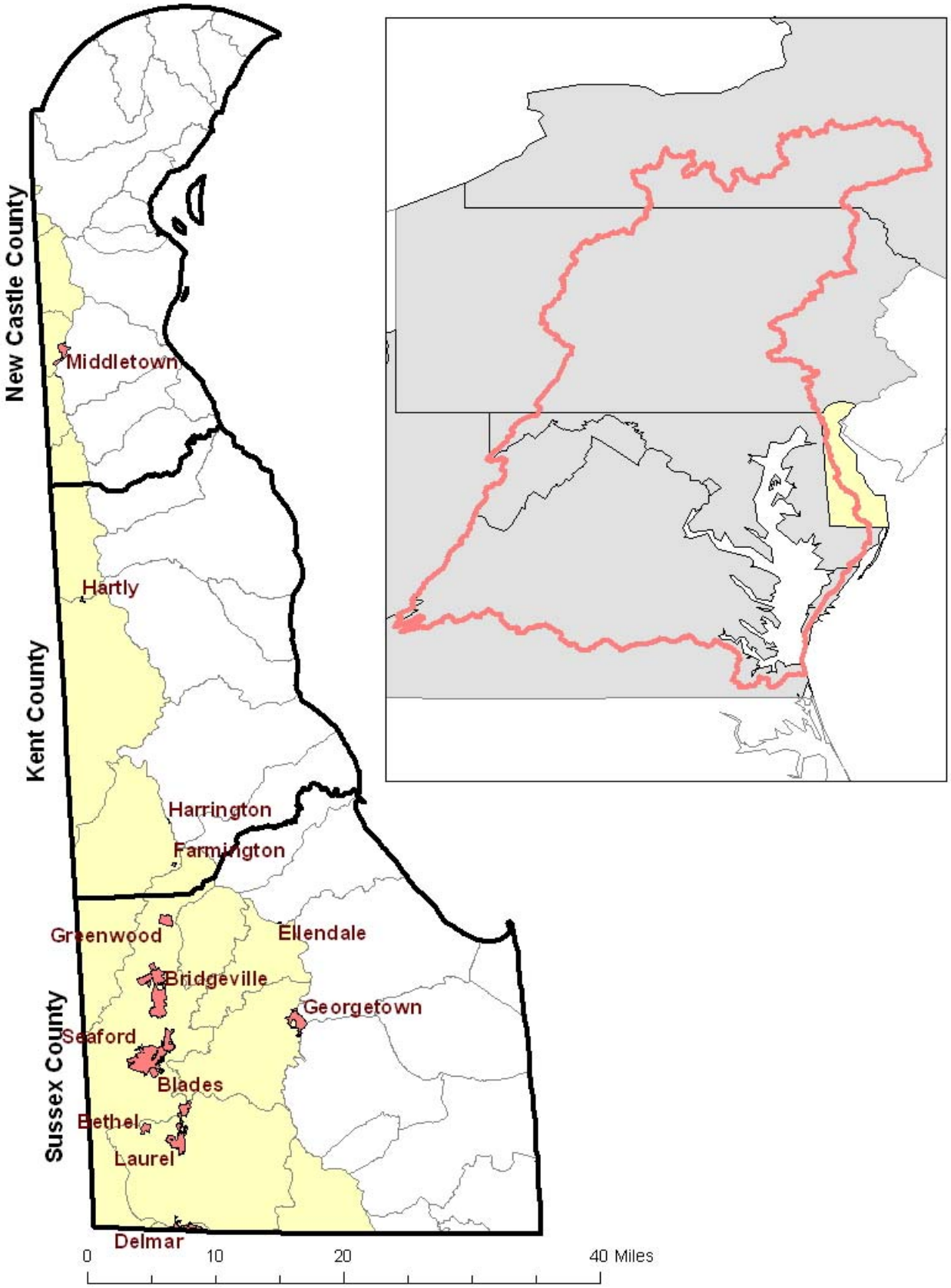


Figure 2: The Chesapeake Drainage within Delaware

Major Basin	Minor Basin	303(d) Segment	Land River Segment	County
Eastern Shore of Chesapeake Bay	Upper Eastern Shore	Elk River (ELKOH)	A10003EU1_2981_0000	NEW CASTLE
			A10003EU1_2983_0000	NEW CASTLE
		C&D Canal (C&DOH_MD)	A10003EU0_3010_0000	NEW CASTLE
		C&D Canal (C&DOH_DE)	A10003EU0_3011_0000	NEW CASTLE
		Bohemia River (BOHOH)	A10003EU0_3201_0000	NEW CASTLE
		Sassafras River (SASOH)	A10003EU0_3361_0000	NEW CASTLE
		Upper Chester River (CHSTF)	A10003EU2_3520_0001	NEW CASTLE
			A10001EU2_3520_0001	KENT
	Middle Eastern Shore	Upper Choptank River (CHOTF)	A10001EM2_3980_0001	KENT
			A10001EM3_4326_0000	KENT
	Lower Eastern Shore	Middle Nanticoke River (NANOH)	A10001EL2_4400_4590	KENT
			A10001EL2_4590_0001	KENT
			A10005EL2_4590_0001	SUSSEX
			A10005EL0_4591_0000	SUSSEX
			A10005EL0_4594_0000	SUSSEX
			A10005EL0_4597_0000	SUSSEX
		Upper Nanticoke River (NANTF_DE)	A10001EL0_4560_4562	KENT
			A10005EL0_4560_4562	SUSSEX
			A10005EL0_4561_4562	SUSSEX
			A10005EL0_4562_0001	SUSSEX
			A10005EL0_4631_0000	SUSSEX
			A10005EL0_4632_0000	SUSSEX
			A10005EL0_4633_0000	SUSSEX
			A10005EL2_4630_0000	SUSSEX
		Pocomoke River (POCTF)	A10005EL2_5110_5270	SUSSEX
		Wicomico River (WICMH)	A10005EL0_5400_0001	SUSSEX

Table 1: Delaware Drainage Basins and Land River Segments

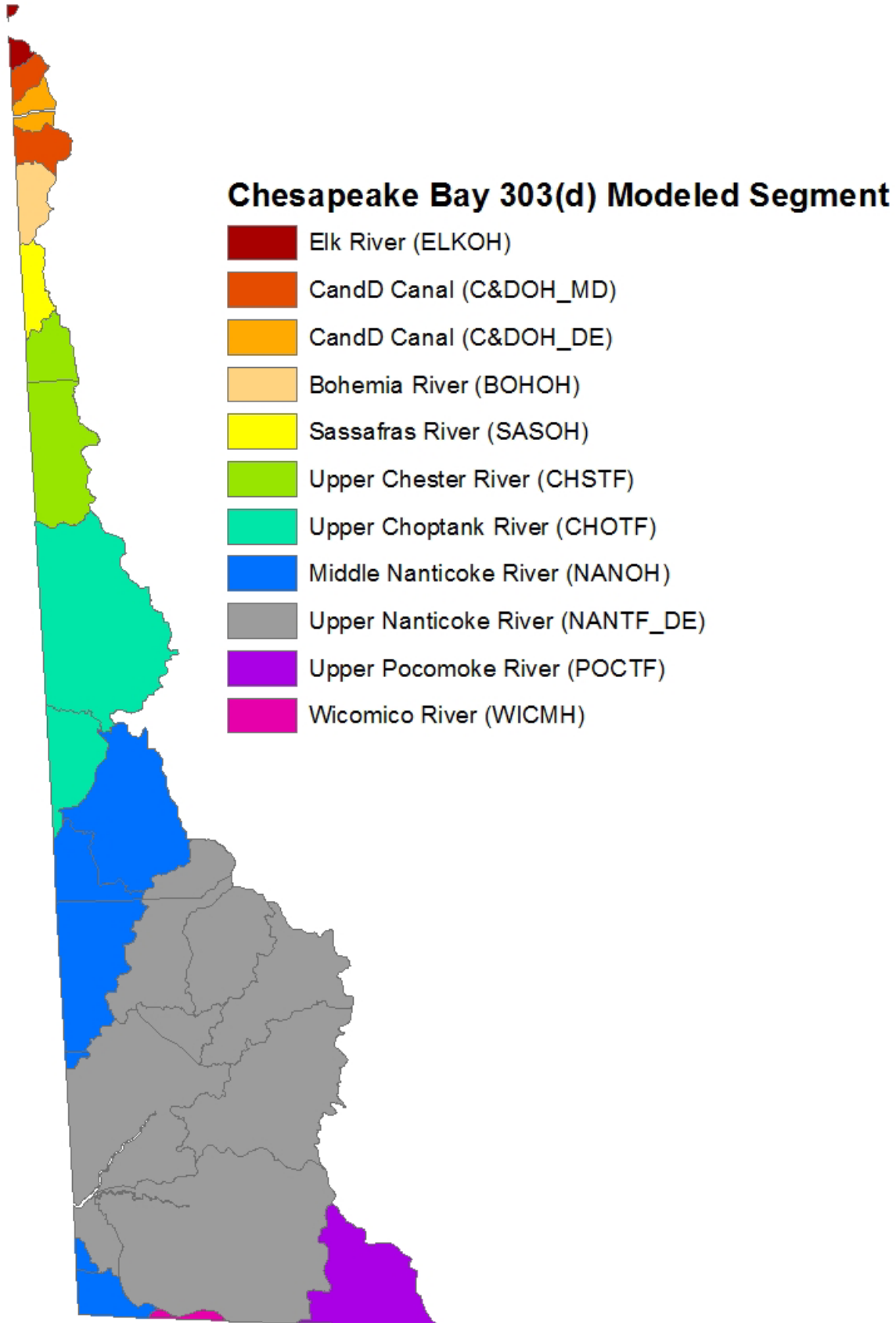


Figure 3: Chesapeake Bay Model 303(d) Segments

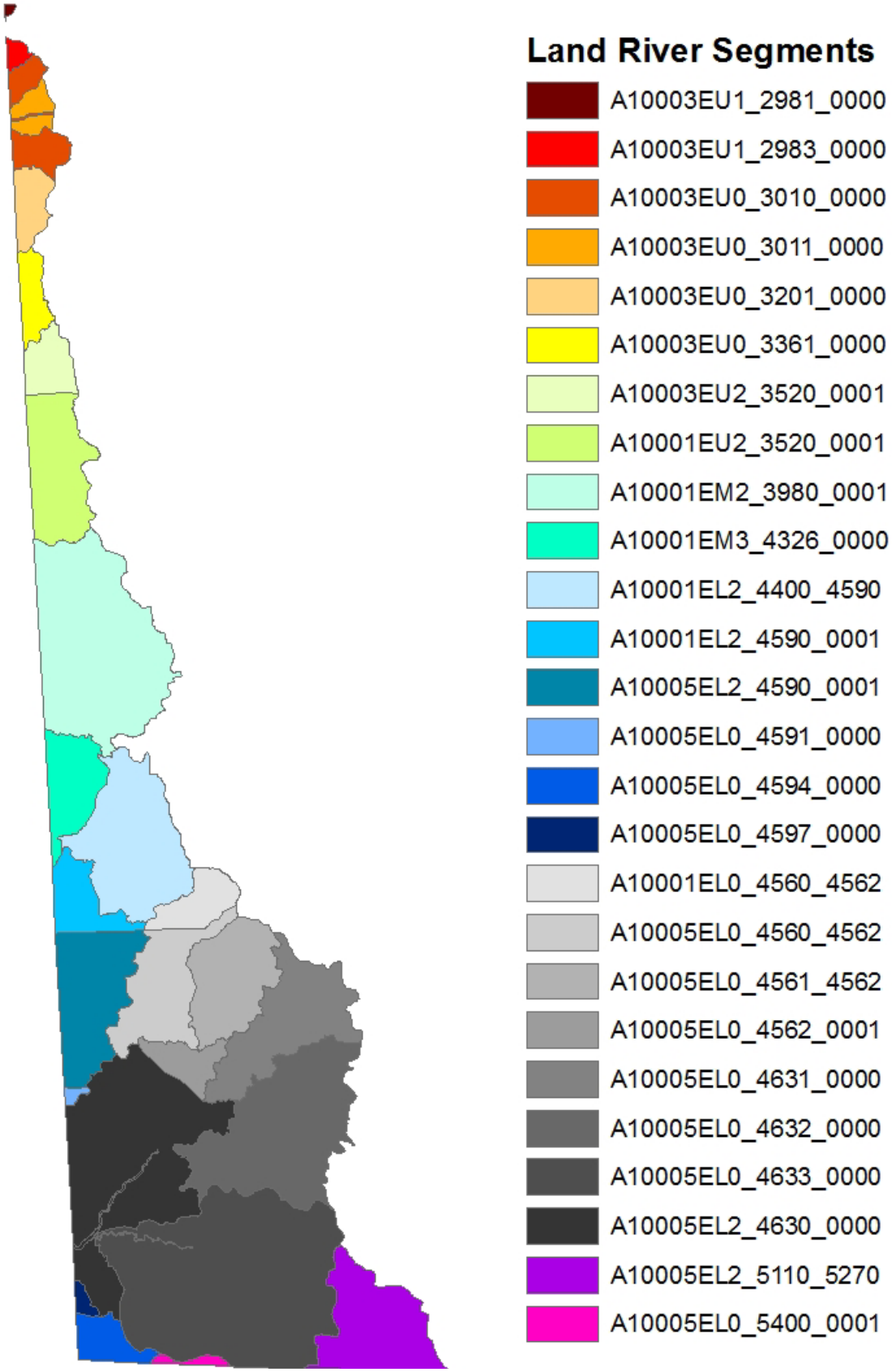


Figure 4: Chesapeake Bay Model Land River Segments

2.1.2 Topography and Soils

2.1.2.1. Soil Pedology/Geologic Development

The Chesapeake Bay drainage is located entirely within the Coastal Plain physiographic province; soils found in this province typically reflect their geologic origin. Coastal plain soils are primarily derived from parent materials containing fluviomarine sediments (e.g., medium to coarse sands containing pebbles, gravel, and other marine and alluvial sediments), with some soils overlain by loamy or windblown (eolian) silty sediments. Elevational differences between the northernmost and the southernmost portions of the drainage further contribute to the observed soil differences. For example, progressively older rock outcroppings are often encountered moving north as slopes become steeper and are subject to greater erosional forces that leave older rock formations exposed. Conversely, younger, sandier soils are often encountered moving south, as the topography slopes more gently. Older exposed rock formations are commonly used as the basis for mapping certain specific soil types in the northern portion of the drainage, while younger sandier sediments are commonly used as the basis for mapping specific soil types in the southern portion.

2.1.2.1. Soil Drainage Classes/ Hydric Soils

Soils in the Chesapeake Bay drainage – like soils everywhere - are generally classified into natural drainage classes on basis of their frequency, depth, and duration of soil saturation or wet periods. That is, soil drainage classes reflect a soils natural depth of wetness due to a seasonal high water table. Soil drainage classes are typically identified/assessed through visual observation of soil redoximorphic features (i.e., white or grey color soil color features that reflect the reduction of iron because of low oxygen concentrations due to saturated soil conditions) to determine and assess a saturated zone. Based on the observed depth to a saturated zone, seven classes of soil drainage are recognized– excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. Soil map units suggestive of wetlands – or, hydric- are typically in the poorly drained or the very poorly drained soil drainage classes. The remaining soil drainage classes are generally considered non hydric or upland. The identification of hydric soils is important because they are one of three key parameters (i.e., including hydrology and hydrophytic vegetation) used to delineate jurisdicational wetlands regulated by the Army Corps of Engineers. Wetland associated hydric soils are functionally important for maintaining or improving water quality by removing pollutants through sedimentation processes and denitrification. Therefore, protection of wetlands and hydric soils is essential for maintaining water quality in the Chesapeake Bay drainage. In the Chesapeake Bay drainage, hydric soil mapping units comprise approximately 40% of the total soil acreage.
The Chesapeake herein is further divided into the following five sub basins: Chester-Sassafras, Choptank, Nanticoke, Pocomoke and the Wicomico.

Chester-Sassafras sub basin – (Includes Elk Creek, C &D Canal West, Bohemia Creek, Sassafras and Chester River watersheds) - The Chester- Sassafras sub basin comprises about 9% of the total land area in the Chesapeake drainage. Approximately 64 percent of the sub basin is in New Castle county and the remaining 36% in Kent county. Hydric soil mapping units comprise approximately 39% of the sub basin's acreage. The Chester-Sassfras sub basin is further subdivided into subordinate sub basins as defined by the boundaries' of New Castle and Kent County.

New Castle County portion of the Chester-Sassafras sub basin – The northern portion of the Chester-Sassafras sub basin is located in New Castle County. Approximately 31% of the sub basin's total acreage is comprised of hydric soil map units. The primary hydric soil map units mapped here are Fallsington, Hammonton-Fallsington-Mullica complex, and Othello; collectively these map units comprise approximately 65% of the total hydric soil acreage. These soils have seasonal high water tables at or near the soil surface, and have moderate to slow water permeabilities with moderate to high runoff potentials. Topographically these map units typically occupy the lowest landscape positions, and contain landscape features such as depressions, swales, un-dissected flats, or drainage ways.

The most prominent non-hydric soil map units in the sub basin are Reybold, Woodstown, and Ingleside-Hammonton-Fallsington complex; collectively these soil map units comprise approximately 37% of the total acreage of non-hydric soils. These soils usually have seasonal high water tables above 20 inches, and have moderate water permeability rates with slight runoff potentials. Topographically these map units occupy well-dissected upland flats or terraces.

Kent County portion of the Chester-Sassafras sub basin – The southern portion of the Chester-Sassafras sub basin is located in Kent County. Approximately 53% of the sub basin's total soil acreage is comprised of hydric soil map units. Some of the major hydric soil map units mapped in this sub basin is Fallsington, Hurlock, and Longmarsh- Indiantown; collectively these map units comprise approximately 60% of the total acreage of hydric soils. These soils have seasonal high water tables at or near the soil surface, and have moderate to slow water permeabilities with moderate to high runoff potentials. Topographically these map units occupy the lowest landscape positions, often containing landscape features such as depressions, swales, un-dissected flats, or drainage ways.

The major non- hydric or upland soil mapping units mapped here are Hammonton, Ingleside, and Unicorn; collectively these map units comprise approximately 56% of the total acreage of non-hydric soils. These soils usually have a seasonal high water table above 20 inches, and have moderate to rapid soil permeabilies with slight runoff potentials. Topographically, these map units are found on well-dissected upland flats or terraces.

Choptank sub basin – The Choptank sub basin comprises about 25 percent of the greater Chesapeake drainage, and is entirely in Kent County. Approximately 34% of the sub basin's total soil acreage is comprised of hydric soil map units. The major hydric soil map units in the Choptank sub basin are Fallsington, Kentuck, and Longmarsh-Indiantown; collectively these map units comprise about 65 percent of the sub basins' total acreage of hydric soils. The soils in these map units have seasonal high water tables at or near the soil surface, and have moderate to slow water permeabilities with moderate to high runoff potentials. Topographically these map units occur in lower landscape positions, often containing landform features such as depressions, swales, un-dissected flats, or drainage ways.

The major non-hydric or upland soil map units mapped in the sub basin are Hambrook, Hammonton, and Woodstown; collectively these map units comprise about 38 percent of the total non-hydric soil acreage in the sub basin. The soils in these map units are typically moderately well to well drained and exhibit seasonal high water tables at soil depths usually greater than 20 inches. These soils also have moderate permeabilities with slight runoff potential. Topographically, these map units are found on well-dissected upland flats or terraces.

Nanticoke sub basin – The Nanticoke is the largest sub basin and comprises approximately 65 percent of the land area in the greater Chesapeake drainage. Most of the sub basin is in Sussex County. Approximately 43% of sub basin's total soil acreage is comprised of hydric soil map units. The most prominent hydric soil map units mapped in the Nanticoke sub basin are Fallsington, Hurlock, and Corsica; collectively these map units comprise about 62 percent of the total hydric soil acreage in the sub basin. These soils have seasonal high water tables at or near the soil surface, and have moderate to slow water permeabilities with moderate to high runoff potentials. Topographically, these soil map units typically occur in the lower landscape positions, often containing landscape features such as swales, un-dissected flats, or drainageways.

The primary non-hydric soil or upland soil map units in the sub basin are Pepperbox-Rosedale, Hammonton, and Evesboro; collectively these map units comprise approximately 40 percent of the total acreage of non-hydric soils in the sub basin. Moreover, these soils map units typically exhibit seasonal high water tables at soil depths greater than 20 inches from the soil surface, and have moderate to rapid water permeability with low to moderate runoff potentials. Topographically, these map units are found on higher landscape positions containing well-dissected upland flats or terraces.

Pocomoke sub basin – The Pocomoke sub basin comprises less than 1% (~.8%) of the land area in the greater Chesapeake drainage. Approximately 50% of the total soil acreage in the sub basin is comprised of hydric soil map units. The major hydric soil map units mapped in the Pocomoke sub basin are Hurlock, Askecky, and Mullica; collectively these map units comprise about 72% of the total hydric soil acreage. These soils typically have seasonal high tables at or near the soils surface, and have moderate to slow permeabilities with moderate to high runoff potentials. Topographically these map units are found in the lowest landscape positions, often containing landscape features that include depressions, swales, un-dissected flats, or drainage ways.

The major non-hydric soil or upland soil map units mapped in the Pocomoke sub basin are Klej, Klej-Galloway, and Rumford; collectively these soil map units comprise approximately 62 percent of the sub basins' acreage of hydric soils. Seasonal high water table are typically found at depths greater than 20 inches, and have moderate water pemeabilities with low to moderate runoff potentials. Topographically, these map units are found on higher landscape positions containing well-dissected upland flats or terraces.

Wicomico sub basin – The Wicomico is the smallest sub basin and comprises less than 1% (~.12%)of the total land area in the greater Chesapeake drainage. Approximately 48% of the total soil acreage in the Wicomico sub basin is comprised of hydric soil map units. The primary hydric soil map units in the Wicomico sub basin are Lenni, Fallsington, and Corsica; collectively these soil map units comprise approximately 79% of the sub basin's total acreage of hydric soils. These soils are poorly drained and have seasonal high water tables at or near the soil surface, and have moderate to slow water permeabilities with moderate to high runoff potentials. Topographically, these soil map units typically occur in the lower landscape positions, often containing landscape features such as swales, un-dissected flats, or drainageways.

The primary upland or non-hydric soil map units are Pepperbox-Rockawalkin, Keyport, and Woodstown; collectively these map units comprise approximately 50 percent of the sub basins' total acreage of upland soils. These soils typically have seasonal high water tables greater than 20 inches from the soil surface, and have moderate water pemeabilities with low to moderate runoff potentials. Topographically these map units are found on higher landscape positions containing well-dissected upland flats or terraces.

2.1.3. Land Use

Land use is important to consider when formulating an action plan to address nonpoint source pollution in the Chesapeake Bay Watershed. As water runs over the landscape, it picks up pollutants that are discharged into streams through runoff. Additionally, water runs through the soils, carrying pollutants with it into the groundwater. The polluted groundwater then seeps into the surface water, providing another conduit for nonpoint source pollution (Fetter, 1994). Thus, activities that occur on land impact the quality of both our ground and surface waters.

The Chesapeake Drainage within Delaware is predominantly rural (Figures 5 and 6). According to the 2007 Land Use and Land Cover (LULC) data, about 50% of the watershed is in agriculture, 40% is in natural lands uses of forests and wetlands, and 10% is developed (DOSPC, 2007). The towns are still relatively small, but growing. Over this time, agricultural practices as well as natural land covers like forests and wetlands have decreased. Agricultural uses have decreased by 42,305 acres, or 7.0%. Natural areas have decreased by 16,116 acres, 9.0%. During this same time period, there has been a steady increase in developed land uses, which include residential, commercial, and industrial areas. This portion of the landscape has increased by 35,346 acres since 1984, a 272% increase.

Given the large portion of the watershed engaged in agriculture, and the consistent growth in urban/residential acreage, this WIP can only be successful if agriculture is addressed and provisions are included to ensure that development occurs in a manner that is protective of surface and ground water quality.

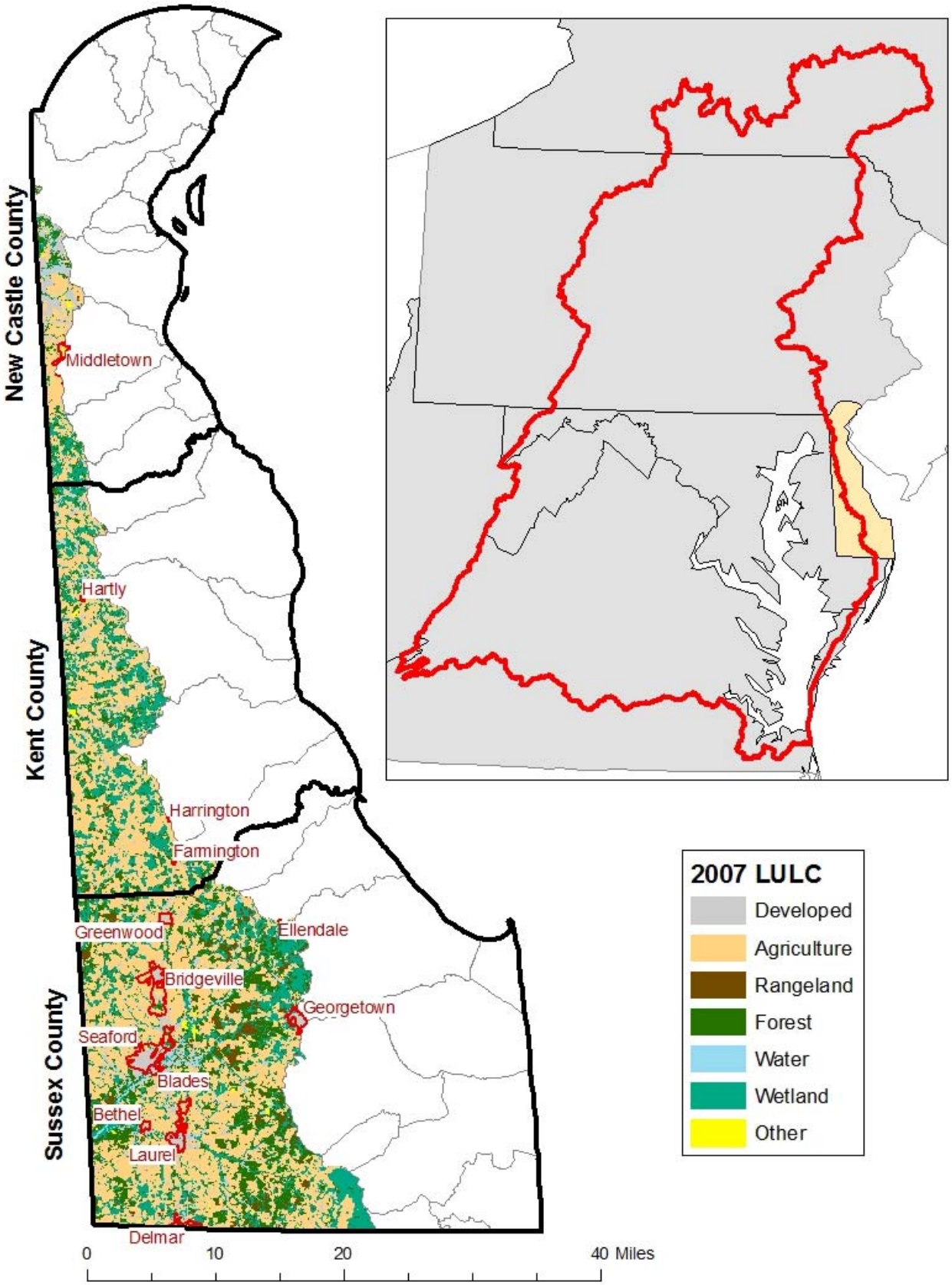


Figure 5: 2007 Land Use and Land Cover Data for the Chesapeake Drainage

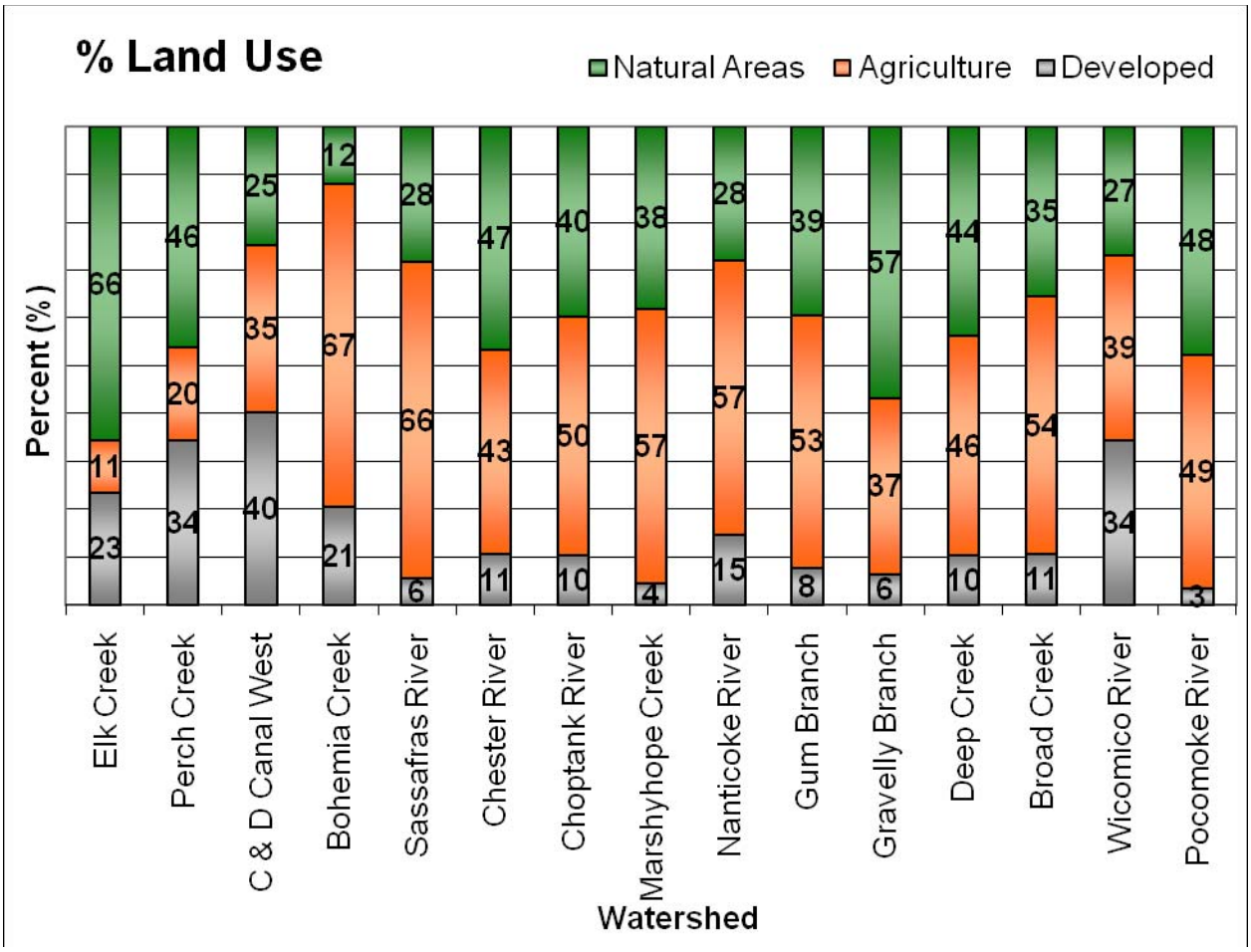


Figure 6: 2007 Land Use Percentages for Chesapeake Watersheds

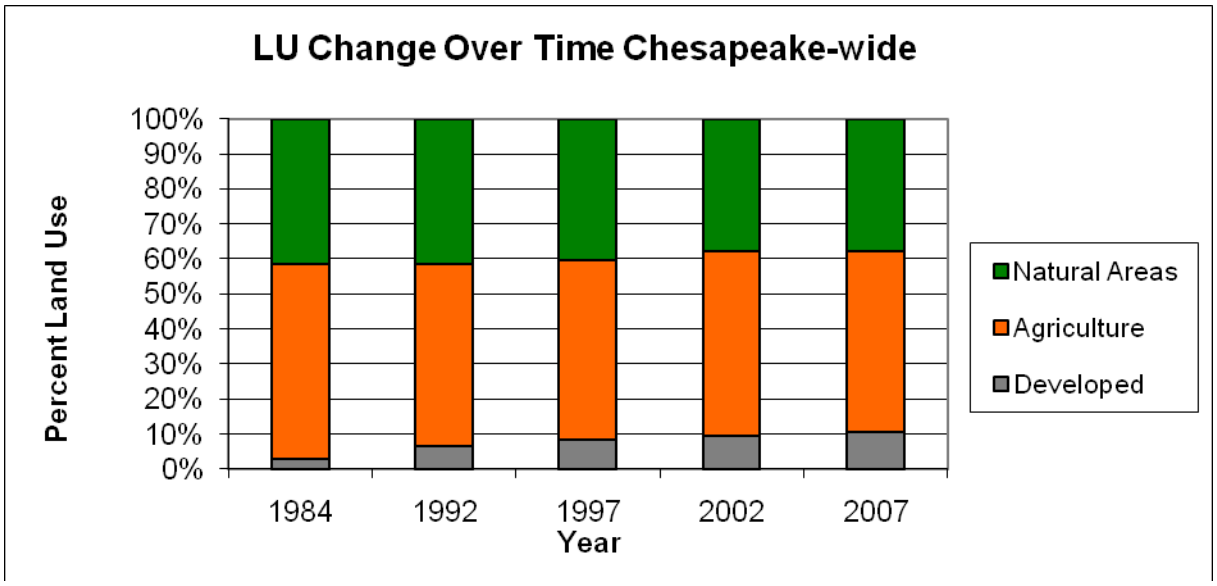


Figure 7: Land Use Changes Over Time in the Chesapeake Drainage

2.2. Water Quality in Delaware's Chesapeake Tributaries

Water quality of the Chesapeake Bay Watershed has been monitored for more than 25 years by federal, state, academic, and citizen monitoring groups.

Groundwater quality in the Chesapeake Bay Basin watershed has been highly impacted by agricultural activities in addition to residential and commercial development, including on-site wastewater (septic) discharges (Andres et al., 2007).

The surface waters (rivers, streams, and ponds) have been routinely monitored for many years. Intensive monitoring was conducted prior to TMDL model development, and sampling continues on at least a monthly basis at several locations. Collected data from this monitoring has revealed both nitrogen and phosphorus enrichment in the rivers, streams, and ponds of the Chesapeake (DNREC, 2010). Although nutrients are essential elements for plants and animals, their presence in excessive amounts can cause significant negative impacts to fish and other aquatic life (EPA, 2002).

Symptoms of nutrient enrichment can include excessive macroalgae growth, phytoplankton blooms (some potentially toxic), large daily swings in dissolved oxygen levels, loss of submerged aquatic vegetation (SAV), loss of aquatic habitat, and fish kills (EPA, 2002; Figure 8). These symptoms can be fatal to bay creatures, and pose a dire threat to the future of Delaware's Chesapeake tributaries, as well as the bay

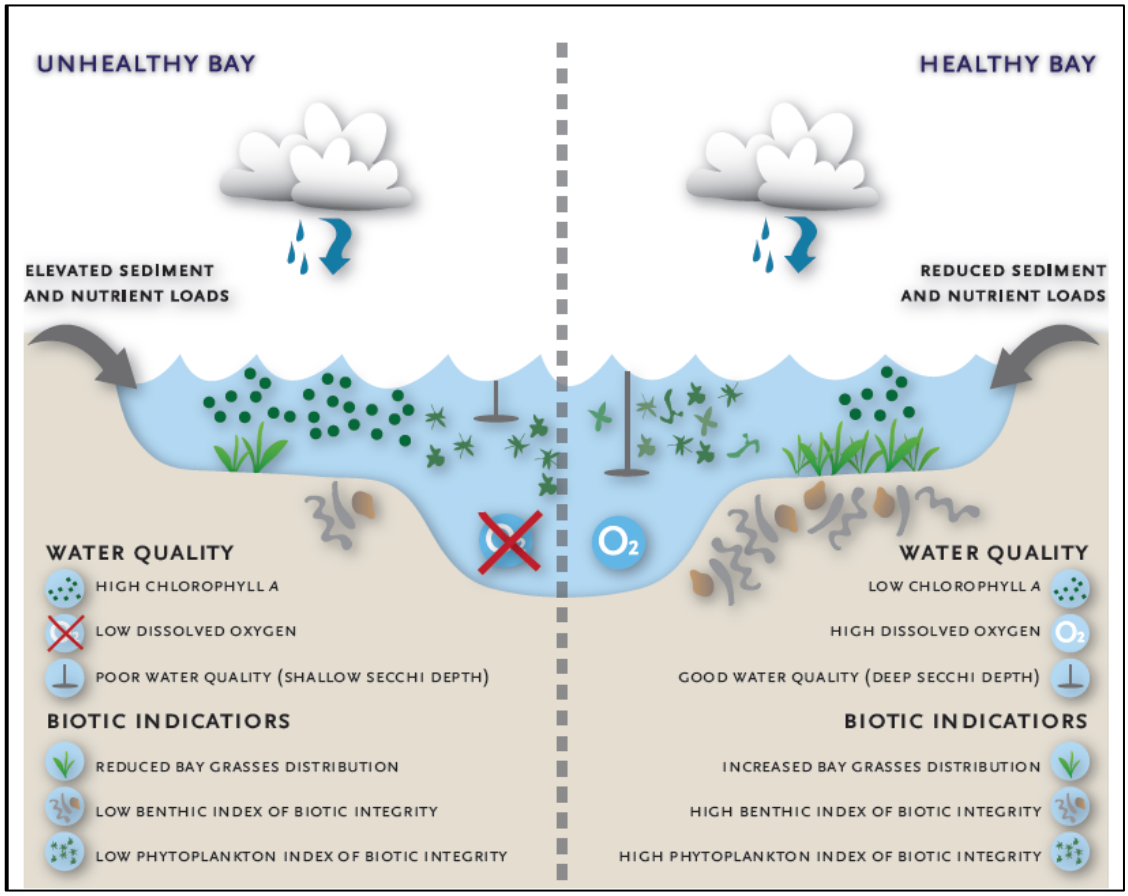


Figure 8: Comparison of good water quality versus poor water quality

itself. Not only is this a threat to the Bay as a significant natural, ecological, and recreational resource, it is also a threat to the Bay as a significant economical source. Local and State economies depend on the Bay to provide recreation, produce revenue, maintain property values, and improve quality of life. With the huge responsibility of maintaining people, animals, and plants living within the watershed, the Bay must be protected from further harm caused by excessive nutrients.

Furthermore, nutrient over-enrichment and violation of water quality standards have been documented by the State's Watershed Assessment Reports (305(b) Reports) and list of impaired waters (303(d) List) since 1996 (DNREC, 1996; DNREC, 1998a; DNREC, 2002; DNREC, 2004; DNREC, 2006a; DNREC, 2008, DNREC 2010). These reports summarize the designated uses for waters in the State and indicate whether those uses are being achieved. The designated uses for the waters of the Chesapeake are:

- Primary contact recreation,
- Secondary contact recreation,
- Fish, aquatic life, and wildlife (with special protection of open water fish and shellfish, shallow-water bay grass, and migratory fish spawning and nursery areas in the Nanticoke River and Broad Creek),
- Industrial water supply,
- Agricultural water supply (in some locations only in the freshwater segments), and
- Waters of Exceptional Recreational and Ecological Significance (ERES) in several watersheds of the Chesapeake (Figure 9). These waters are recognized as special natural assets of the State, and must be protected and enhanced for the benefit of present and future generations of Delawareans.

EPA has designated uses for tidal water, and they are:

- Migratory spawning and nursery (Feb. 1 – May 31),
- Open water (year-round)
- Shallow water (submerging aquatic vegetation growing season)

The designated uses must meet certain water quality criteria. When these criteria are not met, the waters are required to have Total Maximum Daily Loads (TMDLs) established. The primary pollutants and/or stressors causing violation of water quality standards in the Chesapeake are high concentrations of nutrients, low levels of dissolved oxygen, high levels of bacteria, and high water temperatures.

Pollutant loads to surface waters fall into two categories: point sources and nonpoint sources. A point source is a specific source, such as an effluent pipe. Specifically for Delaware's Chesapeake Basin, point sources include wastewater treatment plants. Nonpoint sources of pollution are more diffuse and harder to track. In Delaware, nonpoint source pollution occurs as a result of using land for agriculture or urban development, and includes runoff from fertilizers and leaching from septic systems. In these cases, nitrogen and phosphorus enter surface waters through groundwater discharges or overland runoff.

In the Chesapeake Bay watersheds, phosphorus is the nutrient most frequently found to limit plant growth in freshwater streams. Phosphorus contributes to eutrophication as it moves into surface waters through erosion, runoff, and subsurface flow in artificial drainage and groundwater discharge. Excessive accumulation of soil phosphorus must be minimized in order to reduce the transport of soluble or sediment bound phosphorus to sensitive water bodies. Compared to the amount found in fertilizers and required by crops, the amount of phosphorus that will impair water quality is very low (Sims and Campagnini, 2002).

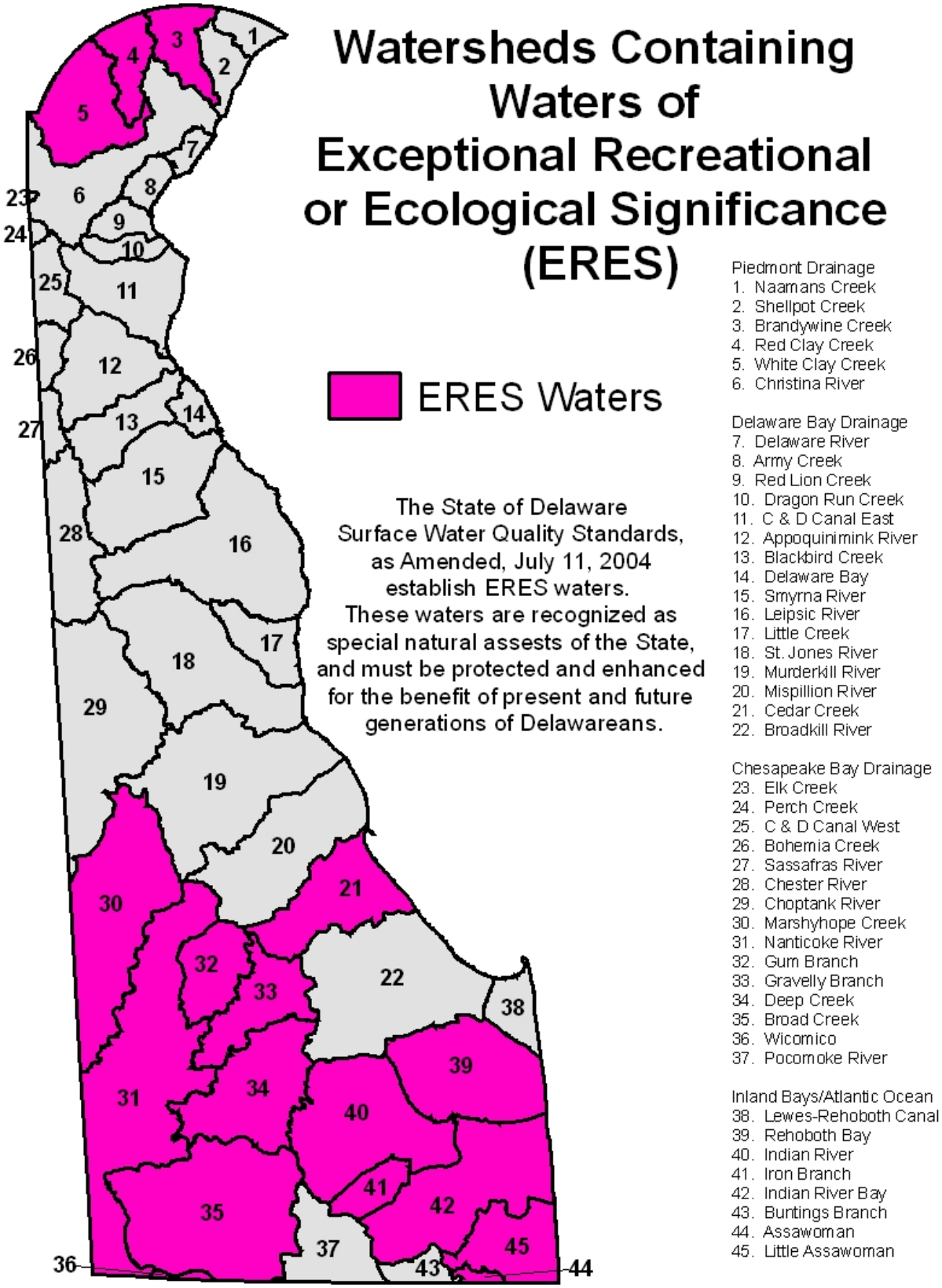


Figure 9: Waters of Exceptional Recreational and Ecological Significance (ERES)

Nitrogen can be transported from soils to ground water by leaching, and from soils to surface water by erosion or runoff. Nitrate leaching is a major concern in humid regions with excessively well-drained soils that overlay shallow water tables, conditions common throughout Delaware. Nitrate-contaminated water can be highly dangerous to people, plants, and animals. Drinking water with high nitrate levels has been associated with several health problems, the most serious being methemoglobinemia (deficiency of oxygen in blood) in infants. Additionally, ground water with high nitrate levels that discharge into sensitive surface waters can contribute to the long-term eutrophication of these water bodies. Erosion and surface runoff can transport soluble inorganic and organic nitrogen to surface water. Most of the nitrogen lost in this manner is sediment bound organic nitrogen. Although the solubility of nitrate favors its loss in runoff instead of sediment transport, total nitrogen losses are usually several times greater than soluble nitrogen (Sims and Campagnini, 2002).

According to EPA, the nitrogen, phosphorus, and sediment from Delaware make up 2%, 2%, and 0.8% of the total loads to the Chesapeake, respectively. Within the State, the nutrients and sediment primarily come from agricultural sources, which make up the largest portion of the landscape (Figures 10, 11, and 12).

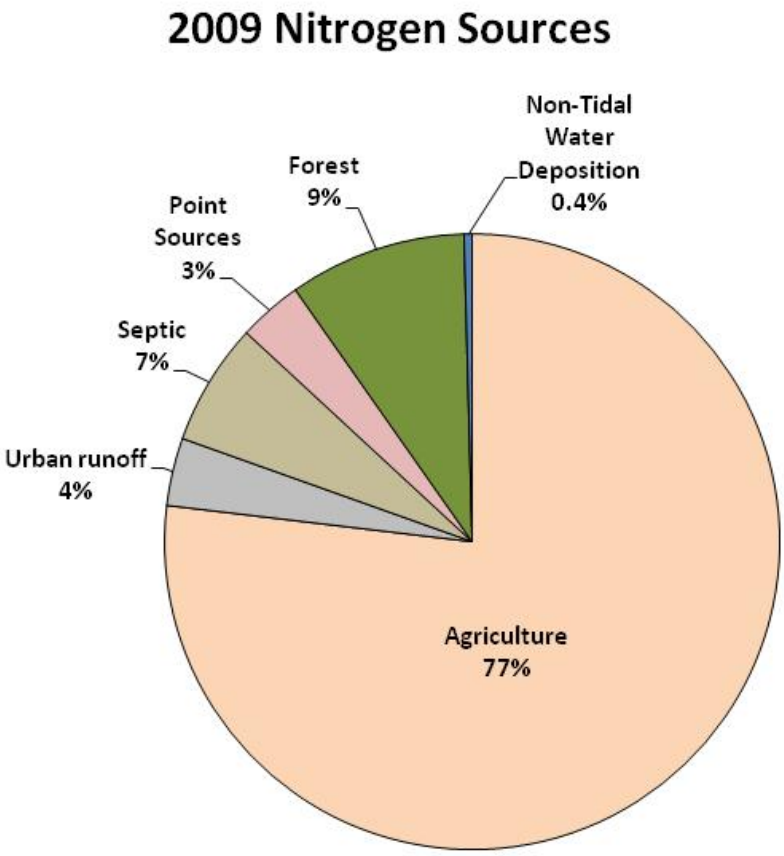


Figure 10: Sources of nitrogen loading in Delaware's Chesapeake calculated by EPA's Phase 5.3 model

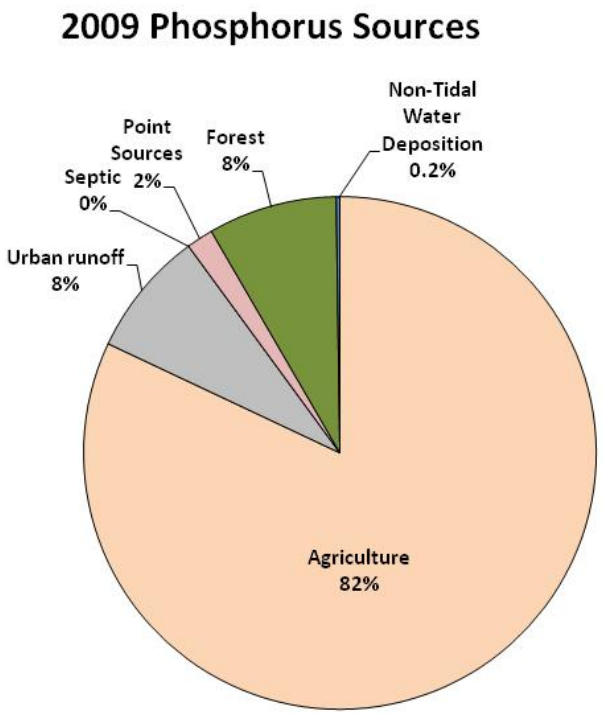


Figure 11: Sources of phosphorus loading in Delaware's Chesapeake calculated by EPA's Phase 5.3 model

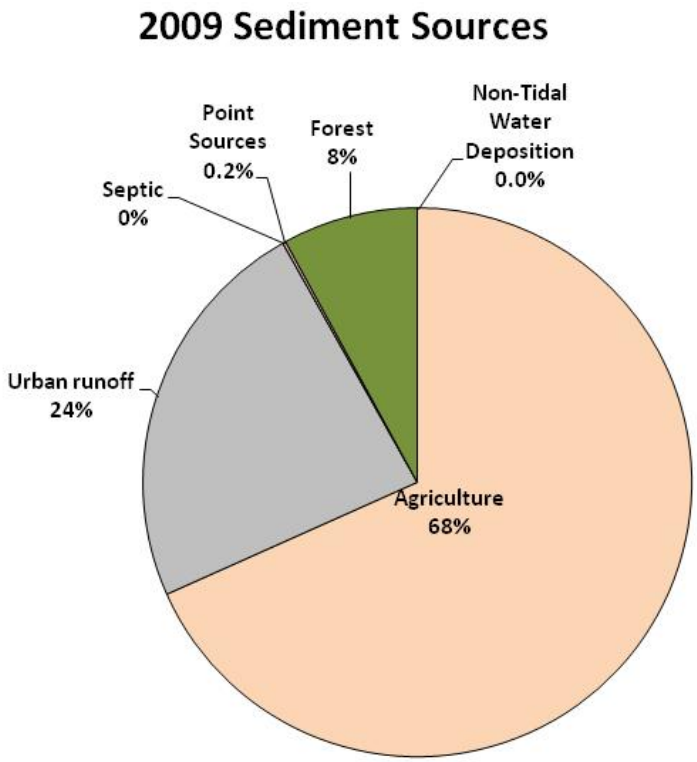


Figure 12: Sources of sediment loading in Delaware's Chesapeake calculated by EPA's Phase 5.3 model

2.3. Delaware's Total Maximum Daily Loads, Chesapeake Tributary Action Teams, and the Pollution Control Strategy Development Process

A TMDL sets a limit on the amount of pollution that can be discharged into a waterbody such that water quality standards can still be met. A non-scientific definition for TMDL could be "pollution limit." TMDLs consist of three parts: a wasteload allocation (WLA) for point sources, a load allocation (LA) for nonpoint sources, and a margin of safety (MOS).

$$TMDL = WLA + LA + MOS$$

2.3.1. Delaware's TMDLs

TMDLs were developed by DNREC in response to data collected from water quality monitoring. The data indicated that numerous streams within the Chesapeake were impaired; they do not meet Delaware's Water Quality Standards for dissolved oxygen, or meet target concentrations for nitrogen or phosphorus. These TMDLs include a waste load allocation (WLA) for point sources, a load allocation (LA) for nonpoint sources, and an implicit margin of safety.

DNREC TMDLs were established for nitrogen and phosphorus in the Nanticoke River watershed (including Gum Branch, Gravelly Branch, Deep Creek, and Broad Creek) in 1998 (DNREC, 1998b). This TMDL WLA requires the municipal wastewater treatment plants in the watershed (Bridgeville, Laurel, and Seaford) to employ biological nutrient reduction (BNR) or an equivalent process to reduce their total nitrogen (TN) and total phosphorus (TP) loads. To achieve this, facilities were upgraded and currently they are all operating below their TMDL permitted limits. The Invista industrial facility also had to reduce its nitrogen load as a result of this TMDL. The remaining point sources were capped at their baseline loads, and since the TMDL establishment, one has been eliminated and two have significantly decreased their discharges. The LA portion of this TMDL also requires a 30% reduction in the nonpoint source nitrogen load and a 50% reduction in the nonpoint source phosphorous load, both from the 1992 baseline levels.

DNREC TMDLs were also established for nitrogen and phosphorus in the Chester River, Choptank River, Marshyhope Creek (DNREC, 2006b), and Pocomoke River in 2006 (DNREC, 2006c). There are no point sources of pollution in these watersheds. These TMDLs called for nonpoint reductions ranging from zero to 55% for nitrogen and 25% to 55% for phosphorus (See Figures 13 and 14).

DNREC also established bacteria TMDLs in the Chesapeake watersheds in 2006 (DNREC, 2006d).

DNREC's TMDLs are designed to address local impacts by achieving Delaware's water quality standards and Maryland's standards at the state line, whereas the EPA TMDL that is being developed tracks nutrients from where they enter the system to assess their downstream impact on the main stem of the bay. Additionally, DNREC does not have water quality goals or TMDLs for sediment, so the EPA limits will be the first within the state. The TMDL that calls for the most stringent reductions will supersede the other.

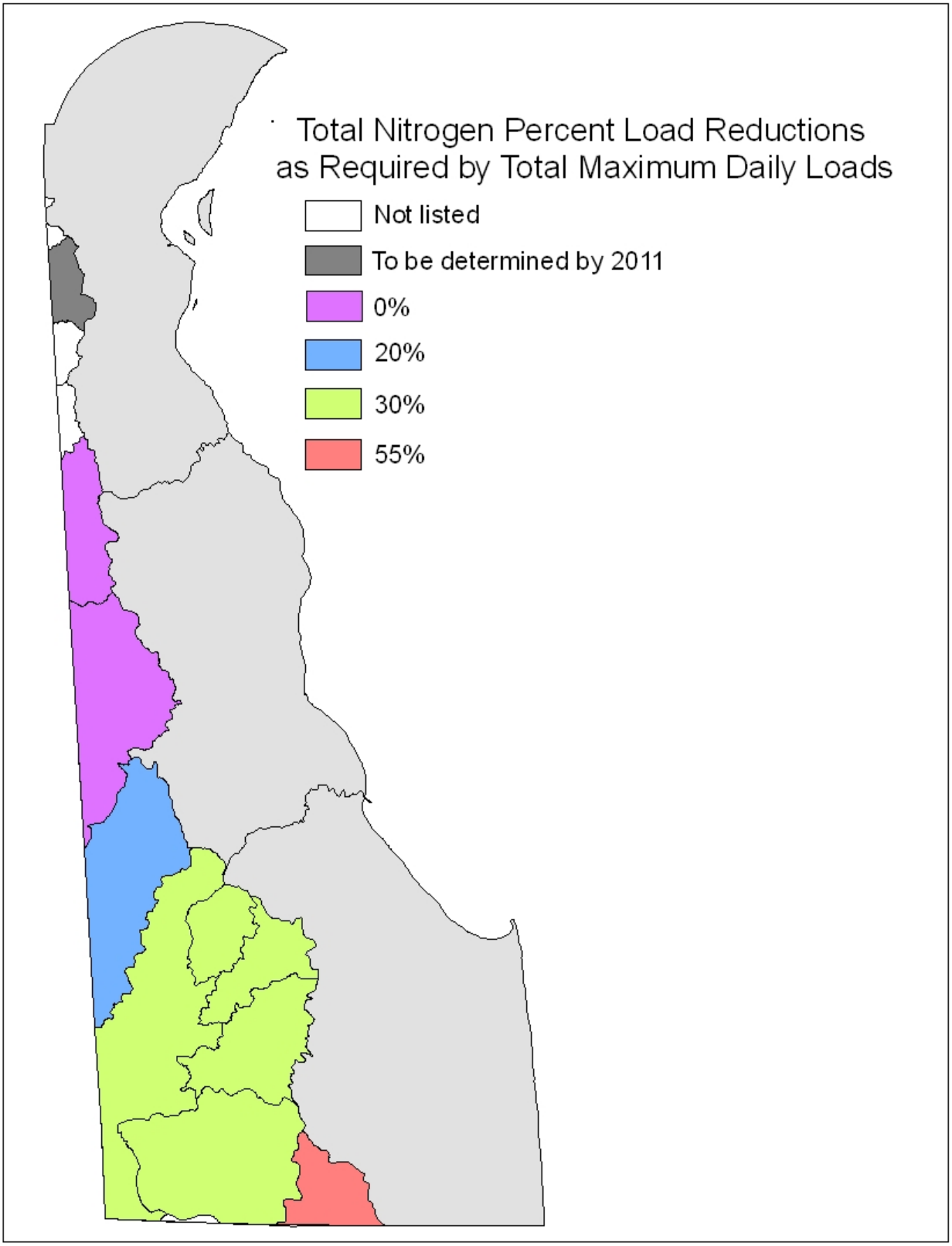


Figure 13: Nonpoint source nitrogen reductions required by DNREC TMDLs

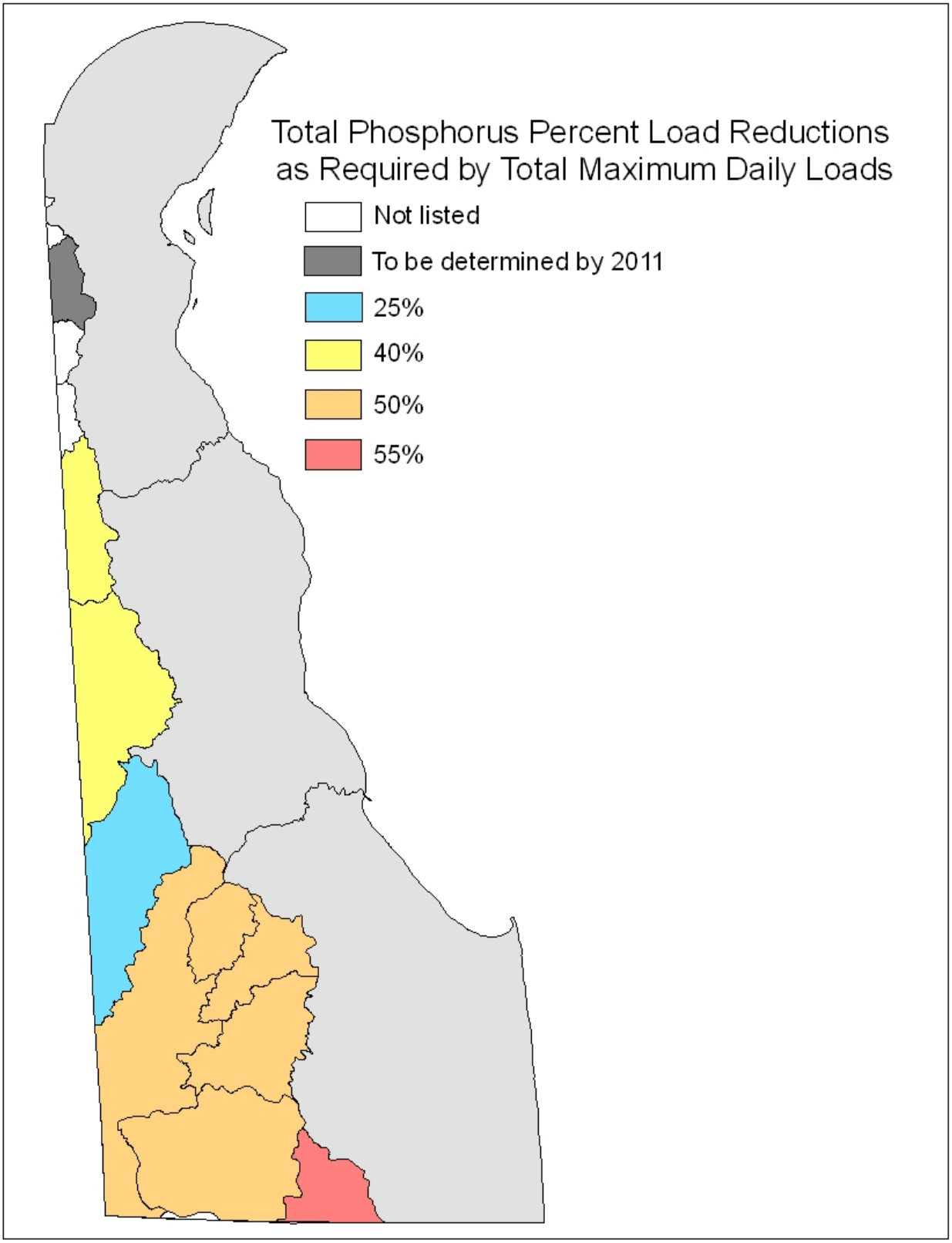


Figure 14: Nonpoint source phosphorus reductions required by DNREC TMDLs

2.3.2. Tributary Action Teams and Pollution Control Strategies

All DNREC TMDL regulations stipulate that nutrient reductions will be achieved through the development of a Pollution Control Strategy (PCS) developed by DNREC in concert with the affected public.

A PCS, similar to a Tributary Strategy, is a set of actions designed to improve water quality, and specifically achieve a TMDL. A PCS may include both voluntary and regulatory actions that can reduce pollution from current and future land practices. In Delaware, local Tributary Action Teams (TATs) are diverse groups of stakeholders with various interests, concerns, knowledge, and beliefs. They were formed to recommend PCS actions and best management practices (BMPs) appropriate for their own individual watersheds. In the Chesapeake there are two TATs: the Nanticoke TAT, which first began meeting in 1998, and the Upper Chesapeake TAT, which covers the Chester and Choptank watersheds and began meeting in 2007 (Figure 15). The Nanticoke TAT consists of farmers, developers, town managers, conservationists, and residents with homes along the tributaries of the Nanticoke River and tidal Broad Creek. The Upper Chesapeake TAT consists of tax ditch managers, local business owners, farmers, and community residents, including members of the local Amish community.

The process used by Delaware's TATs was based on "Public Take – Real Choices, Real Strategies," which was primarily designed by representatives from DNREC and the University of Delaware's Cooperative Extension Service and Marine Advisory Service, the Center for the Inland Bays (Appendix A). Using this form of public process, the public is brought together and given the opportunity to address the process in the beginning rather than at the end. The process includes six steps: organization of work teams; education; issue framing; evaluation of the issue framework; public forums/choice work; and recommendations. Once teams were formed, they identified common threads and core values to guide their work. During the education portion of the process, teams listened to presentations on multiple topics such as wastewater treatment plants, septic systems, stormwater, golf courses, and agriculture. Teams then worked through ranking priorities, gathering wider public input, and drafting recommendations for DNRECs consideration.

In Delaware's previous water quality improvement efforts, after the TMDL was developed, the implementation mechanism, the Pollution Control Strategy, was formulated. The current EPA TMDL approach requires the implementation mechanism – the Watershed Implementation Plan – to be identified during the TMDL development process. The PCS work that was started with Delaware's TATs in the Chesapeake has been reviewed, updated, and enhanced to better assist Delaware's WIP.

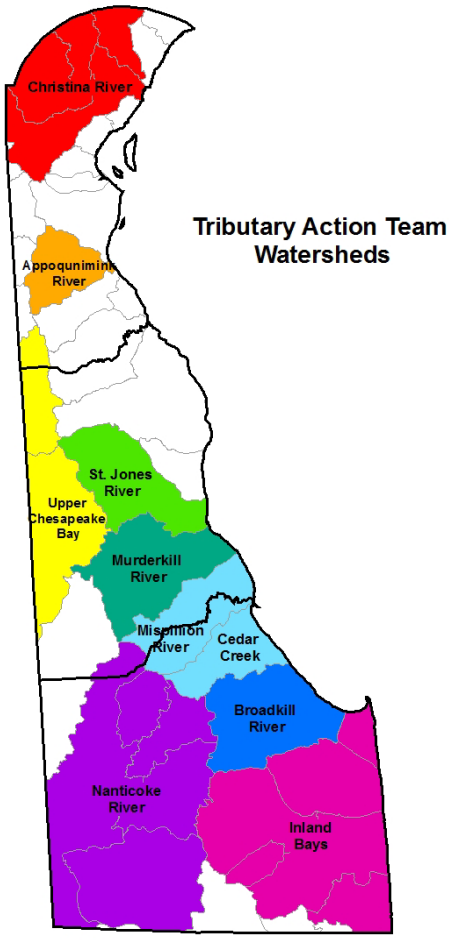


Figure 15: Tributary Action Teams in Delaware

2.4. EPA's Total Maximum Daily Loads

Below are excerpts from EPA's documentation regarding their TMDL for the Chesapeake Bay.

Since 2000, the seven jurisdictions in the Chesapeake Bay watershed (Delaware, District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia) and the U.S. Environmental Protection Agency, who along with the Chesapeake Bay Commission are partners in the Chesapeake Bay Program, have been planning for a Chesapeake Bay TMDL. Since September 2005, the seven jurisdictions have been actively involved in decision-making to develop the TMDL. In the October 2007 meeting of the Chesapeake Bay Program's Principals' Staff Committee, the jurisdictions and EPA agreed that EPA would establish the TMDL. Since 2008, EPA has sent official letters to the jurisdictions detailing all facets of the TMDL, including: schedules for developing the TMDL and pollution reduction plans, EPA's expectations and evaluation criteria for jurisdiction plans to meet the TMDL pollution limits, reasonable assurance for controlling nonpoint source pollution, and backstop actions that EPA could take to ensure progress.

The TMDL also resolves commitments made in a number of consent decrees, Memos of Understanding, and settlement agreements dating back to the late 1990s that address certain waters identified as impaired in the District of Columbia, Delaware, Maryland and Virginia. Additionally, President Obama issued Executive Order 13508 on May 12, 2009, which directed the federal government to lead a renewed effort to restore and protect the Chesapeake Bay and its watershed. The Chesapeake Bay TMDL is a keystone commitment in the strategy developed by federal agencies to meet the President's Executive Order.

The draft TMDL – the largest ever developed by EPA – includes pollution limits to meet water quality standards in the Bay and its tidal rivers. The TMDL is designed to ensure that all pollution control measures to fully restore the Bay and its tidal rivers are in place by 2025, with 60 percent of the actions completed by 2017. The final TMDL will be established December 31.

On July 1, EPA set draft Bay watershed limits for nitrogen and phosphorus at 187.4 million and 12.5 million pounds per year, respectively, and on Aug. 13 set a range of allowable sediment pollution levels at between 6.1 and 6.7 billion pounds per year. These pollution limits were further divided by jurisdiction and major river basin based on state-of-the-art modeling tools, extensive monitoring data, peer-reviewed science, and close interaction with state partners. The TMDL is supported by accountability measures to ensure cleanup commitments are met, including short-and long-term benchmarks, a tracking and accounting system, and additional federal backstop measures, if necessary, to spur progress.

More than 40,000 TMDLs have been completed across the United States, but the Chesapeake Bay TMDL will be the largest and most complex thus far – it is designed to achieve significant reductions in nitrogen, phosphorus and sediment pollution throughout a 64,000-square-mile watershed that includes the District of Columbia and large sections of six states. The TMDL is actually a combination of 92 smaller TMDLs for individual Chesapeake Bay tidal segments and includes pollution limits that are sufficient to meet state water quality standards for dissolved oxygen, water clarity, underwater grasses and chlorophyll-*a*, an indicator of algae levels. It is important to note that the pollution controls employed to meet the TMDL will also have significant benefits for water quality in the tens of thousands of streams, creeks and rivers throughout the region. EPA will establish the final Chesapeake Bay TMDL, after considering public comments and additional input from the jurisdictions, by December 31, 2010.

SECTION 3. DEVELOPMENT OF PHASE I WATERSHED IMPLEMENTATION PLANS AND PUBLIC PARTICIPATION

As part of the EPA TMDL, each jurisdiction is required to develop a Watershed Implementation Plan (WIP), similar to a PCS in that it details how load allocations will be achieved and maintained into the future. Additionally, jurisdictions will have to exhibit accountability by achieving 2-year milestone goals. This process differs from the process previously used in Delaware; DNREC had always been responsible for establishing a TMDL and then developing a PCS. The new approach requires the implementation mechanism to be identified during the TMDL development process. This approach potentially provides EPA with more assurance that jurisdictions have considered their current capacity and future needs. This approach also provides a certain level of assurance to EPA that implementation plans will be developed and executed in a timely manner; however, the success still largely depends on the inclusion of stakeholders throughout the process.

3.1. WIP Development Schedule

Since developing WIPs is a large process that involves a lot of coordination and communication, EPA has allowed the jurisdictions to adopt a three-phase approach (Table 2). Draft Phase I WIPs are to be submitted by September 1, 2010 and Final Phase I WIPs by November 29, 2010. Phase II WIPs in draft and final forms are due to EPA by June 1 and November1, 2011, respectively. Phase III WIPs must be received by EPA in 2017 and will describe refined actions and controls to be implemented between 2018 and 2025 to achieve WQS. With each successive WIP, the detail at which allocations are made will become increasingly specific.

Table 2: Comparison of elements within the Chesapeake Bay TMDL and Phase I, II, and III WIPs

Topic	Bay TMDL	Phase I WIP	Phase II WIP	Phase III WIP
Individual or Aggregate WLAs and LAs to Tidal States	x			
Gross WLAs and Las for Non-Tidal States if those States Submit WIPs that meet EPA Expectations	x			
Loads for individual significant point sources, or, where appropriate, aggregate point sources		x	x	x
Loads for nonpoint source sectors		x	x	x
Proposed actions and, to the extent possible, specific controls to achieve point source and nonpoint source target loads		x	x	x
Point source and nonpoint source loads by local area			x	x
Specific controls and practices to be implemented by 2017		To possible extent	x	
Refined point source and nonpoint source loads				x
Specific controls and practices to be implemented by 2025				x

3.2. Eight Elements of a WIP

EPA identified eight elements that they expect each jurisdiction to address in their WIPs (Table 3).

Table 3: Eight Elements of a WIP

Element	Description
1. Interim and Final Nutrient and Sediment Target Loads	WIPs are expected to subdivide Interim and Final target loads by pollutant source sector within each of the 92 areas draining to Section 303(d) tidal water segments, and identify the amount and location of loads from individual or aggregate point sources and nonpoint source sectors (Phase I).
2. Current Loading Baseline and Program Capacity	WIPs are expected to include evaluation of current legal, regulatory, programmatic, financial, staffing, and technical capacity to deliver the target loads established in the TMDL (Phase I).
3. Accounting for Growth	WIPs are expected to describe procedures for estimating additional loads due to growth and provide EPA with information to inform additional pollution load reductions that are at lease sufficient to offset the growth and development that is anticipated in the watershed between 2011 and 2025.
4. Gap Analysis	WIPs are expected to identify gaps between current state capacity (Element 2) and the capacity needed to fully attain the Interim and Final nutrient and sediment target loads for each of the 92 drainage areas for impaired segments of the Bay TMDL (Element 1).
5. Commitment and Strategy to Fill Gaps	WIPs are expected to include a proposed strategy to systematically fill the gaps identified in Element 4 (Phase I).
6. Tracking and Reporting Protocols	WIPs are expected to describe efforts currently underway or planned to improve transparent and consistent monitoring, tracking, reporting, and assessing of effectiveness of implementation actions.
7. Contingencies for Slow or Incomplete Implementation	If the proposed strategies outlines in Element 5 are not implemented, WIPs are expected to provide for alternative measures resulting in equivalent reductions and an indication of what such contingencies might entail.
8. Appendix with Detailed Targets and Schedule	WIPs are expected to include detailed Interim and Final load targets for each tidal Bay segment drainage area, source sector, and local area (after November 2011) in an Appendix, with a reduction schedule comprising the two-year target loads at the scale of each major basin within a State or the District. The two-year target loads allow EPA to assess whether future two-year milestones are on schedule to meet interim and final water quality goals.

3.3. Consequences and Contingencies

If jurisdictions fail to develop their WIP or meet their 2-year milestone goals, EPA has identified a set of potential consequences to impose. These consequences include the possibility of EPA instituting backstop allocations, taking over responsibility for developing WIPs, and EPA increasing their regulatory oversight and extending their regulatory authority to additional sources of pollution. EPA may deny National Pollutant Discharge Elimination System (NPDES) permits or require additional reductions from regulated sources, increase and target federal enforcement and compliance, and expand NPDES coverage to currently unregulated sources. Examples of currently unregulated sources in many locations include Concentrated Animal Feeding Operations (CAFO) in the agriculture community and Municipal Separate Stormwater Systems (MS4s) in the developed community. Additionally, EPA may condition or redirect grant funds the states rely on to implement voluntary cost-share programs. Considering the potential consequences, jurisdictions must not only identify actions that are immediately available for them to implement, but also identify contingencies. These contingencies include additional actions that they may have to turn to if the original actions are not successfully implemented, or do not result in the anticipated nutrient and sediment reductions.

Following Delaware's Draft Phase I WIP submission on September 1, 2010, EPA reviewed the document and determined that "serious deficiencies" existed. Most specifically, the specific actions that the WIP identified did not go far enough to achieve the necessary load reductions for nitrogen and phosphorus. EPA identified several areas related to wastewater treatment plants, municipal stormwater, and concentrated animal feeding operations that they are prepared to institute backstop allocations for if this final Delaware Phase I WIP is unsuccessful in closing the gaps. During the fall of 2010, significant revisions to the draft WIP have occurred in order to minimize the need for any EPA backstop allocations. According to preliminary model runs, this final version of Delaware's Phase I WIP will meet the numeric loading requirements established by EPA and every effort has been made to provide reasonable assurance in a qualitative fashion in this text.

3.4. Delaware's Chesapeake Interagency Workgroup

The public plays a crucial role in the development of the Chesapeake WIP. There are numerous stakeholders in the Chesapeake drainage in Delaware. Because most of the land area is used for agriculture, area farmers are especially concerned about implications of new or revised agriculture requirements and goals. Developers, landowners, and local governments are interested in how a Chesapeake TMDL and WIP affect opportunities for growth. Existing homeowners have concerns about requirements for on-site wastewater treatment and disposal systems and their ability to fertilize their yards and gardens. Additionally, environmentalists are interested in how the State is going to address environmental issues. The public also includes long-time citizens of the area, ample in experience and advice on what they have seen, and what they would like to see in the future for Delaware's portion of the Chesapeake.

In order to achieve these requirements and an aggressive schedule, DNREC has convened the Chesapeake Bay Interagency Workgroup made up of representatives from each DNREC Division, Department of Agriculture, Department of Transportation, Office of State Planning Coordination, County Conservation Districts, US Department of Agriculture, and other stakeholders. The Interagency Workgroup first met in January 2010.

Within the Workgroup, eight subcommittees have been formed to address: Agriculture; Stormwater; Wastewater; Land Use and Comprehensive Plans; Restoration; Public Lands; Funding; and Information Technology. A ninth subcommittee focused on communication has also been developed. Subcommittees have been tasked with recommending and reviewing sub-allocating methodologies to the various point and nonpoint sources within the basins, assessing current data tracking and reporting systems, determining maximum implementation goals and methods to fill program and funding gaps, and assisting with writing and providing information for the WIP. Subcommittees have been and will continue communicating proposed actions to respective stakeholder groups, and soliciting their input on WIP elements. Since January 2010, the subcommittees have been meeting routinely, or as needed, to accomplish these tasks.

Each subcommittee of the Chesapeake Interagency Workgroup has focused on developing a particular section of the WIP. The general composition of each subcommittee is provided at the beginning of each section, and a list of the individuals that participated in each group can be found in Appendix B.

3.5. Presentations to Stakeholder Groups and the Public

Several Interagency Workgroup subcommittees invited additional stakeholders to participate during the development of the draft Phase I WIP. Other presentations outside of subcommittee meetings also occurred prior to the submission of the Draft Phase I WIP on September 1, 2010. These presentations included:

- Delaware's Nonpoint Source Annual Committee Meeting – March 18, 2010
- Clean Water Advisory Council Meeting – June 16, 2010
- EPA TMDL Webinar – July 8, 2010
- Delaware Nutrient Management Commission Meeting – 7/13/10
- Delaware Farm Bureau Board – 8/12/10

Over the course of five weeks following the submission of the Draft WIP on September 1, 2010, Interagency Workgroup members traveled throughout Delaware, meeting with town and stakeholder groups, presenting Delaware's Draft Plan (Table 4). To make the lengthy WIP document more accessible to the public, a presentation was put together that summarized the main sections of the WIP: Wastewater, On-Site Wastewater, Stormwater, Land Use, Agriculture, Restoration, and Public Lands. The presentation also covered important points of interest, including the purpose of the WIP, the value of the Chesapeake Bay, the causes and sources of pollutants entering the Chesapeake Bay, the Chesapeake Bay TMDL, the impact Delaware specifically has on Chesapeake Bay water quality, Delaware's future load allocations, the process of implementing the WIP, and the consequences set by EPA for missing water quality goals.

During the meetings, particular issues of high concern for the various stakeholders present were also addressed. After the presentations, questions and concerns were answered and discussed. Stakeholders were given the opportunity to submit further questions and comments in writing by October 31, 2010, to be answered by relevant subcommittee members. Many responses have been received from stakeholders, and DNREC is currently in the process of providing responses.

EPA presented the TMDL at a public meeting and webinar on Monday, October 11, 2010 from 5-7pm at the Delaware Technical and Community College, Owens Campus, Arts and Science Center, Theatre, in Georgetown, Delaware. Delaware presented its WIP at this meeting as well.

Week 1	9/21/2010 9:00 AM	Town of Laurel
	9/21/2010 11:00 AM	Town of Blades
	9/22/2010 12:00 PM	Town of Delmar – in Dover
	9/23/2010 11:00 AM	City of Seaford
	9/23/2010 1:30 PM	Town of Georgetown
	9/23/2010 3:00PM	Town of Bridgeville
	9/23/2010 4:00 PM	Positive Growth Alliance Board and Interested Members - Lewes
	9/23/2010 7:30 PM	Sussex Conservation District Board - Georgetown
Week 2	9/27/2010 10:00 AM	Sussex County Administrator and staff - Georgetown
	9/27/2010 2:00 PM	Town of Greenwood
	9/28/2010 3:00 PM	Sussex County Association of Realtors - Georgetown
	9/29/2010 10:00 AM	Environmental, Watershed, Land Group Presentation - Dover
	9/30/2010 3:00 PM	Kent County - Dover
Week 3	10/6/2010 6:00 PM	Nanticoke Tributary Action Team - Seaford
	10/6/2010 2:00 PM	Agriculture Stakeholder Meeting - Georgetown
	10/7/2010 6:30 PM	Upper Chesapeake Tributary Action Team - Marydel
Week 4	10/11/2010 ALL DAY	EPA meets with agriculture, local government, and homebuilder stakeholder groups during the day and presents TMDL to Delaware public at 5:00PM
Week 5	10/20/2010	Delaware On-site Wastewater Recycling Association Conference - Dover

Table 4: Stakeholder Meetings Schedule

SECTION 4. INTERIM AND FINAL NUTRIENT AND SEDIMENT LOAD TARGETS

The nutrient and sediment loads in Table 5 below have been allocated to the State of Delaware. The nitrogen and phosphorus loads were released by EPA on July 1, 2010 and the sediment loads were released August 15, 2010. These loads will be distributed among the various point and nonpoint sources of pollutants according to the specifications outlined in the following sections.

Table 5: Interim and Final Nutrient and Sediment Loads from DE

	Nitrogen Load (million pounds/year)	Phosphorus Load (million pounds/year)	Sediment Load (tons/year)
2009 Load	4.18	0.32	32,269
2017 Interim Load (60% of 2025 Load)	3.44	0.28	30,254-31,989
2025 Final Load	2.95	0.26	28,911-31,803
% Reduction between 2009 and 2025	29%	18%	1-10%

4.1. Process for Developing WLAs and LAs

The April 2, 2010 Guidance from EPA, specifically Appendices 1 and 2, was consulted to sub-allocate the above loads between the various point and nonpoint sources. Each Chesapeake Interagency Workgroup subcommittee representing a source sector contributed to the process. The Wastewater Subcommittee recommended wasteload allocations for the major and minor municipal and industrial wastewater treatment plants, the Stormwater Subcommittee recommended a policy for assigning all stormwater related loads to the wasteload allocation, and the Agriculture Subcommittee provided information and guidance on allocating loads from animal operations between those that are regulated (receiving a wasteload allocation) and those that are not (receiving a load allocation).

4.2. Waste Load Allocations or Practices to Include in Permits

4.2.1. Wastewater

4.2.1.1. Significant Wastewater Facilities

The waste load allocations for the significant wastewater facilities in Delaware's portion of the Chesapeake can be found in Table 6 below. The table includes the permitted design flow, proposed concentrations, and corresponding annual loads for Total Nitrogen (TN), Total Phosphorus (TP), and Total Suspended Solids (TSS).

Significant municipal wastewater facilities have a design flow greater than or equal to 0.4 million gallons per day. Significant industrial wastewater facilities have total nitrogen loadings of 27,000 pounds per year, and 3,800 pounds per year for total phosphorus.

Table 6: Wasteload Allocations for Significant Wastewater Facilities

CB 303(d) Seg	NPDES	Outfall	Flow (mgd)	BOD5 (mg/l)	Total Nitrogen		Total Phosphorus		Total Suspended Solids	
					Conc. (mg/L)	WLA (lb/year)	Conc. (mg/L)	WLA (lb/year)	Conc. (mg/L)	WLA (lb/year)
NANTF_DE	DE0020249 – Bridgeville (1)	001	0.8	12	4.0	9,747	1.0	2,437	15	365,000
NANTF_DE	DE0020125 – Laurel (1)	001	0.7	8.7	4.0	8,529	1.0	2,132	15	32,210
NANTF_DE	DE0020265 – Seaford (1)	001	2.0	12	4.0	24,367	1.0	6,092	8.0	49,275
NANTF_DE	DE0000035 – Invista (2)	011	16.4	3.0	3.44	172,000	0.0	0	15	2,053
Subtotal						214,643		10,661		448,538

(1) Flow is based on current design; BOD5 is based on current flow limit and BOD5 load limit; TN and TP are based on current flow limit and proposed concentrations of 4.0 mg/L TN, and 1.0 mg/L TP.
(2) Flow is average for 2009; BOD5 based on current BOD5 load limit and average 2009 flow; TN conc. based on 60% reduction from current permitted load and ave. 2009 flow; TP is a net load.

4.2.1.2. Non-significant Municipal Facilities

The waste load allocations for the non-significant municipal facility in Delaware's portion of the Chesapeake can be found in Table 7 below. The table includes the permitted design flow and concentrations for Total Nitrogen (TN), Total Phosphorus (TP), and Total Suspended Solids (TSS).

Table 7: Wasteload Allocations for Non-Significant Municipal Facilities

CB 303(d) Seg	NPDES	Outfall	Flow (mgd)	BOD5 (mg/l)	Total Nitrogen		Total Phosphorus		Total Suspended Solids	
					Conc. (mg/L)	WLA (lb/year)	Conc. (mg/L)	WLA (lb/year)	Conc. (mg/L)	WLA (lb/year)
NANTF_DE	DE0050725– Mobile Gardens (1)	001	0.06	15	13.2	2,414	1.8	322	15	1,096
Subtotal						2,414		322		1,096

(1) Flow is based on current design; BOD5 is based on current flow limit and BOD5 load limit; TN and TP are based on current flow limit and load limits from the Nanticoke TMDL.

4.2.1.3. Non-significant Industrial Facilities

The waste load allocations for the non-significant industrial facility in Delaware's portion of the Chesapeake can be found in Table 8 below. The table includes the permitted design flow and concentrations for Total Nitrogen (TN), Total Phosphorus (TP), and Total Suspended Solids (TSS).

Table 8: Wasteload Allocations for Non-Significant Industrial Facilities

CB 303(d) Seg	NPDES	Outfall	Flow (mgd)	BOD5 (mg/l)	Total Nitrogen		Total Phosphorus		Total Suspended Solids	
					Conc. (mg/L)	WLA (lb/year)	Conc. (mg/L)	WLA (lb/year)	Conc. (mg/L)	WLA (lb/year)
NANTF_DE	DE0050971–BASF (1)	001	0.8	0	2	2,234	0.0	0	4.0	4,891
Subtotal						2,234		0		4,891

(1) Flow is based on current design; BOD5 is based on current flow limit and BOD5 load limit; TN and TP are based on current flow limit and load limits from the Nanticoke TMDL.

4.2.2. Stormwater (Construction, Post-Construction, MS4, and Industrial)

In the EPA Memorandum dated 22 November 2002, the Appendix regarding establishment of a TMDL Waste Load Allocation (WLA) is cited. It is clear that the intent of the EPA was to ensure the regulated point-source discharges within an MS4 would be addressed by the WLA component of a TMDL. The memo also stated that stormwater discharges from sources not regulated by the National Pollutant Discharge Elimination System (NPDES) program may be addressed by a load allocation component of a TMDL. This seems not to rule out the possibility that a non-NPDES regulated stormwater discharge could also be addressed by the WLA component. This is the strategy that Delaware would like to use in the Chesapeake WIP for issues related to stormwater from developed and developing urban and suburban lands.

When land is developed, the construction phase of that development is regulated by an NPDES Construction General Permit until the site is stabilized and completed. That stormwater discharge would be a WLA for the TMDL in that watershed. The post-construction stormwater discharge from these developed lands would still be counted as a WLA for the following reasons:

- Only a small land area in Delaware, and a much smaller land area in the Chesapeake, is subject to an MS4 permit program requirement. However, Delaware has statewide requirements for all land development, including post constriction stormwater runoff, to meet requirements for water quality. These state regulations are currently being revised to reflect the need to meet the TMDL load reductions whether in an MS4 or not.
- Many of the developed areas in the state discharge to a publically owned drainage or stormwater conveyance system even outside the current MS4 areas. This seems to be one of the criteria EPA uses for determining if a stormwater discharge is regulated. If the goal is to be consistent with

determining types of stormwater discharges associated with various runoff conditions, there is no difference between the runoff from a developed area within the MS4 and outside the MS4.

- It will be much easier and much more consistent to apply the WLA uniformly across all urban and suburban lands because Delaware regulates land development of all types in all areas. The land uses will be broken down between commercial or non-residential and residential, establishing specific strategies to reach the target load reductions. These lands will be further broken down to those that were developed before 1991 when the Delaware stormwater regulations became effective and the lands developed under the current regulations and those lands that will be developed under future regulations.

Delaware is planning to have all of the urban/suburban lands and the stormwater discharges associated with them (construction, post-construction, MS4, and industrial) addressed by the WLA component of the TMDL for the Chesapeake Bay watershed. Table 9 shows the wasteload allocations for regulated stormwater. The values below are the delivered loads determined by Chesapeake Bay Program modeling following the September 1, 2010 Draft Phase I WIP and will be updated pending model outputs of the Finall Phase I WIP.

Table 9: Wasteload Allocations for Regulated Stormwater

CB 303(d) Seg	Total Nitrogen	Total Phosphorus	Total Suspended Solids
	WLA (lb/year)	WLA (lb/year)	WLA (tons/year)
ELKOH	2,216	336	19
C&DOH_MD	15,455	2,419	200
C&DOH_DE	5,969	983	89
BOHOH	5,124	864	40
SASOH	271	47	4
CHSTF	1,416	286	61
CHOTF	3,591	1,078	234
NANOH	4,168	972	264
NANTF_DE	89,614	15,592	6,073
POCTF	1,096	329	41
WICMH	1,927	338	65
Subtotal	130,846	23,242	7,088

4.2.3. Concentrated Animal Feeding Operations (CAFOs)

Delaware has estimated the number of animal operations within the Chesapeake and provided EPA with the number by subwatershed that should be considered an AFO and those that should be a CAFO. EPA will calculate the loads from the CAFO operations and include them as a WLA. Table 10 shows the wasteload allocations for regulated agriculture. The values below are the delivered loads determined by Chesapeake Bay Program modeling following the September 1, 2010 Draft Phase I WIP and will be updated pending model outputs of the Finall Phase I WIP.

Table 10: Wasteload Allocations for Regulated Agriculture

CB 303(d) Seg	Total Nitrogen	Total Phosphorus	Total Suspended Solids
	WLA (lb/year)	WLA (lb/year)	WLA (tons/year)
ELKOH	-	-	-
C&DOH_MD	-	-	-
C&DOH_DE	-	-	-
BOHOH	-	-	-
SASOH	-	-	-
CHSTF	571	55	-
CHOTF	1,960	203	0
NANOH	2,240	214	0
NANTF_DE	10,353	875	0
POCTF	543	55	-
WICMH	33	3	-
Subtotal	15,701	1,405	0

4.2.4. Resource Extraction

Resource extraction is not considered to be a significant source in Delaware; all current active borrow pit areas have been designed to have zero discharge. If a new facility is proposed for the future with a potential water discharge, an industrial discharge permit would be required and captured under the industrial permit category.

4.3. Load Allocations

Tables 11-13 below show the load allocations by 303(d) segment and source sector. The values below are the delivered loads determined by Chesapeake Bay Program modeling following the September 1, 2010 Draft Phase I WIP and will be updated pending model outputs of the Finall Phase I WIP. These load allocations have been determined through supplying the EPA-Chesapeake Bay Program watershed model with best management practice implementation scenarios that are expected to occur by 2025. The load reductions resulting from the implementation of these practices reduces the loads from each contributing segment to the values found in the tables below.

According to preliminary model runs, the final version of Delaware's Phase I WIP will meet the numeric loading requirements established by EPA and every effort has been made to provide reasonable assurance in a qualitative fashion in this text.

Table 11: Nitrogen Load Allocations (lbs/year)

CB 303(d) Seg	Agriculture	Unregulated Stormwater	Septic	Forest	Non-Tidal Water Deposition	Subtotal
ELKOH	512	-	4,772	2,109	-	7,393
C&DOH_MD	24,417	-	14,100	5,375	195	44,087
C&DOH_DE	11,189	-	1,828	3,073	705	16,795
BOHOH	29,916	-	4,883	3,976	150	38,925
SASOH	24,778	-	2,380	5,066	9	32,233
CHSTF	86,161	-	13,555	23,202	190	123,108
CHOTF	205,733	-	25,160	42,516	460	273,870
NANOH	275,038	-	20,185	57,488	408	353,120
NANTF_DE	1,559,277	-	170,841	250,225	16,775	1,997,119
NANTF_MD	7	-	26	54	-	87
POCTF	80,484	-	3,845	18,003	17	102,348
WICMH	2,234	-	1,086	1,097	-	4,417
Subtotal	2,299,747	-	262,663	412,184	18,910	2,993,504

Table 12: Phosphorus Load Allocations (lbs/year)

CB 303(d) Seg	Agriculture	Unregulated Stormwater	Septic	Forest	Non-Tidal Water Deposition	Subtotal
ELKOH	82	-	-	145	-	227
C&DOH_MD	3,203	-	-	370	11	3,584
C&DOH_DE	1,477	-	-	212	41	1,729
BOHOH	3,898	-	-	273	9	4,179
SASOH	3,239	-	-	344	1	3,584
CHSTF	11,209	-	-	1,796	12	13,017
CHOTF	29,715	-	-	3,701	33	33,449
NANOH	29,399	-	-	4,173	16	33,588
NANTF_DE	119,530	-	-	14,698	619	134,847
NANTF_MD	1	-	-	3	-	4
POCTF	7,294	-	-	1,267	1	8,561
WICMH	155	-	-	68	-	223
Subtotal	209,200	-	-	27,051	741	236,992

Table 13: Sediment Load Allocations (tons/year)

CB 303(d) Seg	Agriculture	Unregulated Stormwater	Septic	Forest	Non-Tidal Water Deposition	Subtotal
ELKOH	6	-	-	8	-	13
C&DOH_MD	295	-	-	27	-	322
C&DOH_DE	137	-	-	16	-	153
BOHOH	191	-	-	11	-	202
SASOH	229	-	-	19	-	249
CHSTF	1,044	-	-	153	-	1,197
CHOTF	2,354	-	-	324	-	2,678
NANOH	2,274	-	-	398	-	2,672
NANTF_DE	8,448	-	-	1,850	-	10,297
NANTF_MD	0	-	-	0	-	0
POCTF	130	-	-	42	-	173
WICMH	3	-	-	4	-	6
Subtotal	15,111	-	-	2,852	-	17,962

4.4. Temporary Reserve

Since the watershed model will be refined during Phase II WIPs in 2011, EPA expects the jurisdictions to incorporate a 5% Temporary Reserve into final Phase I WIPs. Depending on the results of the 2011 model refinements, the temporary reserve will be revised or removed as appropriate during the Phase II WIP development process.

Using the 2025 final load values in Table 5 above, the following additional pollutant reductions are needed to achieve the 5% reserve: 147,523 pounds/year for TN (or 2025 load goal of 2,802,940 pounds/year for TN); 13,091 pounds/year for TP (or 2025 load goal of 248,721 pounds/year for TP); and 1,446-1,590 tons/year sediment (or 2025 load goal of 27,465-30,213 tons/year for TSS).

According to preliminary model runs, Delaware's Final Phase I WIP will result in the following pollutant loads: 2,857,645 pounds/year TN; 230,551 pounds/year TP; and 21,365 tons/year for TSS. Therefore, the actions identified in Delaware's best management practice scenario input decks for 2025 achieve the temporary reserve for both phosphorus and sediment, since loads have been reduced further than the targets with the reserve. For nitrogen, the 2025 target has been achieved, but with only a 3% reserve, rather than a 5% reserve. Delaware has made every effort to provide reasonable assurance in a qualitative fashion in this text and has identified contingency actions to account for the entire 5% reserve.

Additionally, Delaware would like to point out the limitations and uncertainty of the modeling as well as the fact that numerous practices that likely result in nutrient and sediment reductions have not been incorporated into the model yet. Some of these issues include:

- Delaware utilizes phosphorus based nutrient management plans which are not expressly modeled;
- Heavy Use Area Protection Pads are used at many poultry operations but not given credit as a BMP in the model;

- The model groups stormwater BMPs into several broad categories and modeling of more specific types of practices may be more appropriate;
- Source reduction (hydrology) BMPs for the urban stormwater environment should be more specifically modeled;
- Several different types on onsite wastewater treatment and disposal systems are currently in use throughout Delaware, and perform better than the generic type of onsite systems captured in the watershed model however, these types of systems are not currently incorporated into the model;
- Many voluntary practices have not been captured in the model and will not be able to be captured in the model until it is recalibrated, which is not anticipated to be done until 2017.

For all of these reasons and the additional reasonable assurance and contingency actions outlined in the following sections, Delaware feels that although the entire 5% temporary reserve has not been achieved for nitrogen, adequate reductions and assurances have been achieved. The numbers are estimates and balance and consideration should be given to the narrative report. Therefore, Delaware respectfully requests that EPA approve this Final Phase I WIP as proposed.

4.5. Interim Load Reductions

EPA also expects the Final Phase I WIP to identify the load reductions that Delaware will achieve every two years, beginning in 2011 on a major basin, or in Delaware's case a state-wide, basis. Additionally, in 2017, EPA is requesting that the loads be broken down by sector.

Implementation rates will vary across source sectors. Delaware is proposing to allow the wastewater treatment plant point sources to increase their loads over time by allowing the facilities to grow to their current permitted volume capacity. This increase in loads will occur gradually over time and depends on the economy and local growth patterns. Growth projections by both EPA and the University of Delaware project growth to occur at a relatively steady rate between 2010 and 2017 and 2025 in Delaware's portion of the Chesapeake.

The Agriculture Subcommittee believes implementation of practices in the agriculture sector and hence their load reductions will be steady, or linear, over time. Since several agriculture best management practices result in land conversion, the loads from forested and natural areas will increase at the same rate due to the land use conversions. The Stormwater Subcommittee anticipates that reductions of loadings from the existing urban runoff lands, which will result from redevelopment and retrofit opportunities as they occur, are likely to be slow in the near term and accelerate in the future (depending on the availability of funds for retrofit projects and the cost-effectiveness of those projects); however for this analysis, a linear reduction is assumed and will be modified during Phase II of the WIP.

For onsite wastewater treatment and disposal (septic) systems, the rates of implementation must be collectively considered for three different practices. First, several thousand existing septic systems are expected to be eliminated between now and 2025; the majority (70%) will likely occur by 2017. Second, a statewide pump-out and inspection program will be instituted in 2011 and reductions from this program will be steady over time. Finally, advanced treatment will be required (pending passage of a new regulation) for onsite systems within a certain proximity to tidal waters and associated tidal wetlands when those systems fail beginning in 2017, so reductions resulting from this practice will not occur until further in the future. Taken together, reductions from existing septic systems will likely occur steadily over time.

Given that Delaware is dependent on the actions of the jurisdictions to our west with respect to reductions associated with nontidal water deposition, it is difficult to predict how and when these reductions will occur. Until better information is provided, a linear reduction is assumed.

The tables below show the nitrogen, phosphorus, and sediment loads between 2009 and 2025. The 2009 values were calculated by the watershed model as a progress run. The 2025 values were calculated based on the information provided in this Final Phase I WIP and the input decks that were submitted for modeling purposes. The total loads for each year between 2011 and 2023, as well as the source sector loads in 2017 (shown in italics), were estimated using linear interpolation.

Table 14: Total Nitrogen Two-Year Milestone Loads (lbs/year)

TN (lbs/yr)	Point Source	Agriculture	Urban Runoff	Septic	Forest	Non-Tidal Water Deposition	All Sources
2009	140,173	3,211,127	148,088	266,930	394,536	18,664	4,179,517
2011							*4,014,686*
2013							*3,782,956*
2015							*3,584,675*
2017	*189,208*	*2,408,328*	*135,832*	*229,598*	*404,617*	*18,812*	*3,386,394*
2019							*3,254,207*
2021							*3,122,020*
2023							*2,989,832*
2025	221,899	1,873,128	127,661	204,709	411,338	18,910	2,857,645

Table 15: Total Phosphorus Two-Year Milestone Loads (lbs/year)

TP (lbs/yr)	Point Source	Agriculture	Urban Runoff	Septic	Forest	Non-Tidal Water Deposition	All Sources
2009	5,330	258,874	25,022	-	25,659	730	315,614
2011							*302,854*
2013							*290,095*
2015							*277,335*
2017	*8,723*	*206,510*	*22,353*	-	*26,254*	*736*	*264,576*
2019							*256,070*
2021							*247,563*
2023							*239,057*
2025	10,985	171,601	20,574	-	26,651	740	230,551

Table 16: Total Suspended Solids Two-Year Milestone Loads (tons/year)

TSS (tons/yr)	Point Source	Agriculture	Urban Runoff	Septic	Forest	Non-Tidal Water Deposition	All Sources
2009	58	22,044	7,593	-	2,574	-	32,269
2011							*30,633*
2013							*28,998*
2015							*27,362*
2017	*269*	*16,328*	*6,497*	-	*2,633*	-	*25,727*
2019							*24,636*
2021							*23,546*
2023							*22,456*
2025	409	12,517	5,767	-	2,673	-	21,365

It should be noted that the annual loading values shown by source sector in 2017 and 2025 are only appropriate when assuming 2010 land use stays the same, which is obviously not going to be the case. As land use changes from agriculture to developed, more of the nonpoint load will come from those developed source sectors (urban runoff, septic). The total load or the load per acre in those years, however, will not increase as a result of the offset program that is slated to be developed. It is Delaware's understanding that analyses using the Chesapeake Bay Programs land use and population change model for 2017 and 2025 will be done during Phase II of the WIP and modifications to the tables above will be made upon considering the results of those analyses.

SECTION 5. WASTEWATER

The Wastewater Subcommittee of Delaware's Chesapeake Interagency Workgroup assembled this section of the WIP. Members of the Wastewater Subcommittee have positions within DNREC, and come from both the Groundwater Discharges Section and Surface Water Discharge Section. With respect to wastewater treatment facilities, they have experience in National Pollutant Discharge Elimination System (NPDES) permits for municipal and industrial wastewater discharges and point source discharge TMDL compliance.

5.1. Current Programs and Capacity

For wastewater treatment plants identified in the WIP as currently having nutrient and sediment loads in the Chesapeake, 100% of operations or known sources subject to NPDES regulations have permits. Under both state and federal laws and regulations, any discharge of pollutants from a point source to state surface waters is unlawful unless sanctioned by a permit. Such permits are administered under the NPDES program. The fundamental goal of an NPDES permit is just that, to eliminate discharge of pollutants. Section 402 of the federal Clean Water Act, as amended, and the Delaware Code of Law, Title 7, Part VII, Chapter 60, "Environmental Control," provide the authority for Delaware's NPDES permits. Federal and state regulations promulgated pursuant to these statutes are the regulatory bases for permit issuance. The U.S. EPA has delegated its authority to administer the federal NPDES permit program in Delaware to the State of Delaware, with the exception of pre-treatment and federal facilities.

The entire major" and half of "minor" permitted wastewater facilities are inspected and audited on an annual basis by the Division of Water, Surface Water Discharges Section Compliance and Enforcement Branch. For wastewater treatment plants, penalties for non compliance include but are not limited to: manager's warning letter, notice of violation (NOV), and Secretary Order. Wastewater treatment plants cannot be issued a cease and desist to shut down.

5.1.1. Surface Water Discharges Section

The Surface Water Discharges Section (SWDS) regulates point sources of pollution, which include municipal and industrial wastewater treatment systems and their construction, biosolids applications, and stormwater discharges associated with industrial activities. This section also provides support to the Board of Certification for Wastewater Operators, where technical assistance is provided directly to wastewater treatment facilities to assist with facility operations. The SWDS is responsible for eliminating pollutant discharges into State surface waters by issuing regulatory permits under the National Pollutant Discharge Elimination System (NDPES). An NPDES permit legally sanctions the discharge of substances that may become pollutants. However, the NPDES permit is designed to limit the discharge of those substances so that there will be no adverse effect on the quality of the receiving waters, or interference with the designated uses of those waters. The health of a water body is measured by its attainment of designated uses. If potential pollutants in a NPDES discharge are reduced to levels that allow receiving waters to meet applicable designated uses, then, in effect, the pollutant discharge has been eliminated. Municipal sewage treatment or industrial plants that discharge wastewater to surface waters of Delaware are issued permits specifying discharge limitations, monitoring requirements, and other terms and conditions that must be met. In addition to wastewater, wastewater facilities often generate a waste sludge solid that is also an NPDES discharge under federal and State regulations.

The SWDS is supporting the development of the Chesapeake Bay WIP in two separate teams; Stormwater and Wastewater. Representing SWDS for the Wastewater team is Tony Hummel who is an Engineer IV with vast experience in wastewater treatment plants, effluent monitoring and advanced wastewater treatment systems. The SWDS contains five branches: the Compliance and Enforcement Branch, Wastewater Residuals Branch, Storm Water Branch, the Discharges Permits Branch, and Wastewater Facilities Construction Branch.

The Compliance and Enforcement Branch conducts assessments of wastewater treatment facilities to ensure compliance with applicable permits and recommends enforcement as necessary in order to protect surface water quality. The Branch is also the liaison to the Wastewater Operator Board of Certification responsible for the issuing of Wastewater Operator Licenses.

The Wastewater Residuals Branch is responsible for the Biosolids Program. The Biosolids Program issues permits and ensures compliance for the Land Application and the Distribution & Marketing of Biosolids. In addition this Branch is also responsible for the Concentrated Animal Feeding Operations (CAFO) regulation which is administered in cooperation the Delaware Department of Agriculture (DDA).

The Storm Water Permit Branch is responsible for the National Pollutant Discharge Elimination System (NPDES) permitting and compliance of industrial stormwater, Phase I permits, Phase II permits, and MS4s. In addition this Branch is also responsible for the General NPDES permit program for Aquatic Pesticide applications scheduled to be promulgated in April 2011.

The Discharges Permits Branch is responsible for reviewing, writing, and issuing NPDES permits (Non Storm Water Permits).

The Wastewater Facilities Construction Branch conducts the review of plans and issues permits for the construction of wastewater collection, transmission and treatment systems.

5.1.2. The Compliance and Enforcement Response Guide

This guide was developed primarily to assist DNREC managers and staff in developing comprehensive compliance assurance strategies and in designing appropriate case-specific enforcement strategies. Its publication will also serve to inform the regulated community, elected officials and general public about the manner in which the Department intends to conduct its compliance and enforcement activities.
The Guide establishes a framework for the Department's compliance and enforcement activities by setting forth the goals, principles and processes. Its development was the result of an internal review to improve the consistency, efficiency, and effectiveness of its enforcement activities and to promote a centralized process for coordination on air, waste, water, and other environmental violations.

This guide is in the process of being updated by the Compliance and Enforcement Response Guide Workgroup. A revised version will be available in October of 2010.

5.2. Accounting for Growth

Growth is expected across the Chesapeake, impacting communities with wastewater treatment systems. Short term growth for Seaford and Laurel may be accommodated within the proposed loads, however, longer term growth will be problematic for these communities without significant treatment plant upgrades.

Growth for Bridgeville can be accommodated within the proposed loads though plant upgrades and/or increasing the amount land applied effluent. Although the facility exceeds the proposed loads for TN, the department is committed to working with the Town to find solutions. Until plant upgrades occur or additional lands can be identified for spray irrigation, the Department will work with Bridgeville to increase land application in an effort to meet the nutrient allocations under the WIP. All of these communities have communicated with DNREC that significant financial hardship will result if unfunded upgrades are mandated or required.

The proposed TN Load for Invista is based on a 60% reduction from their current permitted load which was based on the Nanticoke TMDL. This load should accommodate any anticipated growth for the facility. Mobile Gardens and BASF loads are insignificant, and are proposed to remain at their current permitted levels for both TN and TP.

Tables 17-19 below show the difference between current loads and proposed loads for the six wastewater facilities in Delaware's Chesapeake drainage: Bridgeville Sewage Treatment Plant (STP), Laurel STP, Seaford STP, Invista, Mobile Gardens, and BASF. In each table, the actual loads are based on the maximum loads from recent discharge monitoring report (DMR) values. Proposed nutrient loads for Bridgeville, Laurel and Seaford are based on the current flow limit and proposed concentrations of 4.0 mg/L TN and 1.0 mg/L TP. Proposed nutrient loads for Invista are based on a 60% reduction from the current permitted TN load and the current permitted net load for TP. Proposed nutrient loads for Mobile Gardens and BASF are based on the current NPDES Permit Effluent Limitations. Proposed TSS loads for all facilities are based on the current NPDES Permit Effluent Limitations.

Table 17: Current and Proposed Total Nitrogen (TN) Loads (lbs/year) and Room for Growth

NPDES Permit Number	Facility Name	Annual TN Load		
		Actual	Proposed	Difference
DE0020249	Bridgeville STP	19,237	9,747	(- 9,490)
DE0020125	Laurel STP	6,653	8,529	1,876
DE0020265	Seaford STP	18,065	24,367	6,302
DE0000035	Invista	110,067	172,000	62,213
DE0050725	Mobile Gardens	813	2,414	1,601
DE0050971	BASF	0	2,234	2,234

Table 18: Current and Permitted Phosphorus (TP) Loads (lbs/year) and Room for Growth

NPDES Permit Number	Facility Name	Annual TP Load		
		Actual	Proposed	Difference
DE0020249	Bridgeville STP	3,918	2,437	(-1,481)
DE0020125	Laurel STP	1,256	2,132	876
DE0020265	Seaford STP	4,562	6,092	1,530
DE0000035	Invista	0	0	0
DE0050725	Mobile Gardens	248	322	74
DE0050971	BASF	0	0	0

Table 19: Current and Permitted Total Suspended Sediment (TSS) Loads (lbs/year) and Room for Growth

NPDES Permit Number	Facility Name	Annual TSS Load		
		Actual	Proposed	Difference
DE0020249	Bridgeville STP	5,630	365,000	359,370
DE0020125	Laurel STP	3,335	32,210	28,875
DE0020265	Seaford STP	5,165	49,275	44,110
DE0000035	Invista	395	2,053	1,658
DE0050725	Mobile Gardens	181	1,277	1,096
DE0050971	BASF	0	4,891	4,891

Local water quality will be maintained and local TMDLs will be met despite these anticipated new or increased loads from point sources. The increasing loads from wastewater treatment plants will be routinely monitored through DMRs, which are submitted monthly and reviewed by compliance staff. Current standards dictate that any issues found must be remedied within five days of discovery.

As growth occurs and the volume and loading from the facilities nears the levels proposed above, one of two scenarios are likely to play out. The facilities may include or transition to spray irrigation of their wastewater, which in Delaware, is considered a beneficial reuse. Alternatively, the facilities can engage in some sort of credit exchange program, which is currently being investigated and developed in the State.

5.3. Gap Analysis

For WWTPs, the compliance and participation rates are at 100%, and are actively being maintained. No additional regulatory or enforcement authorities are needed to meet these compliance and implementation rates. There is currently a mandate to submit water quality data. Existing benchmarks are being modified into stricter, more heavily enforced limits.

Currently, all of the major and half of the minor permitted wastewater facilities are inspected/audited on an annual basis by the Division of Water, Surface Water Discharges Section, and Compliance and Enforcement Branch. The recent hiring of a full time permit writer puts Section staffing at a level that is sufficient to keep up with permit issuance demands. With the additional workload of the NPDES Pesticides General Program and the Chesapeake TMDL the Section will make minimum progress on the current permit backlog. The Section applied for and received funding from the Chesapeake Bay Regulatory and Accountability Program Grant which in part will be used to hire a seasonal employee. The new employee will be utilized to offset the workload from the Pesticides General Program which will in turn allow the Section to reduce permit backlog.

5.4. Strategy to Fill Gaps

For WWTPs, there are few modifications planned for existing regulatory programs concerning additional nutrient and sediment reductions. There are no plans to modify permitting strategies for WWTPs; however, there is a backlog that needs to be addressed to catch up statewide. Staff and funds are needed to

complete this task. The permit renewal dates for the NPDES wastewater facilities in the Chesapeake can be found in Table 20.

The significant municipal facilities are currently permitted at 5.6-8 mg/L TN and 1.43-2 mg/l TP. The SWDS intends to reduce the permitted loads based on concentrations of 4.0 mg/L TN and 1.0 mg/L TP and the current design flows. Future increases in flow via growth will require facility upgrades which will present significant financial hardships for the affected communities without external financial assistance. The only non-significant municipal facility is Mobile Gardens MHP. Current permit limits for the facility are 13.2 mg/L TN and 1.8 mg/L TP. SWDS intends to maintain the permitted concentrations and resulting loads based on the current design flows. Future increases in flow will be addressed by maintaining current loads while tightening concentration limits. Mobile Gardens has rapid infiltration basins (RIBs) and uses a stream discharge as a back-up if needed.

For Invista, the significant industrial facility, the current permitted nitrogen load will be reduced by 60% during fall 2010-winter 2011 to achieve additional nutrient reductions by replacing the current large plant with a package plant. The non-significant industrial facility, BASF, will also be allowed to maintain its existing permitted loads to account for growth.

Compliance/participation rates for WWTPs do not need to be improved, as they are currently at satisfactory levels. For the Bay jurisdiction to ensure timely permitting and eliminate backlogs, the industrial stormwater and biosolids regulations will undergo revisions starting in 2011. The Chesapeake Regulatory & Accountability grant provided by EPA is helping to fund these efforts.

Monitoring requirements have not been consistent at all facilities and that will be addressed during future permit revisions. For example, dissolved oxygen is monitored at Bridgeville (DO permit limits also), Laurel, Invista, and Mobile Gardens, but it is not required at Seaford or BASF. Nutrient species monitoring is also inconsistently required. Bridgeville's permit requires monitoring of Total Kjeldahl Nitrogen (TKN) and Ammonia Nitrogen, but no other nutrient species monitoring is required by any other permit. Industrial WWTP monitoring and reporting will be also required by permits in the future.

Table 20: NPDES Permit Renewal Dates

Facility	Renewal Date
BASF	31 January 2011
Invista	31 August 2011
Bridgeville	31 January 2012
Mobile Gardens	31 March 2013
Seaford	31 May 2013
Laurel	31 May 2014

5.5. Contingencies

If compliance rates with regulatory programs are not achieved, enforcement actions will be taken. If other sectors are not able to produce needed reductions, the Department may consider requiring the wastewater treatment plants to upgrade to ENR (Ecological Nutrient Removal) (4mg/L TN; 1 mg/L TP) or better (3 mg/L; 0.3 mg/L TP) by 2025. Currently, DNREC does not believe this is necessary, as the municipal

facilities have already upgraded to BNR (Biological Nutrient Removal) or equivalent. Also, the current strategy accommodates for growth, and any additional improvements would require securing funding first. There is a need for State and Federal funding resources to include grants to make upgrades to existing facilities affordable for the local communities.

5.6. Tracking and Reporting Protocols

The SWDS currently uses the Permit Control System to track wastewater facility permitted loads and will transition to the Integrated Compliance Information System (ICIS) along with EPA ICIS. Therefore, the tracking and reporting system for wastewater facilities is transparent, accessible, and compatible with EPA decision support tools. Additionally, actual permitted values are reported monthly through DMRs.

SECTION 6. ON-SITE WASTEWATER

The On-site Wastewater Subcommittee assembled this section of the WIP. Members of the Onsite Wastewater Subcommittee were crossovers from the Wastewater Subcommittee. They have positions within DNREC, and come from the Ground Water Discharges Section. They have experience in site evaluation and permitting, construction permitting, operation and management of large, community, and municipal land based wastewater treatment and disposal systems, and non-hazardous liquid waste transporters.

For people living in either a small town, with neighbors a short walk away, or a rural area, with pastures as far as the eye can see, installing a septic system may be their only option for wastewater management. In order to obtain an individual residential on-site wastewater treatment and disposal system (OWTDS) in Delaware, three steps must be achieved. First, a site evaluation is performed by a DNREC licensed soil scientist to assign the appropriate system type and location. Once the owner receives the site evaluation, a licensed system designer can design an OWTDS and obtain the necessary construction permits. When all permits are in order, a licensed contractor will install the OWTDS. Under the Delaware Code, Title 7, Chapter 60, site evaluations must be performed on unimproved lots before the sale of the lot.

6.1. Current Programs and Capacity

6.1.1. Ground Water Discharges Section

The Ground Water Discharges Section (GWDS) is responsible for overseeing all aspects of the siting, design, and installation of onsite wastewater treatment and disposal systems (OWTDS, septic systems). The section also issues waste transporter permits and licenses to percolation testers, designers, soil scientists, system contractors, liquid waste haulers, and system inspectors. The Ground Water Discharges Section is broken down into two branches; the Small Systems Branch, which has two offices (one in Dover, serving Kent and New Castle Counties and the other in Georgetown, serving Sussex County) and the Large Systems Branch in Dover (serving all three counties).

The Small Systems Branch reviews and approves site evaluations, permit applications, and conducts installation and compliance inspections of systems with daily flows equal to and less than 2,500 gallons per day (gpd). This is a three-step process that includes the site evaluation, the design/permit application, and the construction/installation of the system.

The Large Systems Branch reviews and approves spray irrigation wastewater systems and on-site wastewater treatment and disposal systems with daily flows greater than 2,500 gpd, Innovative/Alternative Technologies, Advanced Treatment Units, underground injection wells, and other means associated with land application of treated wastewater.

In regard to the cumulative target loads for point and nonpoint sources of nitrogen, phosphorus, and sediment from on-site wastewater, Delaware is currently using information from Phase 5.3 of the watershed model. Delaware plans on creating a map for individual and large/community OWTDS.

Individual OWTDS are required by permit conditions to have the septic tank pumped out once every three years. Any OWTDS with a design flow of 2,500 gpd and above are required by the current Regulations Governing the Design Installation and Operation of On-site Wastewater Treatment and Disposal Systems

to have a licensed operator to oversee operations of the OWTDS, and submit compliance reports with monitoring data on a routine basis as established in the operating permit. All OWTDS's with a design flow of 2,500 gpd or greater are issued individual operating permits with a maximum 5 year term. The On-Site Regulations are currently open for review and several modifications resulting in increase nutrient reduction are being proposed on a state-wide basis (See Section 6.4).

Penalties for non compliance include but are not limited to: voluntary compliance agreements, verbal warning, manager's warning letter, non-compliance notifications, Notice of Violation (NOV), and Secretary Order, which could include fines.

For voluntary and/or incentive-based programs identified in the WIP as currently controlling nutrient and sediment loads, programs verify that controls are installed and maintained through Department inspections and monitoring data (effluent, ground water, and soils). Repercussions and penalties for false reporting or improper installation or maintenance of voluntary practices are Under chapter 60 DE code fines can be as high as $10,000 a day.

6.1.2. Local Ordinances Regarding On-site Systems

6.1.2.1. Kent County

Nutrient Load Reduction Requirements for On-Site Septics in the Kent County Code: This provision establishes that on-site disposal systems achieve the required nutrient reduction targets in the watershed where a TMDL has been promulgated and a nutrient load reduction established. So, any new on-site septic system located within the Chesapeake Bay Watershed, needs to achieve the nutrient load reductions established by the TMDL through the use of best available technologies. Specifically § 187-53 D (5) stipulates: Individual residential on-site disposal systems sited in a watershed with an established total maximum daily load (TMDL) shall be designed and installed in accordance with the nutrient load reductions prescribed by the TMDL or they shall use the best available technologies in order to achieve the required nutrient reduction targets set for the particular watershed.

Prohibition of Community Waste Water Systems: Kent County has prohibited private community waste water systems countywide. While the impetus for this regulation was land use whereby the prohibition of these systems discourages high-density residential development in areas where there are little to no services, it also has the added benefit of protecting water quality.

6.2. Accounting for Growth

In general, more residential septic systems are anticipated to be installed within the watershed to support potential future growth; however, the timing and location of these installations will depend upon local land use decisions. EPA has provided the jurisdictions with their projections on these growth parameters, and that information is displayed in Table 21 and Figure 16.

To better understand the placement of these systems and how these systems might be mitigated through future central wastewater expansion, Delaware is currently working with the University of Delaware to identify areas that are likely to experience growth based upon small area population projections through 2025, and to identify the potential growth to be on central sewer, individual septic systems and or on a community OWTDS.

To better understand the projected growth within the Delaware segment of the Chesapeake Bay watershed, the University of Delaware through the Community Land Use Model to consider the future growth which is determined by considering existing land uses, EPA Smart Growth Principals, proposed development projects, building permit absorption data and the State's Small Area Population projections (which were then modified to account for the various sub-watersheds identified by the EPA). Based upon these inputs and assumptions, the State has determined the number of new septic systems within the watershed, the expansion of local and regional central treatment systems and the absorption of existing septic systems for the Delaware portion of the Chesapeake Bay watershed and classified these systems into the following:

Current Sewer – Areas within the watershed which are served by either the private wastewater provider or either a municipal or county wastewater treatment system.

Short Term Wastewater Expansion – These are areas within the watershed that are currently on septic systems; however, these will be absorbed onto a central wastewater system by 2017.

Long Term Wastewater Expansion – These are areas within the watershed that are currently on septic systems; however, these will be absorbed onto a central wastewater system by 2025.

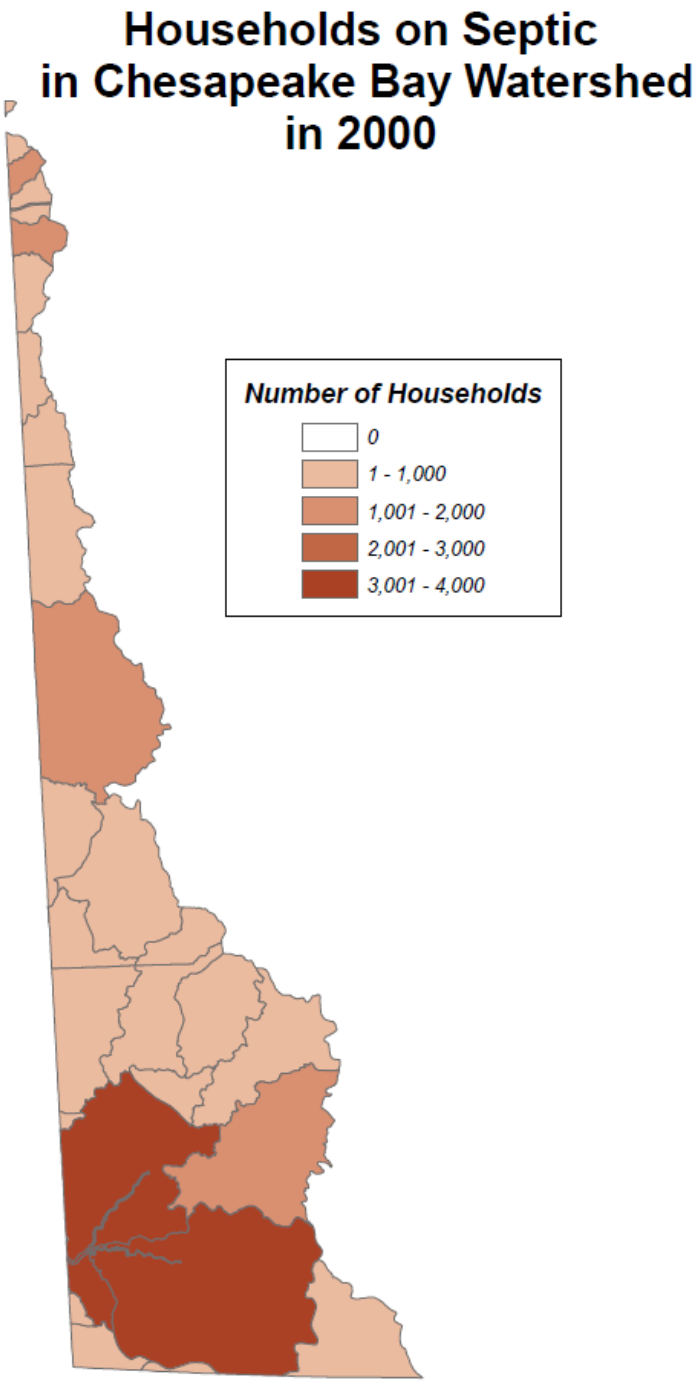


Figure 16: EPA's Estimated Number of Septic Systems in Delaware's Chesapeake in 2000

FIPSCAT	Septics 2000	Septics 2010	% Increase 2000 to 2010	Septics 2017	% Increase 2000 to 2017	Septics 2025	% Increase 2000 to 2025
A10003EU1_2981_0000	55	55	0	55	0	55	0
A10003EU1_2983_0000	281	416	48	512	82	613	118
A10003EU0_3010_0000	1,033	2,001	94	2,544	146	2,959	186
A10003EU0_3011_0000	317	599	89	729	130	806	154
A10003EU0_3201_0000	355	616	74	823	132	1,061	199
A10003EU0_3361_0000	187	212	13	230	23	252	35
A10003EU2_3520_0001	267	298	12	322	21	349	31
A10001EU2_3520_0001	634	820	29	887	40	941	48
A10001EM2_3980_0001	1,845	2,338	27	2,496	35	2,612	42
A10001EM3_4326_0000	265	342	29	371	40	395	49
A10001EL2_4400_4590	712	879	23	924	30	950	33
A10001EL2_4590_0001	134	166	24	175	31	181	35
A10005EL2_4590_0001	519	699	35	813	57	929	79
A10005EL0_4591_0000	24	34	44	41	75	50	111
A10005EL0_4594_0000	103	142	38	168	63	196	90
A10005EL0_4597_0000	36	50	42	61	72	73	105
A10005EL2_4634_0000	0	0	0	0	0	0	0
A10001EL0_4560_4562	237	288	22	300	26	304	28
A10005EL0_4560_4562	538	768	43	928	72	1,099	104
A10005EL0_4561_4562	576	835	45	1,018	77	1,223	112
A10005EL0_4562_0001	190	248	30	281	48	313	65
A10005EL0_4631_0000	537	715	33	825	54	934	74
A10005EL0_4632_0000	1,545	2,034	32	2,349	52	2,674	73
A10005EL0_4633_0000	3,003	3,972	32	4,582	53	5,196	73
A10005EL2_4630_0000	3,591	4,727	32	5,368	50	5,947	66
A10005EL2_5110_5270	332	438	32	504	52	570	72
A10005EL0_5400_0001	77	95	23	105	36	114	48
Total	17,392	23,788		27,411		30,796	

Table 21: EPA Projections on Septic System Increases (number of systems) between 2000 and 2025

New Castle County

The New Castle County portion of the Bay watershed includes the headwaters of several watersheds; such as the Elk River, C&D Canal, Bohemia River, the Sassafras River and the Upper Chester River. These headwaters constitute the smallest area of the Bay watershed within Delaware; however within the past several years they have experience some of the greatest residential growth. The community of Middletown, Delaware in southern New Castle County in the period from 2000 to 2008 increased its population by nearly 100%. However, this growth has not come without significant investment by Middletown and New Castle County for the expansion of sewer.

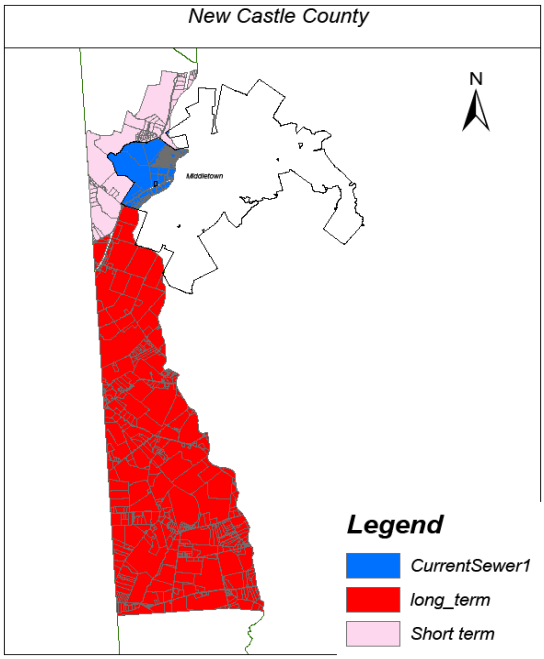


Figure 17: New Castle County Wastewater

Both the Town and County have a shared goal to implement regional wastewater service for their respective jurisdictions and as a result as described in Table 22 both jurisdictions will offer regional wastewater treatment to the entire New Castle County portion of the watershed by 2025. In addition, to minimize the future growth of septic systems within areas identified as Long Term Wastewater Expansion the County through current land use policies has established large lot subdivision requirements; such as 1 unit per 5 acres or 1 unit per 10 acres. In addition the County has passed ordinances that restrict the development on private utility wastewater treatment plants within the Long Term Wastewater Expansion; again further limiting the number of future septic systems within the watershed.

EPA River Segment	2010 Land Use Scenario		2017 Land Use Scenario		2025 Land Use Scenario	
	Septic	Sewer	Septic	Sewer	Septic	Sewer
2981	23	0	0	33	0	43
2983	548	0	397	639	0	1354
3010	1618	0	1604	897	0	3375
3011	1062	0	1062	772	0	2126
3201	267	319	0	1194	0	1830
3361	89	0	0	354	0	586
3520	106	0	106	0	0	301
Total	3713	319	3169	3889	0	9615

Table 22: Residential Wastewater Type for New Castle County

Kent County

The Kent County portion of the Bay watershed includes the headwaters of several watersheds; such as the Upper Chester River, Upper Choptank River, and the Middle Nanticoke River. These watersheds constitute nearly 1/3 of the County and all of these watershed fall outside of the County's Regional Growth Zone. However, to address the growth within the local jurisdictions of Harrington, Hartly, and Farmington which are either fully or partially within the watershed; the County has established connections for these jurisdictions to the County's existing sewer system within the Growth Zone. Within the next five years the waste generated within these municipalities will be transmitted and treated outside of the watershed. However, this leaves a potentially large amount of rural land to be developed within the watershed.

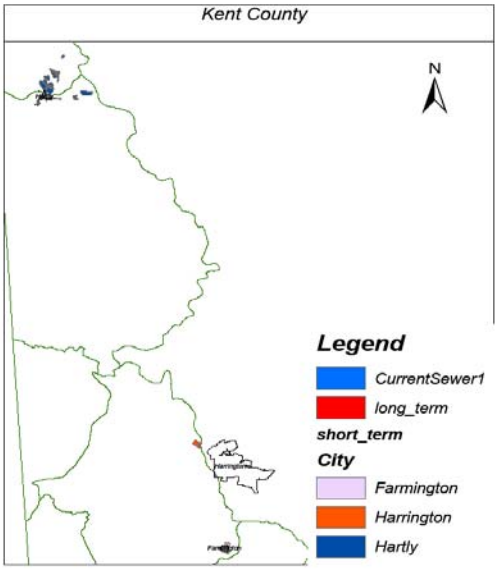


Figure 18: Kent County Wastewater

In response this future growth the County has implemented a series of land use ordinances that are intended to direct growth the County's established growth zone while allowing for modest growth. Over the past five years the County has establish a major subdivision ordinance which requires large lots of 4 acres in size or more with significant requirements for investment in infrastructure such as dry septic requirements, central water systems and public roads built to State standards. Also the County has restricted private utility wastewater treatment systems throughout the County and as a result of these ordinances no major subdivisions have been recorded within the watershed.

The County does however allow for single lot subdivisions and minor lot subdivisions of 10 lots or less within all rural portions of the County. This has resulted in the higher number of septic systems within the watershed as seen in Table 23.

EPA River Segment	2010 Land Use Scenario		2017 Land Use Scenario		2025 Land Use Scenario	
	Septic	Sewer	Septic	Sewer	Septic	Sewer
3520	824	0	1207	0	1435	0
3980	2387	0	3000	0	3380	0
4326	230	0	417	0	493	0
4400	760	0	737	511	1002	479
4560 K	253	0	504	0	655	0
4590 K	198	0	312	0	402	0
Total	4652	0	6177	511	7367	479

Table 23: Residential Wastewater Type for Kent County

However, as part of the Phase Two implementation process of the Delaware WIP, the State and County will be reviewing these lots to determine when a portion of these may sunset in accordance to County code,

determine which are unbuildable due to environmental regulations and which ones may be constructed within the period of 2010 to 2025 resulting in a 40% or 2,773 reduction in the number of septic systems with of those 15% or 929 reduction in septic systems and within the period of 2010 to 2017 and an additional 25% or 1,844 reduction in septic systems within the period of 2017 to 2025. These reductions are illustrated within Table 24.

EPA River Segment	2010 Land Use Scenario		2017 Land Use Scenario		2025 Land Use Scenario	
	Septic	Sewer	Septic	Sewer	Septic	Sewer
3520	824	0	1025	0	1076	0
3980	2387	0	2550	0	2535	0
4326	230	0	354	0	369	0
4400	760	0	626	511	751	479
4560 K	253	0	428	0	491	0
4590 K	198	0	265	0	301	0
Total	4652	0	5248	511	5523	479

Table 24: Proposed Septic Systems Reductions for Kent County

Sussex County

The Sussex County portion of the Bay watershed includes the headwaters of several watersheds; such as the Upper Nanticoke River, the Middle Nanticoke River, Pocomoke River, and Wicomico River. This is the largest segment of the Chesapeake Bay Watershed within Delaware and encompassing nearly half of Sussex County and touches 9 out of the 24 local municipalities; these include Ellendale, Georgetown, Greenwood, Bridgeville, Seaford, Blades, Laurel, Bethel, and Delmar. It is for these reasons that the sewer and septic system growth requires greater detail to understand the impacts within the watershed.

Summary of Current Sewer Activities

To address the need for wastewater service within the watershed, the local communities, Sussex County, the State, and the USDA Rural Development Program have developed a series of regional partnerships or provided significant investment to a local wastewater provider to enhance their local infrastructure to further remove failing septic systems from the watershed. These activities include:

- Georgetown, Ellendale and the East New Market Sanitary Sewer

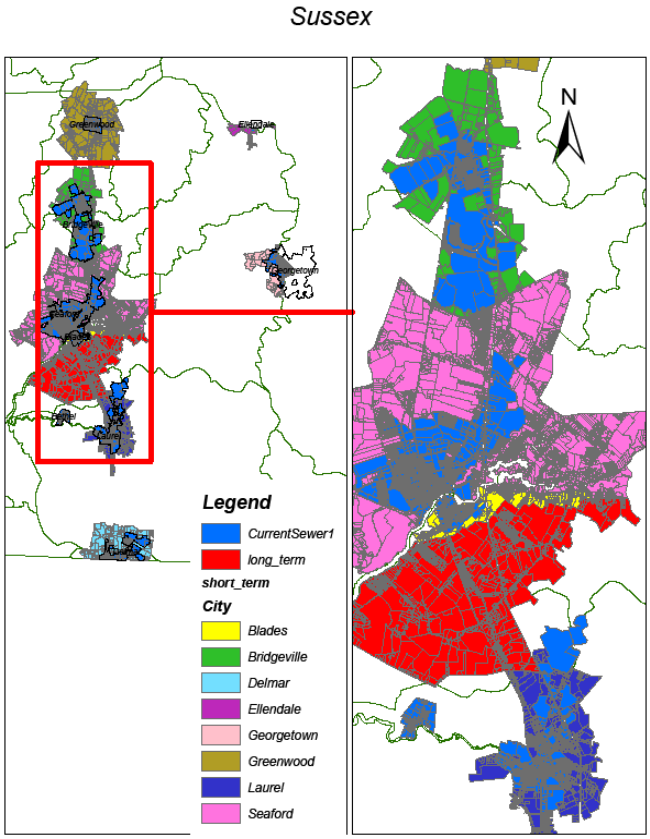


Figure 19: Sussex County Wastewater

District – Wastewater is collected from the Town of Ellendale, the unincorporated Sussex County community of New Hope and portion of the Town of Georgetown within the watershed and is then treated at the Georgetown Wastewater facility and discharged outside of the Bay Watershed.

- Bridgeville and Greenwood Combined Wastewater Treatment Facility – Wastewater is collected from both Towns and is treated at the Bridgeville Wastewater Treatment Facility where it is discharged within the watershed.
- Seaford, Blades, and the Blades Sanitary Sewer District – Wastewater is collected from the City of Seaford, the Town of Blades, and the unincorporated areas of Sussex County surrounding the Town of Blades and is treated at the Seaford Wastewater Treatment Facility where it is discharged within the watershed.
- The Town of Laurel - Wastewater is collected from within the Town and is treated at the Laurel Wastewater Treatment Facility where it is discharged within the watershed.
- The Town of Bethel – This historic community has no significant infrastructure and currently all homes within the community are served by individual septic systems.
- The Town of Delmar – Wastewater is collected from within the Town and is treated at the Delmar Treatment Facility where it is discharged within the watershed; however, outside of the State of Delaware.

However, even with these sewer improvements, there is still a large portion of the County which is considered rural and relies on septic systems and the number of septic systems that are currently within the watershed and those projected for 2017 and 2025 can be seen in Table 25.

EPA River Segment	2010 Land Use Scenario		2017 Land Use Scenario		2025 Land Use Scenario	
	Septic	Sewer	Septic	Sewer	Septic	Sewer
4560 S	1401	462	1842	493	1802	919
4561	1146	0	1303	0	1417	0
4562	954	0	1003	256	989	720
4590 S	864	0	982	0	1121	0
4591	12	0	31	0	50	0
4594	278	0	369	0	455	0
4597	65	0	65	0	65	0
4630	7386	2025	7410	3715	7435	4560
4631	1258	0	1309	297	1297	762
4632	2901	220	3164	554	3151	1099
4633	6545	462	6444	1451	6428	2419
5110	814	0	959	0	1092	0
5400	210	540	219	555	228	540
Total	23834	3709	25100	7321	25530	11739

Table 25: Residential Wastewater Type for Sussex County

To reduce the number of septic systems for the Sussex County portion of the watershed, the proposed reductions for those watershed segments with existing significant wastewater treatment infrastructure which may be expanded to allow for the removal of on-site septic systems is as follows:

EPA River Segment	2017 % Reduction	2025 % Reduction
4560 S	10	10
4562	15	15
4630	50	30
4631	40	30
4632	15	15
4633	20	20
5400	100	100

Table 26: Proposed Percentage Reduction for New and Existing Septic Systems

These proposed reductions in number of septic systems within the watershed can then be seen in Table 27:

EPA River Segment	2010 Land Use Scenario		2017 Land Use Scenario		2025 Land Use Scenario	
	Septic	Sewer	Septic	Sewer	Septic	Sewer
4560 S	1401	462	1657	678	1621	1100
4562	954	0	852	407	840	869
4630	7386	2025	3705	7420	5204	6791
4631	1258	0	785	821	907	1152
4632	2901	220	2689	1029	2678	1572
4633	6545	462	5155	2740	5142	3705
5400	210	540	0	774	0	768

Table 27: Proposed Septic Systems Reductions for Sussex County

These proposed reductions and their impacts within the total watershed can be seen in Table 28:

EPA River Segment	2010 Land Use Scenario		2017 Land Use Scenario		2025 Land Use Scenario	
	Septic	Sewer	Septic	Sewer	Septic	Sewer
4560 S	1401	462	1657	678	1621	1100
4561	1146	0	1303	0	1417	0
4562	954	0	852	407	840	869
4590 S	864	0	982	0	1121	0
4591	12	0	31	0	50	0
4594	278	0	369	0	455	0
4597	65	0	65	0	65	0
4630	7386	2025	3705	7420	5204	6791
4631	1258	0	785	821	907	1152
4632	2901	220	2689	1029	2678	1572
4633	6545	462	5155	2740	5142	3705
5110	814	0	959	0	1092	0
5400	210	540	0	774	0	768
Total	23834	3709	18552	13839	20592	15957

Table 28: Revised Residential Wastewater Type for Sussex County
By expanding the regional and local wastewater treatment facilities the number of septic systems is reduced by 6,548 for the period of 2010 through 2017 or during the Short Term Wastewater Expansion and by 4,938 for the period 2017 through 2025 or as part of the Long Term Wastewater Expansion. To further reduce these numbers, as part of the Chesapeake Bay WIP Phase Two planning process, these numbers will be further refined to reflect revisions to the population projections and further land preservation activities. In addition, all partners and the Federal, State, County and local levels will continue to grow funding sources to possible increase these numbers.

More information about Delaware's planned approach to account for growth can be found in Section 8 – Land Use.

6.3. Gap Analysis

The Department in preparation of the TMDLs and Pollution Control Strategies over the past five years have increased staffing in the GWDS program by establishing two new full time positions. One position was an Environmental Scientist position to review and issue permits and to inspect advanced wastewater treatment and disposal systems statewide. The other position was a Senior Compliance Specialist to review and provide QA/QC for inspections made by Class H Licensee that inspect systems at the sale of a property. In order to improve compliance and increase participation rates by 20%, funding should be increased to provide greater outreach, staffing, and technical resources. Recently, three GWDS staff (full time equivalents, FTEs) left the Section and all of these positions need to be re-filled in order to not fall behind on workload and increase work levels to achieve new goals. The Department commitment to funding the onsite program has been further shown in these tight budget times by filling the one vacant position in September 2010 and has started the interview process for the second position. It is anticipated that the third position will be filled by FY12. The Section would be better served by increasing the staffing levels by one FTE ($50K annually). Additional needs to fill gaps are identified below:

- Additional staff or staff movement will likely be needed to maintain a new aggressive operation and maintenance inspection program in addition to the current operation and maintenance program for the innovative and alternative system requirements, and data collection.
- Improved tracking and reporting of pump-outs and inspections, advanced treatment units, and connections to central sewer
    - Delaware's Environmental Navigator, a data management system, needs improvements. Additional funding for database upgrades and management ($50K annual)
- Staff training in advanced treatment units for permitting, inspection, operation, and maintenance requirements.
- Will need funds to update the database to track waste haulers and verify septic system pump out requirements are being met and expect to have grant funding to update the database.
- There is a need for State and Federal funding resources to include grants to make municipal systems affordable and to help low-income on-site users replace or repair failing systems and/or install nutrient reducing technologies
    - See Community Financing for Septic Management in the Inland Bays Watershed prepared by the Environmental Finance Center January 29, 2008.

6.4. Strategy to Fill Gaps

To ensure that local water quality is maintained and/or local TMDLs are complied with in light of anticipated new or increased nutrient loads from additional OWTDSs, the GWDS has already begun the formal process of revising the current OWTDS regulations. The revised regulations, which are currently undergoing public review, are expected to be promulgated in 2011. They include the following proposed actions:

- Statewide elimination of all cesspools and seepage pits
- Statewide inspection and pump-out program requiring properties served by on-site systems to be inspected by a Class H inspector and the septic tank pumped by a Class F liquid waste hauler prior to the transfer of a property. Unsatisfactory systems identified upon inspection would be required to be repaired, replaced, or upgraded, depending on location and date (see N reducing systems within 1,000 feet of tidal waters and associated tidal wetlands below). Currently, homeowners receive a brochure about their OWTDS.
  GOAL: pump out one third (33%) of systems within the Chesapeake each year.
- Stricter controls on large systems including:
  - Performance standards (nutrient limits) for large OWTDS's with monitoring requirements (see definitions and requirements for performance standards below)
  - Large OWTDS applications to include a Surface Water Assessment Report to verify compliance with applicable TMDL requirements
  - Enforcement tools
  - Licensed operators for all large systems
  - Systems serving 50 units or more required to be operated by public utilities
  - Installation of nutrient reducing systems for any innovative and alternative (IA) technologies
  - Mandatory operation and maintenance on IA systems

Proposed OWTDS Performance Standard Definitions and Requirements

Performance Standard Nitrogen level 1 (PSN1) means where total nitrogen levels achieve either:

- an average annual concentration of 5 mg/l (parts per million (ppm)) total nitrogen in effluent sampled at the end-of-pipe of the pretreatment unit; or
- a 90% reduction in the effluent total nitrogen concentration when compared to the influent total nitrogen concentration; or
- an average annual concentration of 5 mg/l beneath any permitted wastewater spray irrigation field as verified by monitoring in-field lysimeters, providing that the design percolate concentration does not exceed 5 mg/l on an average annual basis.
- Discharge limitations are to be expressed as a mass, based on average design flows (221 gallons per day per unit for residential systems).

Performance Standard Nitrogen level 2 (PSN2) means where total nitrogen levels achieve either:

- an average annual concentration of 10 mg/l (parts per million (ppm)) total nitrogen in effluent sampled at the end-of-pipe of the pretreatment unit; or
- an 80% reduction in effluent total nitrogen concentration when compared to the influent total nitrogen concentration; or
- an average annual concentration of 10 mg/l beneath any permitted wastewater spray irrigation field

as verified by monitoring in-field lysimeters, providing that the design percolate concentration does not exceed 10 mg/l on an average annual basis.

- Discharge limitations are to be expressed as a mass, based on average design flows (221 gallons per day per unit for residential systems).

Performance Standard Nitrogen level 3 (PSN3) means where total nitrogen levels achieve either:

- an average annual concentration of 20 mg/l (parts per million (ppm)) total nitrogen in effluent sampled at the end-of-pipe of the pretreatment unit; or
- a 50% reduction in effluent total nitrogen concentration when compared to the influent total nitrogen concentration.

Performance Standard Phosphorus level 1 (PSP1) means where total phosphorus levels achieve either:

- an average annual concentration of 3.9 mg/l (parts per million (ppm)) total phosphorus in effluent sampled at the end-of-pipe of the pretreatment unit; or
- a 75% reduction in effluent total phosphorous concentration when compared to the influent total phosphorus; or
- an average annual concentration of 3.9 mg/l beneath any permitted wastewater spray irrigation field as verified by monitoring in-field lysimeters, providing that the design percolate concentration does not exceed 3.9 mg/l on an annual average basis.
- Discharge limitations are to be expressed as a mass, based on average design flows (221 gallons per day per unit for residential systems).

Performance Standard Phosphorus level 2 (PSP2) means where total phosphorus levels achieve either:

- an average annual concentration of 7.85 mg/l (parts per million (ppm)) total phosphorus in effluent sampled at the end-of-pipe of the pretreatment unit; or
- a 50% reduction in effluent total phosphorus concentration when compared to the influent total phosphorus concentration.
- Discharge limitations are to be expressed as a mass, based on average design flows (221 gallons per day per unit for residential systems).

Requirements for large OWTDSs having flows greater than 2,500 gpd but less than 20,000 gpd:

- All new systems shall meet a Performance Standard Nitrogen level 2 (PSN2).
- All replacement systems shall meet a Performance Standard Nitrogen level 3 (PSN3).
- When the operation and maintenance permit expires for an existing system, the system must meet a Performance Standard Nitrogen level 3 (PSN3). If the Department deems that the large OWTDS must be redesigned, the owner or operator of the system will have up to 60 months from the permit expiration date to bring the OWTDS into compliance with the new standard.
- Where the system location is identified as having high potential for phosphorus mobility, new OWTDSs shall meet a Performance Standard Phosphorus level 2 (PSP2).
- When the operation and maintenance permit expires for an existing system and the system location is identified as having high potential for phosphorus mobility, the system must comply with the Performance Standard Phosphorous level 2 (PSP2).

Requirements for large OWTDSs having flows greater than 20,000 gpd:

- All new systems shall meet Performance Standard Nitrogen level 1 (PSN1).
- All replacement systems shall meet Performance Standard Nitrogen level 2 (PSN2).

- When the operation and maintenance permit expires for an existing system, the Department will require the system to meet Performance Standard Nitrogen level 2 (PSN2). If the Department deems that the OWTDS must be redesigned to meet PSN2, the owner or operator of the system will have up to 60 months from the permit expiration date to bring the OWTDS into compliance with the new standard.
- Where the system location is identified as having high potential for phosphorus mobility, new OWTDSs shall meet a Performance Standard Phosphorus level 1 (PSP1).
- When the operation and maintenance permit expires for an existing system, and the system location is identified as having high potential for phosphorus mobility, the system must comply with the Performance Standard Phosphorous level 1 (PSP1). If the Department deems that the system must be redesigned to meet PSP1, the owner or operator of the system will have up to 60 months from the permit expiration date to bring the OWTDS into compliance with the new standard.

Additionally, the Department is proposing a new performance standard to apply to any OWTDS that uses Rapid Infiltration Basins (RIBs) as a disposal method. For these systems, the Department proposes that the effluent, regardless of design flow, meet at the end of the pip of the pretreatment unit Total Nitrogen concentrations of 3.0 mg/L and Total Phosphorus concentrations of 0.1 mg/L. This standard like the others above will also be based on average annual concentrations and discharge limitations are to be expressed as a mass, based on average design flows (221 gallons per day per unit for residential systems).

Advanced Treatment Upgrades for Existing Individual Systems

The GWDS is also proposing to develop a separate set of regulations governing OWTDS for the Chesapeake watershed in Delaware by 2017, which will also need to go through the formal promulgation process, including public review. This regulation will require all systems within 1,000 feet of tidal waters and associated tidal wetlands in Delaware's Chesapeake drainage to be upgraded to advanced treatment technologies when new systems are installed or when failing systems must be replaced. The systems will achieve Delaware's Performance Standard Nitrogen level 3, which requires an average annual concentration of 20 mg/l total nitrogen in effluent sampled at the end-of-pipe of the pretreatment unit or a 50% reduction in effluent total nitrogen concentration when compared to the influent total nitrogen concentration. These regulations may also require all other systems within the watershed to upgrade to advanced treatment at the time of failure by 2025.

Figure 20 shows the 2,920 parcels located entirely within 1,000 feet of the Chesapeake Bay tidal waters and associated tidal wetland areas. Within the portion of the Chesapeake Bay in Delaware, there are two tidal areas, the Nanticoke River and the western portion of the Chesapeake and Delaware Canal. The parcels were classified to show if they currently have an on-site septic system (904), central sewer service (1,261), or neither, meaning that the parcel is currently undeveloped (755).

GOAL: Upgrade 1,105 systems within 1,000 feet of tidal waters and associated tidal wetlands to advanced treatment (septic denitrification) technologies.

Septic Connections

Through expanding sewer districts, onsite septic systems will be eliminated in the future.

GOAL: Eliminate a minimum of 6,074 systems across the Chesapeake Drainage in Delaware by 2025. This number may be increased pending review of the information discussed above in Accounting for Growth.

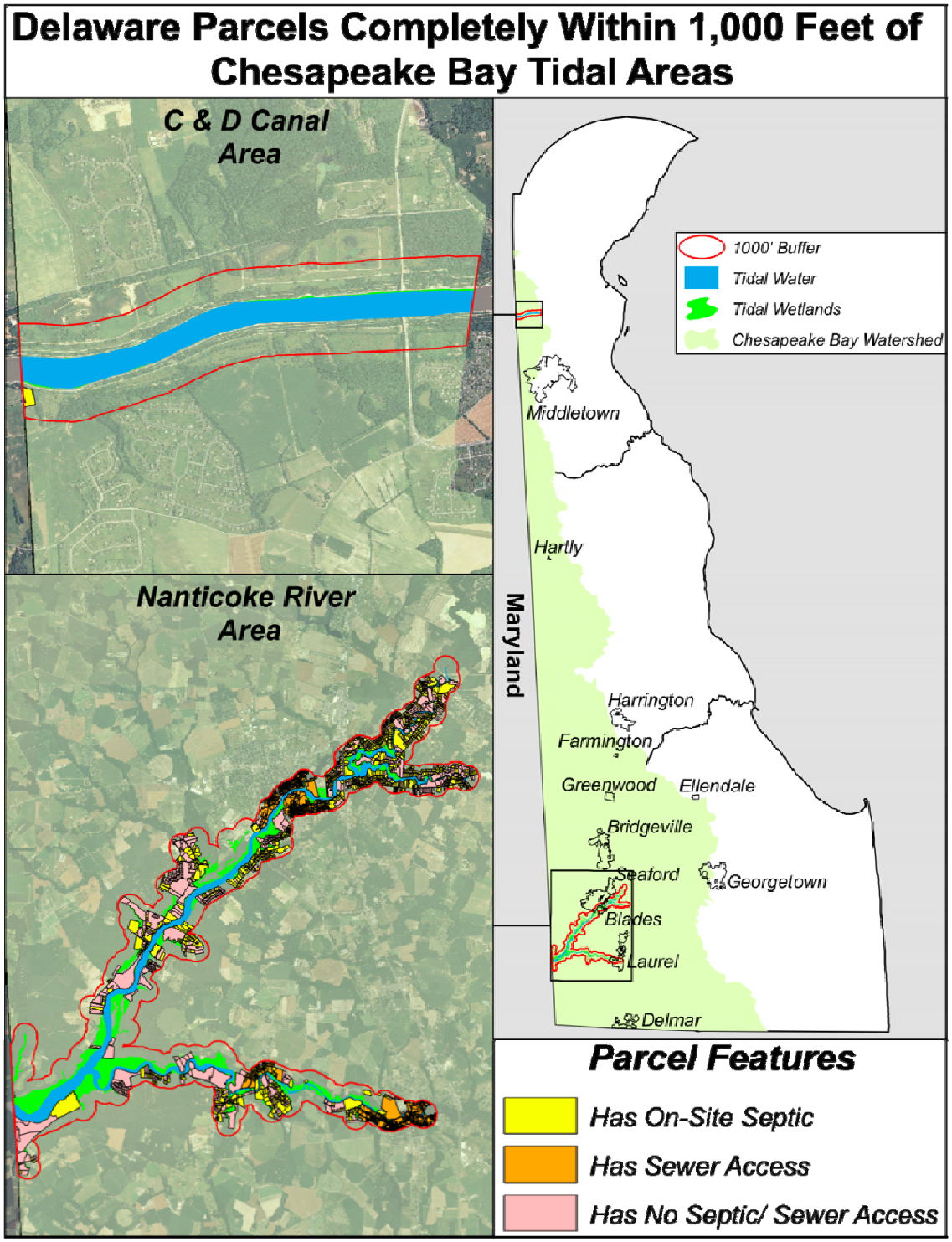


Figure 20: Parcels that will be required to upgrade to advanced treatment pending promulgation of future regulations.

6.5. Contingencies

If compliance rates with regulatory programs are not achieved, the contingency plan is to take enforcement actions. Additionally, as mentioned under 6.4 above, the GWDS will require all systems, not just within 1,000 feet of tidal waters and associated tidal wetlands, to upgrade to advanced treatment at the time of failure by 2025. As part of the contingency plan DNREC will review the recommendations of the white paper prepared by the Environmental Finance Center "Community Financing for Septic System Management in the Inland Bays Watershed." The paper shows how other states have tried to address the issue of funding and affordability by using personal income tax credit programs for septic repair, replacement, and sewer connection (MA); community septic management lending program (MA); responsible management entity concept and application of a septic utility fee (case study NC); and general septic fee (MD). The Department will also be using existing funding sources including the State Revolving Loan Fund (SRF) Septic Rehabilitation Loan Program, Community Development Block Grant (CDBG), and the USDA 504 Housing Rehabilitation Loan Program.

6.6. Tracking and Reporting Protocols

The GWDS uses a database called Environmental Navigator, which tracks all permitted on-site wastewater treatment and disposal systems. The system tracks licenses, service providers, site evaluations, permits, inspections, and violations. It has a GIS capability and DNREC upgrades it annually to include additional fields as required, and as resources are made available. Additionally, work is underway to extract information regarding onsite system BMPs into the National Environmental Information System (NEIEN) schema so that data may be directly sent to the Chesapeake Bay Program through network nodes and receive credit in the model. A description of data generation and acquisition, assessment and oversight, and data validation and usability will be provided in Delaware's Nonpoint Source Best Management Practice Implementation Data Quality Assurance Project Plan (Appendix C). The QAPP will be updated to reflect recent changes by April 30, 2011. DNREC staff is also participating in the development of the Bay TMDL Accounting and Tracking System (BayTAS) Version 1.0 to track the TMDL waste load allocations and load allocations and Delaware's progress toward meeting those goals.

SECTION 7. URBAN/SUBURBAN STORMWATER

Rainfalls events are key in the natural hydrologic cycle. However, in highly developed areas with greater impervious cover, rainfall results in flooding, erosion, and contamination. As the water moves over these impervious surfaces, such as rooftops, driveways, roads, and parking lots, it picks up pollutants such as fertilizers containing excess amounts of nitrogen and phosphorus, sediment, oil from parking lots, trash, and other potentially harmful contaminants.

To meet TMDL standards for water quality, Delaware follows strict stormwater mandates requiring Best Management Practices (BMPs) to be used that will minimize the impact of stormwater runoff rates and volumes, prevent erosion, and capture pollutants. Green Technology BMPs, developed in the late-1990s, have proven to be extremely effective in maintaining high water quality, while also addressing water quantity. This technology intercepts stormwater runoff and directs it to vegetated areas in order to mimic natural hydrology. The vegetated areas first filter many of the pollutants from the water. Depending on the practice chosen, many also have the ability to infiltrate and recharge stormwater runoff to further reduce pollutant loads. Some of the green technologies that Delaware installs, mandated through the Delaware Sediment and Stormwater Program, include bioretention, buffers, conservation site design, filter strips, source area disconnection, biofiltration swales, and infiltration trenches.

The Stormwater Subcommittee gathered members from DNREC, DelDOT, and DDA to combine their expertise and apply it to this section of the WIP. This subcommittee represented the state regulatory permitting authority for MS4s, MS4 permittees within the Chesapeake Bay Watershed, the state permitting authority for construction, post construction, industrial stormwater activities, agency watershed managers and planners, and the state department of transportation, strictly relating to stormwater. The members have experience in NPDES permit coverage for individual stormwater sites and MS4s, engineered sediment and stormwater plans for State and Federal facilities, Delaware Sediment and Stormwater Regulations (DSSR), green technology BMPs relating to stormwater, drainage relief management, and other watershed-related areas of expertise.

From the 2007 land use and land cover data from Delaware's Office of State Planning Coordination, it was discovered that developed lands within the Chesapeake, where urban and suburban stormwater runoff originates, make up about 10% of the overall landscape. Most of the area is considered low density residential (81%). The remaining areas are commercial (5%), high density residential (5%), industrial (3%), open space (2%), roads (2%), and institutional (1%). Within the Delaware portion of the Chesapeake drainage, only about 4% is covered by impervious surfaces. Roads make up 33% of that area (Figure 21).

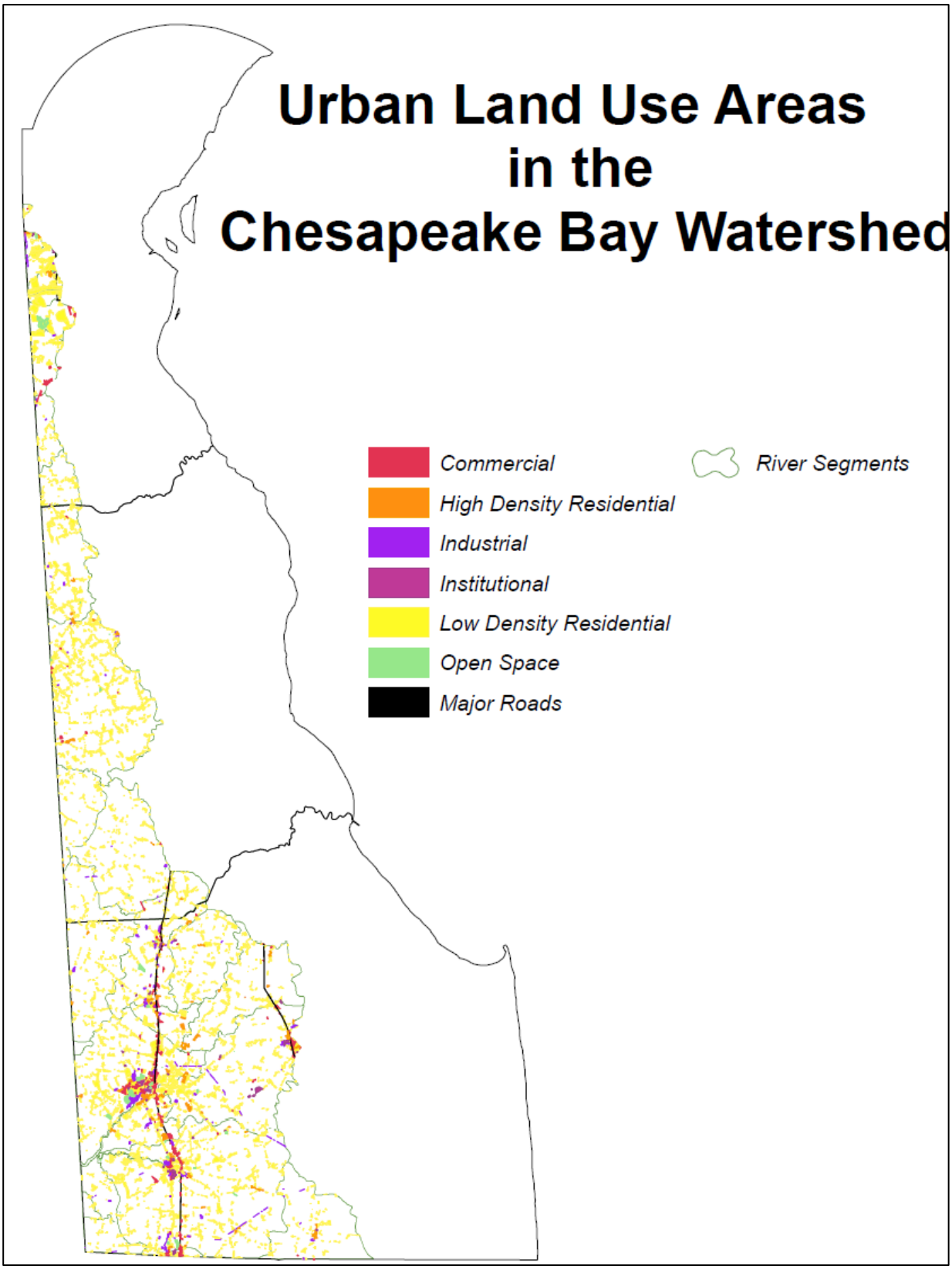


Figure 21: Urban Land Use Areas in Delaware's Chesapeake

7.1. Current Programs and Capacity

Several programs within Delaware address stormwater from urban and suburban lands.

7.1.1. Sediment and Stormwater Program

The Sediment and Stormwater Program is currently managed by the Division of Watershed Stewardship in the Department of Natural Resources and Environmental Control. The Delaware Sediment & Stormwater Regulations (DSSR) require erosion and sediment control during construction and post-construction stormwater quantity and stormwater quality control. The DSSR effectively cover the entire development process, from the time construction begins, through project completion, and permanent maintenance of stormwater management facilities. Unless specifically exempted, any proposed land development project that disturbs more than 5000 square feet must comply with the DSSR. The DSSR are effective State-wide, and are applicable for new development, redevelopment, MS4s and non-MS4s. In order to comply with these regulations, projects must employ stormwater Best Management Practices (BMPs) to address both water quality as well as water quantity impacts. The Sediment & Stormwater Management Plans are vigorously reviewed by local delegated agencies and are only approved if it is deemed that they meet minimum State-wide regulatory requirements. These delegated agencies also ensure these approved plans are contructed properly in the field through a process of frequent inspections on a regular basis that ensures regulatory compliance with the DSSR that includes a final inspection and close-out process. The penalty section of the DSSR provides DNREC with the authority to pursue both civil and criminal actions should enforcement for non-compliance be necessary.

The program's initial emphasis is to prevent existing flooding or water quality from worsening and limit further degradation until more comprehensive, watershed approaches (as detailed in State legislation and regulations) are adopted. Section 10.3.5.1 of the DSSR requires practices collectively referred to as Green Technology BMPs to be given first consideration in the management of stormwater quality on a site. Green Technology BMPs include bioretention, buffers, conservation site design, filter strips, source area disconnection, biofiltration swales, and infiltration trenches. These BMPs use filtering in vegetative areas as well as infiltration and recharge in order to mimic natural hydrology. This approach extracts a relatively high concentration of pollutants from the water, depending on the practice chosen. The resulting cleaner water can then enter into a waterway or soak into the ground to recharge underground water sources. Current regulations require stormwater management practices to achieve an 80% reduction in total suspended solids loads after a site has been developed. This is achievable with present technology. Long-term removal rates of over 80% may require other measures, such as water reuse, which could be required locally.

Impaired waters, including watersheds having established TMDLs, are subject to heightened requirements under the DSSR Section 10.3.5.4. Permanent stormwater management BMPs, again with preference given to Green Technology BMPs, are designed for individual sites to meet the TMDL pollutant reduction target. A treatment train approach, multiple BMPs in series, is often required to meet the target.

In Delaware, day-to-day inspection responsibilities are handled by the local Delegated Agency, made up of specified municipalities, counties, and conservation districts. It is important to coordinate with Delegated Agencies as they can work with Homeowners Associations on stormwater system maintenance education and outreach and compliance. Projects having site compliance issues or problems relating to site design or erosion and sediment control is handled by the State, along with all state and federal facilities. The state

additionally has progressive and enforcement options available, including civil and criminal penalty provisions that can aid in regulatory compliance.

The Sediment and Stormwater Regulations are currently being updated. The additional controls that will result in increased reductions of nutrient and sediment loads due to the proposed revised regulations are summarized in Section 7.4 below.

For construction sites, 100% are permitted through the NPDES Construction General Permit (CGP), with 100% inspected annually by a local delegated agency and/or DNREC's Sediment and Stormwater Program. If deficiencies are found at a site, these are noted on an inspection form and a time frame is given for correction. If the issues are not corrected, it could result in a Notice of Violation (NOV). Penalties for noncompliance under the Delaware Sediment and Stormwater Program include state enforcement, including civil and criminal penalties, as well as administrative penalties at the state level.

7.1.2. Surface Water Discharges Section

Another program with a similar goal for improving water quality is the Surface Water Discharges Section (SWDS). The SWDS supports the development of the Chesapeake Bay WIP in regards to industrial stormwater, municipal stormwater, and wastewater. The (SWDS) regulates point sources of pollution including municipal and industrial wastewater treatment systems and their construction, biosolids applications, and stormwater discharges associated with industrial activities. The SWDS is responsible for issuing regulatory permits under the NDPES. With respect to stormwater, there are several options in NPDES permitting, general permit program for industrial stormwater sites, individual NPDES permits for sites, and individual Municipal Separate Stormwater Sewer Systems (MS4s) permits issued to towns or municipalities over a certain population, or issued to other agencies where stormwater runoff has been identified to be of concern.

7.1.2.1. General Permit Coverage for Industrial Storm Water and Individual NPDES Permits

The main focus of the General Industrial Storm Water Permitting Program is to prevent the contamination of storm water runoff from a facility by properly handling and storing materials. The General Permit Program is designed to provide NPDES permit coverage to a specified group, category or class of industrial activity, that are required to abide by criteria set forth in the general regulations, Section 9.1 of the Regulations Governing the Control of Water Pollution (General Permit Program). These regulations outline the general provisions or requirements that apply to all discharges within the specified category. Currently, the industrial stormwater program requires monitoring of stormwater effluent, but no submission of data or verification of being within permit guidelines, unless the data is specifically requested by DNREC. Regulated facilities can obtain permit coverage by submitting a "Notice of Intent (NOI)" form or a "No Exposure" Certification Form. "No Exposure" means that all industrial materials and activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snowmelt, and/or runoff. Acceptance of the NOI or No Exposure forms cover a facility under Section 9.1 of the Regulations Governing the Control of Water Pollution (General Permit Program) and requires a facility to comply with all requirements outlined within the regulations.

Conversely, an individual NPDES permit is tailored to a specific discharge and location. These are typically outfalls from municipal sewage treatment facilities or industrial plants that discharge to surface waters of Delaware. The NPDES permit specifies limitations, monitoring requirements, and other terms and

conditions that the permittee must meet in order to be allowed to discharge, and includes stormwater management measures.

Of the 272 NOI sites and 72 No Exposure sites currently under the General Permit Program in Delaware, 51 of those are located within the Chesapeake Bay Watershed. For the 48 total individually permitted sites in Delaware, 5 are within the Chesapeake Bay Watershed.

To date, an inspection tracking system for sites under both the General Permit Program and individual NPDES permits has not been in place, so precise calculations for inspection frequency, overall, is not available. It has been the Surface Water Discharges Section's inspection policy to inspect sites under the General Permit Program once every three (3) years at a minimum, while No Exposure Certified facilities are inspected at a minimum of once every five (5) years. In regards to compliance assistance or enforcement, the industrial stormwater program has traditionally based its program on compliance assistance utilizing voluntary compliance based on inspection output. Since a tracking system was not in place at that time, this number is not broken down by watershed. To date, no cases have been issued Administrative Penalties; however, one upcoming case (located in the Delaware Watershed) will likely be issued an Administrative Penalty by the end of the calendar year, 2010.

For sites having individual permits, Compliance Sampling Inspections (CSI) are conducted once a year for major individual permits, while minor individual permits are inspected once every two years, at a minimum. Sites having individual permits have strict oversight and monitoring, where all TMDL allocations are being strictly followed. In 2010, management staff began issuance of stricter penalties for violators having individual permits.

DelDOT industrial stormwater facilities, which are permitted through the Industrial Stormwater General Permit, are inspected annually. The new Phase I MS4 permit within the Chesapeake Bay Watershed (NCC/DelDOT Phase I MS4) will be requiring the MS4 to inspect industrial facilities within their MS4 jurisdictions annually, with DNREC oversight and evaluation.

7.1.2.2. Individual NPDES Permits for MS4s

Urban stormwater runoff is commonly transported through MS4s, and is often discharged, untreated, into local waterbodies. To prevent harmful pollutants from being washed or dumped into an MS4, certain operators, based on population, must obtain a NPDES permit (Phase I or Phase II) and develop a stormwater management program. Phase I, issued in 1990, requires medium and large cities or certain counties with populations of 100,000 or more to obtain NPDES permit coverage for their stormwater discharges. Phase II, issued in 1999, requires regulated small MS4s in urbanized areas, as well as small MS4s outside the urbanized areas that are designated by the permitting authority, to obtain NPDES permit coverage for their stormwater discharges. Currently, 25% of Delaware is covered under the MS4 program, with only a small portion of the Chesapeake Bay having MS4 permit coverage.

DNREC has information on all existing MS4 areas; however, DNREC's SWDS is looking to EPA's upcoming national rulemaking to find out how MS4 areas will be delineated in the future. For this reason, the future geographic boundaries are currently unknown and pending further guidance from EPA. A small portion of the New Castle County/DelDOT Phase I MS4 area falls within the Chesapeake Bay Watershed. There are no other MS4 areas currently within the watershed. This permit is in the process of being updated, and will address state water quality standards and TMDLS for the Chesapeake Bay Watershed.

It is DNREC's intent to refer to the DSSR for all construction and post construction stormwater management measures in all future MS4 permits. The new regulations will apply to all areas both inside and outside MS4s, and will address all needs in regards to green technology requirements, post construction maintenance measures, and water quantity and quality requirements.

Audits of the MS4 permittees are conducted during the second and fifth permit terms. The program audit is a comprehensive evaluation of all components of the MS4 program, assessing overall implementation and identifying deficiencies prior to permit renewal. Specifically, the audit evaluates program implementation and maintenance used to address the six (6) minimum control measures as identified in the Storm Water Management Plan (SWMP). The audit evaluates requirements as written in the permit, as committed in the SWMP, and as required under the Federal regulations. Audit reports summarize the findings of the MS4 audit in the same order and format of the Permit. Each program component section contains a summary of the findings for the program component and associated required and recommended actions. The recommended actions are based on programs that are being implemented by other MS4s throughout the state or on commitments within Annual Report.

Specifically within the Chesapeake Bay Watershed communities, DNREC has determined by analyzing land use patterns, that retrofits are not the solution to reduction of pollution loading in this area; however, within the new draft Phase I MS4 permit for New Castle County/DelDOT with portions of that permit area lying within the Chesapeake Bay Watershed, a retrofit program is required as part of this permit. DNREC is also considering requiring similar programs as part of all Phase II requirements as permits are renewed in the future.

All BMPs constructed both within and outside MS4 areas are inspected regularly throughout the state, not only through MS4 permit commitments, but also through mandates relating to the current DSSRs, which additionally requires property owners to regularly maintain BMPs.

Of the MS4 permitted agencies in Delaware, DelDOT alone began the stormwater system inventory and inspection in 2001 in New Castle County. Beginning in 2007, the inventory and inspection process included Kent and Sussex Counties. As of 2010, 90,000 structure points (inlets, manholes, outfalls, swale ends), and 12,500,000 linear feet of conveyance (pipes, swales) has been inventoried and inspected. Within the Chesapeake Bay Watershed, DelDOT has inventoried and inspected 3,000 structure points and 650,000 linear feet of conveyance.

New Castle County (NCC), also an MS4 permittee, began the stormwater inventory and inspection in 2001. As of November 2010, NCC has 1407 BMPs that are inspected in the unincorporated areas of New Castle County, with 49 of these located within the Chesapeake Bay Watershed.

In regards to the control of fertilizer use throughout the state, the Delaware Department of Transportation is working with the Appoquinimink Watershed Association to pilot a program to help reduce fertilizer run-off from households. Research has shown that 72% of homeowners who hire landscapers to care for their yards have them apply fertilizers and often those requests are made in the spring. This program is designed to encourage and reward lawn care professionals who follow best practices that will reduce fertilizer run-off while meeting homeowners' needs and educating them on best practices. Although this program is only being piloted within one area in Delaware, this program could possibly be expanded to the entire state and into the Chesapeake Bay Watershed if found to be successful.

7.2. Accounting for Growth

In general, epicenters of high density (>5,000 people/sq. mi.) lie within the municipal boundaries of Wilmington and Newark (Figure 22). This map was generated using ArcGIS to run a Kernel Density analysis on the 2000 Census Blocks. Growth is expected to occur across the State and within the Chesapeake drainage in Delaware (EPA data, Figure 23); however, when and where this growth occurs depends on local land use zoning and ordinaes. Future growth is not expected to match the accelerated growth that occurred over the last decade. DNREC is currently working with the University of Delaware to identify areas that will likely experience growth between now and 2025, also determining if that growth is likely to be in the form of redevelopment within existing town centers or new development. The Stormwater Subcommittee and the University of Delaware will work with counties, municipalities, and development groups to identify when and how anticipated growth will occur.

EPA has provided projected growth estimates within the watershed, based on various parameters (Table 29, Figure 23). The Stormwater Subcommittee and the University of Delaware are in the process of reviewing the data used to determine these projections, and will continue to work with the Chesapeake Bay Program to make needed changes to their Land Use and Population Change Model during Phase II of the WIP process.

In the interim, more information about Delaware's planned approach to account for growth can be found in Section 8 – Land Use. Briefly, the current DSSR enable the formation of stormwater utilities. Additionally, the proposed revised regulations also include provisions for offsets.

FIPSCAT	Total Developed Land 2001	Total Developed Land 2010	% Increase 2001 to 2010	Total Developed Land 2017	% Increase 2001 to 2017	Total Developed Land 2025	% Increase 2001 to 2025
A10003EU1_2981_0000	57	57	0	66	16	71	25
A10003EU1_2983_0000	248	251	1	293	18	330	33
A10003EU0_3010_0000	1,862	2,244	21	2,558	37	2,748	48
A10003EU0_3011_0000	713	823	16	912	28	956	34
A10003EU0_3201_0000	591	690	17	869	47	1,040	76
A10003EU0_3361_0000	34	34	0	37	9	41	19
A10003EU2_3520_0001	19	19	0	21	8	23	17
A10001EU2_3520_0001	311	314	1	339	9	359	16
A10001EM2_3980_0001	898	909	1	969	8	1,013	13
A10001EM3_4326_0000	45	64	42	69	54	73	63
A10001EL2_4400_4590	248	260	5	273	10	281	13
A10001EL2_4590_0001	85	85	0	90	5	93	9
A10005EL2_4590_0001	244	252	3	293	20	334	37
A10005EL0_4591_0000	1	1	0	2	23	2	48
A10005EL0_4594_0000	65	83	26	98	49	113	73
A10005EL0_4597_0000	0	0	0	0	20	0	43
A10001EL0_4560_4562	113	152	35	158	40	161	42
A10005EL0_4560_4562	1,312	1,325	1	1,597	22	1,867	42
A10005EL0_4561_4562	212	225	6	273	29	327	54
A10005EL0_4562_0001	200	222	11	251	25	278	39
A10005EL0_4631_0000	312	318	2	365	17	413	32
A10005EL0_4632_0000	1,327	1,372	3	1,603	21	1,834	38
A10005EL0_4633_0000	2,686	2,762	3	3,194	19	3,620	35
A10005EL2_4630_0000	4,436	4,436	0	4,826	9	5,262	19
A10005EL2_5110_5270	147	152	3	175	19	197	34
A10005EL0_5400_0001	307	309	1	346	13	376	22
A10005EL2_4634_0000	0	0	0	0	0	0	0
	16,475	17,359		19,676		21,811	

Table 29: EPA Projections on Developed Land Increases (acres) between 2001 and 2025

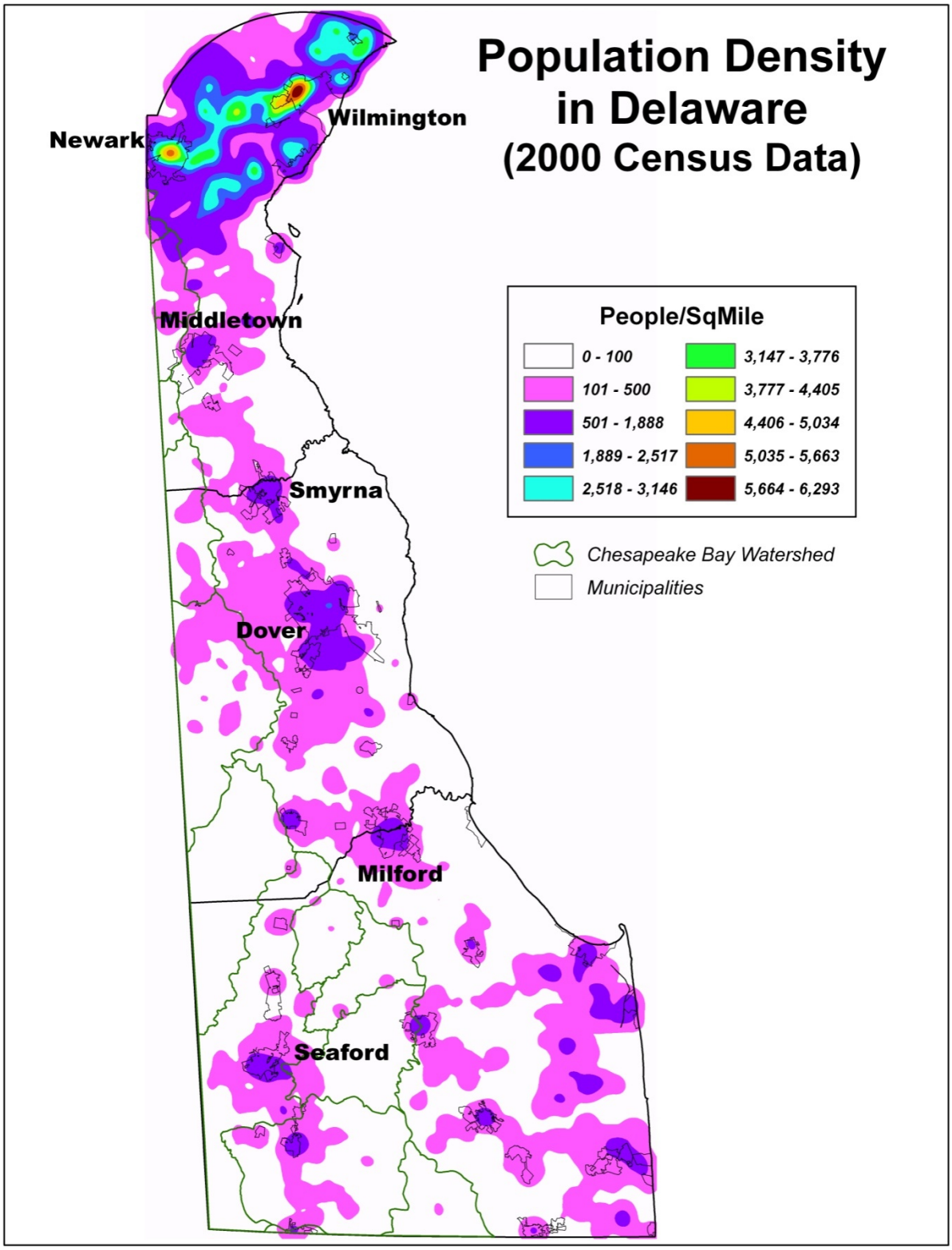


Figure 22: EPA's Estimated Increase in Developed Land in Delaware's Chesapeake through 2025

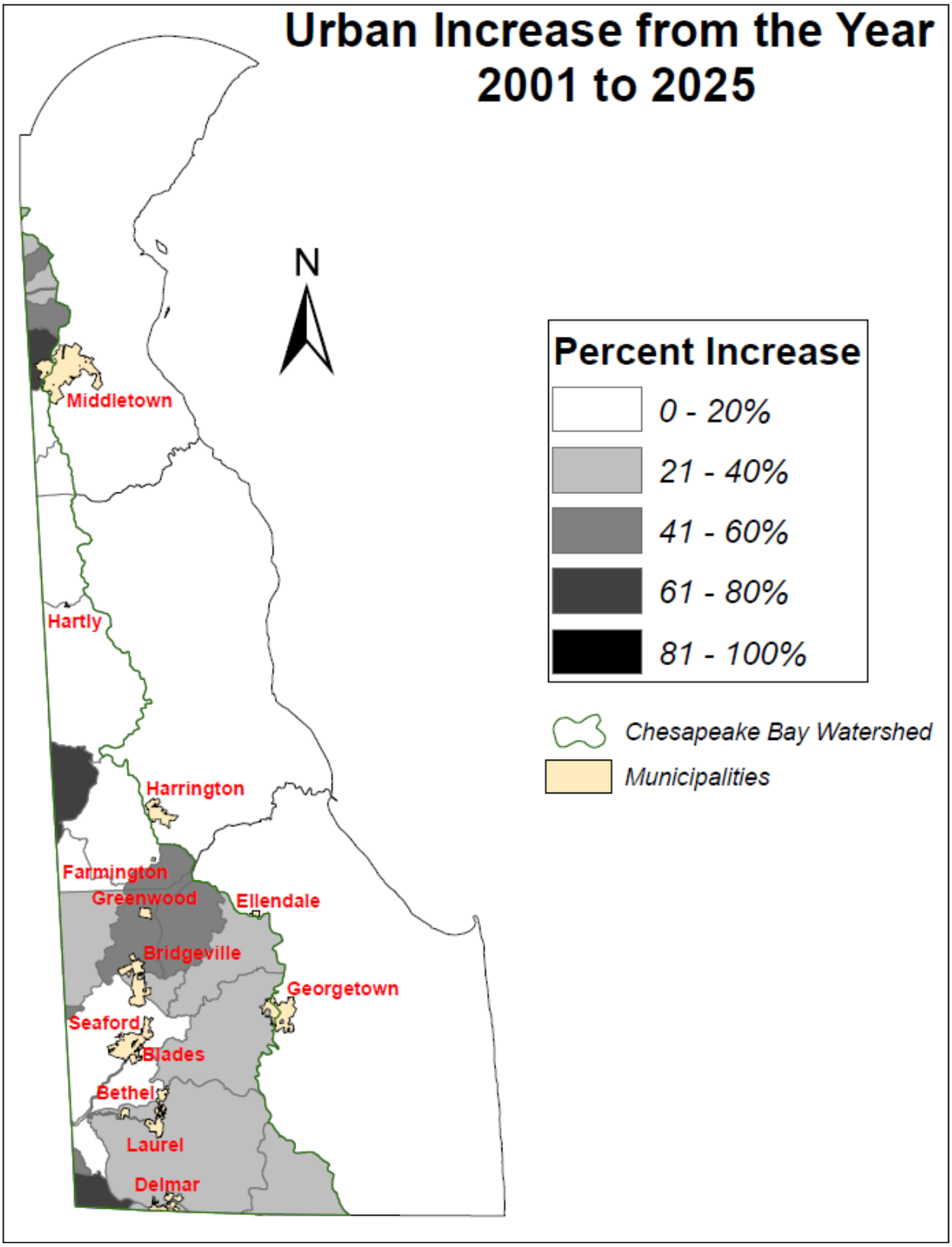


Figure 23: Population Density (2000 Census Blocks) Utilizing ArcGIS to run a Kernel Density Analysis

7.3. Gap Analysis

DNREC's Sediment and Stormwater Program, DelDOT, and DNREC's SWDS (in charge of MS4 and Industrial Stormwater Programs) have determined that additional funding is necessary in order to support heavier implementation and additional enforcement and compliance. With current economic status, the regulatory agencies have not been able to meet full staffing capacity, let alone hire additional staff.

7.3.1. Sediment and Stormwater Program

In order to achieve enhanced water quantity and water quality goals, the Sediment and Stormwater Program has identified the need to revise the existing regulations that govern stormwater runoff from urban and suburban lands. These proposed regulations, which are discussed in more detail in Section 7.4, are expected to be promulgated in 2011, and will apply to new development and redevelopment projects. These regulations will emphasize green technologies, which are expected to be adequate for minimizing new stormwater loads in the urban/suburban sector. Additionally, the permitting and compliance processes will be further enhanced.

One of the primary purposes of a gap analysis is to identify shortfalls in attainment of program goals so that a strategy can be developed to address those shortfalls. In order to finalize a gap analysis for the urban stormwater sector, it will be necessary to ensure any systematic errors in the Phase 5 model have been minimized. Potential sources of errors include:

- Land use classification data for the urban sector
- Urban stormwater BMP data
- Stormwater runoff estimates for the urban sector

Initial analysis of the latest Input Deck runs indicates discrepancies in all three of these areas when compared to local sources. For example, the urban land area used in the model is significantly less than the Delaware State Planning Office's 2007 LULC GIS data indicates. The acres of urban lands managed by stormwater BMPs are also known to be under-counted in the model. In addition, the pollutant loading calculated by the model for the urban sector appears to be significantly higher than would be expected for the inputs used. The net effect of these apparent discrepancies leads to uncertainty in the modeling results. Therefore, it is not possible to definitively determine what the magnitude of the attainment gap may be at this time. The State will coordinate with EPA and Chesapeake Bay Program modelers to ensure the most accurate data is used in the Phase 5 model in order to validate the results of any gap analysis.

7.3.2. Surface Water Discharges Section

7.3.2.1. General Permit Coverage for Industrial Storm Water and Individual NPDES Permits

<u>Lack of Inspection Tracking System</u> – SWDS staff are currently reviewing the inspection process in order to identify ways to make these inspections more efficient, from routing (getting to the sites) to inspection documentation. One of the ways identified was to create a database for tracking and generating inspections. To date, an inspection tracking system for sites under both the General Permit Program and individual NPDES permits has not been in place, so precise calculations for inspection frequency, overall, is not available.

Poor Inspection Frequency for Sites under General Permit Program - SWDS staff are currently reviewing the inspection process in order to identify ways to make these inspections more efficient, from routing (getting to the sites) to inspection documentation. Inspection frequency for sites having individual permit coverage was determined to be adequate, functioning at a very high level of oversight and compliance/enforcement. However, inspection frequency and compliance for sites falling under the General Permit Program was determined to be inadequate. Inspections for such sites are currently conducted, on average, once every two to three years per site. With nearly 400 industrial stormwater sites in Delaware, management staff identified the need for one additional full-time employee so that inspections can be conducted more frequently. The overall goal is to eventually accomplish an inspection frequency of at least once per year for sites having full coverage under the General Permit Program, while sites having No Exposure coverage should be inspected once every two years.

Need to Update Industrial Stormwater Regulations - To improve water quality, the Delaware Industrial Stormwater Program has also identified the need to revise their regulations (in addition to the regulatory update for the Sediment and Stormwater Program) and adopt a BMP technical guidance documents for the program. Currently, the industrial stormwater program requires monitoring of stormwater effluent, but no submission of data or verification of being within permit guidelines, unless the data is specifically requested by DNREC.

Lack of GIS data for Site Location and Navigation - GIS data for all industrial stormwater sites and some individual permitted sites are non-existent. Digital filing systems were determined to be non-existent for the General Permit Program, with documentation available only through hard copy files.

Lack of Education and Information Access - During the time of initial assessment, a website for the Industrial Stormwater Program was not in place, therefore educational material was determined not to be readily available to the public and to industrial site owner/operators. Only general information about the section existed, with no digital availability of the necessary forms (NOI and No Exposure).

7.3.2.2. Individual NPDES Permits for MS4s

Currently, all MS4 permits within Delaware are expired and have been administratively extended, including the one MS4 permit that currently lies within the watershed boundary (Phase I NCC/DelDOT permit). Only a small percentage of the Chesapeake Bay Watershed within Delaware has MS4 permit coverage; therefore, future state initiatives include evaluating additional permit MS4 coverage areas for those urbanized areas within the Chesapeake Bay Watershed.

Since it has been identified that these sites should optimally be inspected at least annually, the new database that has been developed will assist in determining if more resources (one additional full time staff) is necessary in order to meet this goal.

7.4. Strategy to Fill Gaps

7.4.1. Sediment and Stormwater Program

The DSSR were promulgated in 1991 and included a water quality requirement to reduce annual TSS loadings from all new development by 80%. While nutrient load reductions were not specifically required under these regulations, the stormwater BMPs that were implemented to meet this requirement

nonetheless also have some capability to reduce TN and TP loads. Therefore, all new development that occurred in Delaware's portion of the Chesapeake drainage since 1991 has been managed by post-construction stormwater BMPs. These typically included wet ponds, constructed wetlands and other stormwater treatment practices common in other jurisdictions around the Bay during that time period.

The DNREC Sediment & Stormwater Program uses the Delaware Office of State Planning's 1992 Land Use/Land Cover GIS layer as a baseline for determining lands that pre-dated the DSSR. Lands which fall into any of the urban classifications in the 1992 LULC coverage therefore reflect the "legacy" urban stormwater pollutant sources in the Chesapeake drainage. Delaware's contribution to the total drainage to the Chesapeake Bay is approximately 1.1%. Based on an analysis of the 1992 LULC data, the "legacy" urban stormwater sources represent approximately 6% of the Delaware portion of the Chesapeake drainage (0.06% of the total Chesapeake drainage). Further analysis indicates that 77% of this "legacy" urban stormwater load is in low density residential development. Typical pollutant loads from this land use class are relatively low and in many cases may already meet baseline conditions. The remaining non-single family land uses therefore best represent the portion of the "legacy" urban stormwater load that could ostensibly be considered for stormwater retrofits. It would be impractical to assume that this entire "legacy" source could be retrofit with stormwater practices. Assuming an aggressive 25% goal would require approximately 1,500 acres of existing urban lands to be retrofit with stormwater practices. However, it must be noted that this would only account for 0.06% of the Delaware portion of the Chesapeake drainage (0.00004% of the total Chesapeake drainage).

The DNREC Sediment & Stormwater Program has further analyzed the cost effectiveness of performing stormwater retrofits for this "legacy" urban stormwater source. In its *Urban Subwatershed Restoration Manual Series*, *Manual 3*, *"Urban Stormwater Retrofit Practices"*, the Center for Watershed Protection found that urban stormwater retrofit costs are 1.5 to 4 times greater than the cost of constructing those practices for new development based on data collected from nearly 100 retrofit projects in a 2006 survey. Costs for wet pond retrofits ranged from $1,350 to $107,000 per impervious acre treated. Bioretention retrofit costs ranged from $2,000 to $327,000 per impervious acre treated. Design and engineering costs for these projects ranged from 32-40% of base construction costs. The authors further emphasize that other hidden costs to performing urban stormwater retrofits include programmatic costs to find, assess and rank potential retrofit projects.

The Center for Watershed Protection estimates the median cost of a bioretention retrofit project to be $10.50/cu.ft. of runoff treated. A retrofit bioretention facility sized in accordance with Delaware's proposed design criteria to meet the Chesapeake Bay TMDL requirements for TN and TP would cost $93,765 to treat one (1) acre of impervious area using the Center for Watershed Protection's cost estimate and reduce pollutant loads by 11.8 lbs/ac/yr for TN and 1.71 lbs/ac/yr for TP. Based on these figures, a 25% retrofit goal of 1,500 acres would reduce TN loads by 17,700 lbs/ac/yr and TP loads by 2,565 lbs/ac/yr at a cost of over $140M. These facilities have a typical estimated lifespan of 20 years.

For comparison purposes, DNREC's Watershed Assessment Section has estimated that 1 acre of cover crop reduces N loads by 12.4 lbs/ac/yr in Delaware's Inland Bays watershed, which is approximately the same as the treatment capability of a bioretention facility for 1 acre of impervious area. However, the estimated annual cost for this BMP is only $90/ac. Assuming the estimated stormwater retrofit costs could be used to subsidize the cost of planting additional cover crop in Delaware's Chesapeake Bay drainage, $140M would provide 77,777 acres of cover crop each year for 20 years. This would provide N load

reductions of 964,435 lb/ac/yr. This is more than 50 times the N load reduction that could be achieved using stormwater retrofits.

The analysis reveals that the "legacy" stormwater source is a very small percentage of Delaware's overall pollutant loadings to the Chesapeake Bay. Because of this, any pollutant reductions that could be achieved through urban stormwater retrofits would result in minimal gain at very high cost. The benefit/cost ratio for implementing additional agricultural BMPs far exceeds that for implementing stormwater retrofits to get similar pollutant load reductions. Rather than setting retrofit acreage goals based on a broad "shotgun" approach for this widely scattered "legacy" source, Delaware proposes targeting the major urban areas of Seaford and Laurel for a more focused source control effort along with an opportunistic approach to stormwater retrofits as potential projects arise and funds become available. These two municipalities are both located in watershed segments that have been identified as being most "effective" for nutrient reductions. In addition, they both have direct stormwater discharges to waters within the Nanticoke watershed. The overall goal would be to seek funding opportunities for 5 acres in retrofits targeted specifically at the direct discharges from these two municipalities. While source controls would be far more cost effective than retrofitting urban stormwater practices, their benefits are not as well accounted for in the P5 model. Delaware would like to work more closely with EPA and the Chesapeake Bay modelers to ensure these benefits will be adequately credited in its overall strategy to reduce pollutant loads to the Chesapeake Bay.

Redevelopment projects will be required to construct in accordance with the current Sediment and Stormwater Regulations, essentially retrofitting areas as they become redeveloped. Drainage Improvement Projects that receive any type of State assistance will have Green Technologies incorporated into the design as funding is available.

In order to achieve additional nutrient and sediment reductions, the existing DSSR are in the process of being revised and updated, and will be complete within the next year. These regulations will apply to new development and redevelopment projects and will include requirements for both construction site and post-construction stormwater management. A technical document containing technical standards for new development and re-development projects will be developed in conjunction with the proposed revisions to the DSSR.

The emphasis under the proposed revisions for both stormwater quality and stormwater quantity management will be on runoff reduction techniques that encourage infiltration and recharge of stormwater runoff. This method will both decrease pollutant loads and mitigate the hydrologic impacts to receiving waters often associated with land development. All projects developed under the revised Sediment and Stormwater Regulations will be required to meet the TMDL for that particular watershed. All projects developed in the Chesapeake Bay watershed following the effective date of the revised regulations will be subject to this requirement. Projects that cannot meet the state volume management requirement and/or the TMDL due to site limitations will be given the option to provide an offset for their stormwater quality management. An offset program will be developed and outlined in the Technical Document to support the revised regulations.

New effluent limitations set by EPA for construction activities will be incorporated into the next set of state construction general permit regulations, which will occur following EPA's issuance of final effluent limitation guidelines.

7.4.2. Surface Water Discharges Section

7.4.2.1. General Permit Coverage for Industrial Storm Water and Individual NPDES Permits

Lack of Inspection Tracking System - DNREC recently developed and has begun utilizing a comprehensive inspection tracking system, starting in October 2010, maintained in a Microsoft Access database. All inspections (for sites having individual permits and sites covered under the General Permit Program) will now be input and tracked in this database. Also, within this database is the capability of auto-generating standardized letters, which should additionally increase efficiency. The tracking system also has an input deck for all compliance and enforcement issues.

Poor Inspection Frequency for Sites under General Permit Program – With a shortage of permanent, full-time staff, it is undetermined how DNREC SWDS will acquire additional funding to accommodate one additional full-time employee dedicated to conducting inspections. The Chesapeake Regulatory Grant has provided funding for one two-year seasonal employee, where the added staff will be utilized to increase inspection frequency and enforcement/compliance for sites within the Chesapeake Bay Watershed; however, this is a short-term solution to a much larger problem of needing two permanent field employees (at a bare minimum) to conduct inspections for these sites. Additionally, the current full-time staff that was previously dedicating 100% toward conducting industrial stormwater inspections has been reassigned to now dedicating 50% toward addressing new EPA mandates pertaining to NPDES permits for pesticide applicators. This mandate came without any funding allocations to states in order to implement this program, therefore, indirectly affecting the success of the Industrial Stormwater Program negatively.

Through the MS4 permitting process, it was determined that within the next MS4 permit to New Castle County/DelDOT, permittees will be given the added responsibility of conducting inspections on nearly 130 industrial stormwater sites. It was determined by DNREC that oversight will be much greater at these sites from a local perspective. In order to make this transfer successful, the SWDS will be developing a training program for the MS4 permittees on inspection of industrial stormwater sites. As these facilities are transferred over to the MS4 jurisdiction for inspection, the program will need to dedicate less time toward conducting actual inspections, and more time toward training, oversight, and program evaluation.

Need to Update Industrial Stormwater Regulations - Funding was recently provided through the Chesapeake Regulatory Grant which will be used to assist the SWDS with revising the regulations, and possibly creating a BMP technical guidance document for industrial stormwater. In the regulations, stricter monitoring and reporting requirements will be implemented.
These revisions are separate to the updates associated with the Delaware Sediment and Stormwater Regulations. Revisions to the Industrial Stormwater Regulations are expected happen over the next two years (draft available by 2012) and include stricter standards and reporting requirements.

Lack of GIS data for Site Location and Navigation - A rough draft ArcGIS data layer for industrial stormwater sites was completed in October, 2010, which was developed to assist inspectors to navigate and locate sites more quickly. Data will continue to be refined as inspections are conducted over the next two years. The data were then used to create a mapbook that could be utilized by inspectors in the field. The sites can now be viewed (hard copy and digitally) in an organized manner, spatially. Management staff at the SWDS hope that this tool will make inspections more efficient, by being able to identify clusters of facilities that can all be inspected on the same day.

Lack of Education and Information Access - In July, 2010, the SWDS created a website for Delaware's Industrial Stormwater Program, where all forms and other educational material can now be accessed online. All forms were re-formatted to be writable pdf forms, making submission of forms easier for users. This website address now appears on all written correspondence that is generated and sent to site owner/operators.

7.4.2.2. Individual NPDES Permits for MS4s

With one full-time staff now allocated to the MS4 program, it is estimated that all existing MS4 permits in Delaware will be renewed by 2013. A permit renewal schedule was provided to EPA in August, 2010, which outlined specific tasks and milestones for renewing these permits. Within the Chesapeake Bay Watershed, the new Phase I NCC/DelDOT permit is in the process of being re-drafted and re-issued. Additionally, outreach and education, among other BMPs, is incorporated into MS4 permits. Activities within the MS4 portion of the watershed will depend on local jurisdictions updating comprehensive plans, ordinances, and codes to be consistent with nutrient and sediment reduction goals. The SWDS will work with local communities to accomplish these goals, and will additionally evaluate the need for further MS4 coverage within the Chesapeake Bay and throughout the state, after analyzing future growth patterns and existing population data (2010 census).

7.4.3. Data Collection and Management

7.4.3.1. Sediment and Stormwater Program

One of the data gaps identified early in the development of the WIP was information on the area treated by existing urban stormwater management practices. The Sediment & Stormwater Program, along with two of its delegated agencies, have partnered together and contracted the development of an updated project tracking database. This updated database, dubbed "MudTracker", will include data on area treated to help fill this gap. The application itself has already been completed and the partners are now in the process of inputting historic data into database. Sites within the Chesapeake Bay drainage area have been given the highest priority for inclusion and it is anticipated that this task will be completed by the first half of 2011. This will help address some of the modeling discrepancies noted in Section 7.3.1.

7.4.3.2. Surface Water Discharges Section

As part of the Chesapeake Regulatory Grant, one two-year seasonal employee will be hired by the Surface Water Discharges Section to collect data from site owner/operators under the General Permit Program for Industrial Stormwater within the Chesapeake Bay. Data collection is vital to determine current compliance rates, as data submission is not required under the current State regulation. The new regulation will address all federal mandates pertaining to monitoring and data submission requirements.

The Surface Water Discharges Section began utilizing the newly developed Access database in October, 2010. This database tracks all inspections and enforcement actions for each site. An ArcGIS data layer has also been created to improve tracking of industrial stormwater sites.

7.4.4. Funding Opportunities

The funding opportunities to improve stormwater quality in the Bay watershed are tied to several funding sources. The State Revolving Loan Fund (SRF) has recently been utilized for "green projects" of which stormwater is a major component. Recent projects approved for a low interest loan have included a major flood abatement project in Seaford which integrated a water quality component to the project. More projects may seek this funding in an effort to improve community drainage, and a strategy should be employed to assure that a water quality benefit is also a part of the project design.

The state has utilized a special fund named the 21rst Century Resource Conservation and Development (RCD) fund to finance major and minor flooding and drainage projects throughout the state for the past 16 years. While these funds are limited, there should be a concerted effort to integrate water quality management in a retro-fit manner into projects funded through this revenue stream.
State cost share funds if enhanced, could be made available for funding more urban projects with a demonstrated water quality benefit in the future. These funds are made available to landowners and could be expanded to include municipalities with a plan for identifying and implementing water quality practices. The Financial Assistance Branch (FAB) of DNREC through the leadership of the Clean Water Advisory Council (CWAC) is developing a program to deliver funding to municipalities through Stormwater Planning Grants which would require that priority water quality goals be met. In addition, the CWAC and FAB have developed funding through community water quality grants that serve to improve water quality through matching grants.

Other grant funding through Section 319 Grants as well as direct grant funds through the Chesapeake Bay Program and other sources such as National Fish and Wildlife Federation will be used within the watershed, although most of these funds in the past have not been used in the urban corridors. This strategy is changing and more funding in the future will be directed toward the developed portion of the landscape.

The Department will also aggressively seek additional funding and work with the towns, municipalities and the Conservation Districts to identify resources and utilize them to the extent possible to meet the growing demands for funding stormwater source reduction strategies and retro-fits within the Bay watershed.

7.5. Best Management Practices

Stormwater management practices used in Delaware have evolved over the years from traditional treatment practices to the more contemporary use of Green Technology practices that promote recharge and reuse of stormwater runoff. The water quality benefits from the former class of treatment practices are based on their pollutant removal efficiency which in turn is largely based on physical settling and filtering processes. The original technical standards under the DSSR that went into effect in 1991 were based on 80% reduction in annual TSS loads for the first inch of runoff.

Green Technology practices, on the other hand, achieve their benefits through reducing stormwater runoff volume. This not only reduces pollutant loadings, it also has the added benefit of protecting receiving waters from the hydrologic impacts associated with new development. Green Technology practices were initially introduced into the DSSR through revisions that became effective in 2005 which elevated them to the highest preference in the stormwater BMP hierarchy. The current technical standards for these

practices require that they be sized to manage the runoff from a 2.0", 24-hour rainfall, which is approximately the 6-month frequency storm event for Delaware.

The proposed revisions to the DSSR will increase the required treatment volume to the annualized runoff from the 1-year frequency storm event, which is approximately 2.7" of rainfall in Delaware. This would capture and treat all runoff up to the 99th percentile annual precipitation. For new development, the initial goal would be to employ runoff reduction practices to the maximum extent practicable (MEP) to capture runoff volume such that the effective imperviousness for the site is brought down to 0% thereby reducing pollutant loadings by an equivalent amount. Any residual runoff that cannot be captured and managed through runoff reduction techniques would be required to be treated with more traditional stormwater management practices until the targeted TMDL loading rate is achieved. Redevelopment projects would be required to reduce their effective imperviousness to 50% of the existing condition, with a consequential 50% reduction in the existing pollutant load. If site conditions are such that the runoff reduction and/or water quality treatment criteria cannot be met, an offset must be provided such that equivalent water quality objectives can be met elsewhere in the project watershed. This approach is consistent with the recommendations from the National Research Council's report on "*Urban Stormwater Management in the United States*", as well as recent EPA policy memoranda that recognize stormwater flow and volume management as appropriate surrogates for meeting overall water quality and habitat protection goals and objectives.

Although the Chesapeake Bay Phase 5 model has some capability to account for the benefits of these newer Green Technology practices, they are not explicitly modeled as runoff reduction practices. EPA's Scenario Builder spreadsheet tool is used as the interface between BMP data collected by the states and the pollutant reductions as predicted by the Phase 5 model. It is felt that the BMP classifications used in the model will need to expand in order to measure the true benefit of Delaware's Green Technology practices. The following sections provide an overview of the urban stormwater practices used in the current model and some discussion on Green Technology practices that are not adequately represented.

7.5.1. Scenario Builder BMPs

7.5.1.1. Wet Ponds and Wetlands: Currently, Delaware has on record 87 wet pond and wetland structures in the Chesapeake; however not all agencies currently have drainage area populated in databases, but this is being corrected. Using an average drainage area of 16 acres/structure, this equates to 1,392 acres. As new lands are developed, new stormwater practices, with an emphasis on runoff reduction practices, will be implemented.
GOAL: Maintain existing 1,392 acres.

7.5.1.2. Dry Detention Ponds and Hydrodynamic Structures: Delaware does not currently report this practice, however it is likely occurring and it is a naming inconsistency which will be corrected.
GOAL: TBD.

7.5.1.3. Dry Extended Detention Ponds: Currently, Delaware has on record 62 dry extended detention ponds in the Chesapeake; however not all agencies currently have drainage area populated in databases, but this is being corrected. Using an average drainage area of 12.5 acres/structure, this equates to 775 acres. As new lands are developed, new stormwater practices, with an emphasis on runoff reduction practices, will be implemented.
GOAL: Maintain existing 775 acres.

7.5.1.4. Urban Infiltration Practices (no sand or vegetation; no underdrain): Currently, Delaware has on record 35 infiltration practices in the Chesapeake; however not all agencies currently have drainage area populated in databases, but this is being corrected. Using an average drainage area of 4.06 acres/structure, this equates to 142 acres. As new lands are developed, new stormwater practices, with an emphasis on runoff reduction practices, will be implemented.
GOAL: Maintain existing 142 acres.

7.5.1.5. Urban Infiltration Practices (with sand or vegetation; no underdrain): Delaware does not currently report this practice, however it is likely occurring and it is a naming inconsistency which will be corrected.
GOAL: TBD.

7.5.1.6. Urban Filtering Practices: Currently, Delaware has on record 72 urban filtering practices (biofiltration, bioretention, bioswale, filter strip, filtration, forebay micropool) in the Chesapeake; however not all agencies currently have drainage area populated in databases, but this is being corrected. Using various average drainage areas, this equates to 446 acres. As new lands are developed, new stormwater practices, with an emphasis on runoff reduction practices, will be implemented.
GOAL: Maintain existing 446 acres. Plus, increase implementation by 4.71 acres due to the near term installation of 5 bioretention/rain garden fixtures in the Seaford (Appendix D) area and an additional 5 acres of retrofits for the Seaford/Laurel area. Total = 456 acres by 2017.

7.5.1.7. Erosion and Sediment Control: Currently, Delaware has recorded 42 erosion and sediment control sties in the Chesapeake; however the value is out of date and area corresponding to the sites is currently being determined from a database. As new lands are developed, new stormwater practices, with an emphasis on runoff reduction practices, will be implemented. The DSSR require erosion and sediment control on any land disturbing activities exceeding 5,000 square feet.
GOAL: 100% of all sites.

7.5.2. Additional BMPs Not Currently Included in Scenario Builder

7.5.2.1. Spill Prevention and Response: All industrial sites and sites that are covered under an individual permit and under the General Permit Program are required to adhere to strict BMPs relating to storage and spill prevention. These requirement are outlined in their mandated Storm Water Pollution Prevention Plan (SWPPP), individual for each site.
GOAL: To have a BMP manual strictly for industrial stormwater sites to be available at the time of the revised industrial stormwater regulations.

7.5.2.2. Educational BMPs: All MS4 permits contain educational BMPs for stormwater.
GOAL: Maintain such BMPs per the federally mandated requirements.

7.5.2.3. Source Controls: Street sweeping, urban "housekeeping" and similar source control practices are shown to have pollutant reduction benefits based on literature review. However, they are currently not well accounted for in the Chesapeake Bay P5 model.
GOAL: Develop standards and specifications for this practice to facilitate implementation and work with EPA to determine benefits.

7.5.2.4. Vegetated Roofs: While relatively uncommon at this point, this practice is expected to become more popular as LEED certification becomes more prevalent.
GOAL: Develop standards and specifications for this practice to facilitate implementation and work with EPA to determine benefits.

7.5.2.5. Rainwater Harvesting: Rain barrels can be effective at the individual lot scale, while larger installations using cisterns can augment irrigation of landscaped areas.
GOAL: Develop standards and specifications for this practice to facilitate implementation and work with EPA to determine benefits.

7.5.2.6. Impervious Disconnection: Directing stormwater runoff onto turf or wooded areas can significantly reduce annual runoff volumes compared to a connected system of curbed streets and stormdrains.
GOAL: Develop standards and specifications for this practice to facilitate implementation and work with EPA to determine benefits.

7.5.2.7. Soil Amendments: Research is beginning to show that this can be an effective practice for improving the hydrologic condition for poor and/or compacted soils.
GOAL: Develop standards and specifications for this practice to facilitate implementation and work with EPA to determine benefits.

7.5.2.8. Stream Restoration: While this practice is being considered for inclusion in the next version of the Chesapeake Bay Model, there are additional benefits besides the pollutant reduction credits being proposed. Stabilizing impacted streams, restoring natural morphology to channelized systems and installing water control structures on existing drainage ditches all have the potential to greatly improve overall watershed health and function. This will also help meet some of the restoration goals discussed in Section 10 of this document.
GOAL: Develop standards and specifications for this practice to facilitate implementation and work with EPA to determine benefits. Maintain 200 feet of restoration on a low density pervious site in the Seaford area.

7.6. Contingencies

If needed load reductions for the urban and suburban sector cannot be met using current best available technologies (BAT), the technology will need to improve in order to meet any shortfalls. Since Delaware is not currently focusing efforts on retrofits due to their expense, if it is determined that retrofits are indeed necessary, Delaware will strive to identify funding sources that can support these projects.

Continuation of increased inspection and compliance assistance/enforcement within the Chesapeake Bay Watershed beyond the two-year time restriction of the Chesapeake Bay Regulatory Grant is strictly contingent on future funding opportunities for that position.

Additional Federal requirements will be necessary if authority under State regulations cannot meet these goals.

7.7. Tracking and Reporting Protocols

7.7.1. Sediment and Stormwater Program

For new development, the collection, reporting, and verification of stormwater nutrient and sediment controls is the responsibility of delegated agency, with oversight by the DNREC Sediment and Stormwater Program. Currently, not all of the delegated agencies use the same tracking and reporting system, so information in not in a consistent format. However, the delegated agencies have been following a systematic process to gather the necessary data for modeling BMP impacts. Changes to existing collection, reporting, and verification procedures are already underway and will be complete statewide within the next couple years. A new database, MudTracker, will resolve this issue for several of the jurisdictions as it tracks post-development stormwater BMPs.

DNREC and DelDOT are currently working with the EPA to ensure that the reporting of this data is consistent with EPA schema protocols and that the reporting of progress only includes practices and programs that follow EPA-approved definitions of BMPs used in Scenario Builder and the Chesapeake Bay Program Watershed Model Phase 5.3. The state has also requested technical assistance from the EPA contractor Tetra Tech to explore alternative criteria to address scale issues and credit for load reduction stormwater BMPs. Since the major jurisdictions within the Chesapeake will be using MudTracker and the schema protocols are being incorporated, concerns for double-counting have now been minimized. Delaware will continue to work with EPA to gain guidance on certain questions such as whether practices, such as stream restoration, are considered to be a wetland restoration or a stormwater management measure.

Regulatory requirements include design standards, along with routine inspections for new development and re-development. If a stormwater BMP that was installed under the existing (and eventually the revised) regulations is deemed to be non-functional, the BMP must be reconstructed to a functional condition. Therefore the data contained in the database and reported to the Chesapeake Bay Program will only represent fully functioning practices and Delaware has procedures for ensuring that practices are in compliance.

Additionally, work is underway to extract information regarding stormwater BMPs from both MudTracker and DelDOT databases, representing more than 90% of the Chesapeake Bay Watershed in Delaware, into the National Environmental Information System (NEIEN) schema so that data may be directly sent to the Chesapeake Bay Program through network nodes and receive credit in the model. A description of data generation and acquisition, assessment and oversight, and data validation and usability will be provided in Delaware's Nonpoint Source Best Management Practice Implementation Data Quality Assurance Project Plan (Appendix C). The QAPP will be updated to reflect recent changes by April 30, 2011. DNREC staff are also participating in the development of the Bay TMDL Accounting and Tracking System (BayTAS) Version 1.0 to track the TMDL waste load allocations and load allocations and Delaware's progress toward meeting those goals.

In accordance with the DSSR Section 12, construction reviews are conducted weekly by certified construction reviewers (CCR) on projects where soil disturbance is greater than 50 acres. In addition, the Department or the delegated agencies may require a CCR on any project regardless of its size.

Each delegated agency may follow its own CCR policy approved by DNREC. The delegated agencies conduct inspections on a regular basis and use the CCR reports as a tool to help target their inspections. The Sediment and Stormwater Program meets with the delegated agencies monthly to discuss program

issues. The Sediment and Stormwater Program is audited by EPA through the State Review Framework process.

7.7.2. Surface Water Discharges Section

7.7.2.1. General Permit Coverage for Industrial Storm Water and Individual NPDES Permits

The Surface Water Discharges Section conducts inspections of sites covered under individual permits and under the General Permit Program, where inspection documentation and enforcement/compliance are audited by EPA through the State Review Framework process.

The Surface Water Discharges Section began utilizing the newly developed Access database in October, 2010. This database tracks all inspections and enforcement actions for each site. An ArcGIS data layer has also been created to improve tracking of industrial stormwater sites.

For the future revision to the industrial stormwater regulations, the SWDS will be considering the requirement for sites to submit water quality sampling data. Data collection and sample analysis is the responsibility of the permitee.

7.7.2.2. Individual NPDES Permits for MS4s

Approximately 25% of the state of Delaware is covered under MS4 requirements, although only a small portion of that lies within the Chesapeake Bay Watershed. Audits of the MS4 permittees are conducted during the second and fifth permit terms. The program audit is a comprehensive evaluation of all components of the MS4 program, assessing overall implementation and identifying deficiencies prior to permit renewal. Specifically, the audit evaluates program implementation and maintenance used to address the six (6) minimum control measures as identified in the Storm Water Management Plan (SWMP). The audit evaluates requirements as written in the permit, as committed in the SWMP, and as required under the Federal regulations. Audit reports summarize the findings of the MS4 audit in the same order and format of the Permit. Each program component section contains a summary of the findings for the program component and associated required and recommended actions. The recommended actions are based on programs that are being implemented by other MS4s throughout the state or on commitments within Annual Report.

For the MS4 program in Delaware, an annual report is additionally required for all permitted jurisdictions. Permanent BMPs and maintenance of these facilities, such as wet ponds, dry ponds, and infiltration basins, are contained within in the MS4 tracking system of the entity that is permitted which are already being reported to the Chesapeake Bay Program. An Access database has also recently been created to track MS4 reporting.

SECTION 8. LAND USE

This section of the WIP was prepared by the Land Use and Comprehensive Plans Subcommittee. This group included representatives of the Department, the Office of State Planning Coordination, the Department of Agriculture, the University of Delaware's Sustainable Coastal Communities Program, the Home Builders Association of Delaware, Kent County, and New Castle County.

This group was formed to address elements of the Watershed Implementation Plan related to Accounting for Growth and to communicate the requirements of the Chesapeake TMDL to the local governments within the watershed, along with opportunities and tools for compliance. The largest city entirely contained within Delaware's portion of the watershed is Seaford, with a population of approximately 7,000; the smallest is Bethel, with 188 residents. Most of the explosive growth in Sussex County during the mid-2000s occurred on the eastern, coastal side of the county, so this section of the county remains extremely rural. In New Castle County, Middletown (pop. 18,600) is the largest city partially contained within the watershed, although its growth in this westerly direction has to date been restrained by its comprehensive plan and the use of Transfer of Development Rights to preserve land.

8.1. Current Programs and Capacity

Planning and zoning in Delaware is a function of local government. The State has limited ability to influence – or reject --- individual projects within counties and towns. However, each of Delaware's 57 local governments (including its three counties) is required by law to prepare a comprehensive plan, with specific elements required such as wastewater planning and conservation, and towns cannot annex new territory without a comprehensive plan. The State certifies each jurisdiction's comprehensive plan, ensuring that it has met requirements of the law, and withholding of certification can have fiscal consequences for a local government.

All three counties have very different approaches to managing growth. The Chesapeake watershed accounts for about half the land area of Sussex County, where the base, by-right density is two units to the acre and individual septic systems are permitted on half-acre lots. Kent County has more growth restraints in place, particularly on the western side that includes the Chesapeake subwatershed; for example, it has banned community wastewater systems, in effect restricting large, more dense developments in that area. New Castle County, with only a sliver of the Chesapeake watershed within its boundaries, has the most protective zoning and environmental ordinances in the State.

Permitting programs such as wastewater disposal, sedimentation and stormwater, wetlands and subaqueous lands, and the Department of Transportation's power to grant access to its roadways exercise some degree of influence over the configuration and design of development projects, but generally these programs accommodate new development and cannot prohibit it.

Also, statewide land-use planning mechanisms such as the Preliminary Land Use Service and Strategies for State Policies and Spending are described below.

8.1.1. Preliminary Land Use Services

Contaminant sources can often be traced to activities done on land. Any sort of change to land, such as conversion of undeveloped to developed land, carries a high potential for contamination. Contaminants can

enter various pathways that lead to water bodies, infecting the waters and causing numerous problems for those reliant on the water. The Preliminary Land Use Service (PLUS) is a preventative program used to ensure that any sort of land use activity is carefully examined for potential adverse impacts to land and water before implementation.

PLUS is outlined in Chapter 92 of Title 29 of the Delaware Code. It requires applicants to obtain a state agency review of their proposal for major land use changes before they can submit their proposals to local governments. The value and knowledge gained from reviews by state agencies at the start of the land development process assists and supports land use decisions made by local governments. Land use change proposals are submitted to state agencies through the Office of State Planning Coordination, and are subject to monthly PLUS meetings hosted by the Office. During these meetings, applicants meet with state agency resource experts to discuss their plans, identify possible problems, and formulate feasible solutions.

Applicants are able to explain their projects in great detail to a group of planners that come from all relevant state agencies. Planners and applicants can interact in a constructive dialogue to formulate an ideal plan of land use action. By streamlining the process, the State can respond more quickly and coordinate more closely with local timelines. As a result, state comments are received promptly, and better reflect state and local land use plans and regulations.

8.1.2. Comprehensive Plans

By state law, Delaware's three counties and 57 municipalities are required to prepare comprehensive land use plans and update them every five years. Each plan, by law, is required to have conservation and wastewater elements prepared "in consultation with" DNREC. Most conservation elements contain at least one reference to the TMDL in the jurisdiction's watershed.

All comprehensive plans are routed through PLUS for review by state agencies. The plan is "certified" by the state; if the state does not certify the comprehensive plan, the law withholds discretionary capital funds and grants from that jurisdiction. Codified in state law, the state's PLUS and comprehensive planning processes are tools with a significant measure of consistency, enforceability, and authority to meet water quality goals in the Chesapeake watershed.

8.1.3. Public Outreach

In addition to following PLUS procedures, teaching and reaching out to the public through different activities can mitigate and improve water quality. Teaching the use of best management techniques on individual residential lots, such as the installation of rain barrels, planting native plants and grasses, regular maintenance of septic systems, and minimizing fertilizer application are extremely beneficial to assisting water quality. Stenciling storm drains is an activity that involves community awareness, as well as community participation. Publicizing and encouraging various water conservation tactics is a good way to demonstrate the scarcity of water and the necessity to conserve it.

Residential fertilizer use

Both the agricultural and the home building communities have advocated more outreach to homeowners, lawn-care companies and retailers on residential fertilizer . A stakeholder group has developed guidelines for suburban fertilizer use and requirements for certifying lawn care companies.

By 2012 the Department will adopt a voluntary homeowner education and commercial lawn-care certification program, which includes:

- Keep fertilizer and grass clippings off any impervious surfaces. This may involve sweeping granules and clippings back into the grass from sidewalks, driveways and other areas after application.
- Leave behind educational lawn care material and explain to the homeowner that he/she needs to follow the provided lawn care guidelines when performing any lawn care on their own, in order to maintain the integrity of the program.
- For new lawns, test the soil for phosphorus, potassium and pH to determine the specific needs of the lawn before application.
- For established lawns, test the soil once every three years for phosphorus, potassium and pH to determine the specific needs of the lawn. (For developments, one home per development can be tested every 3 years.)
- For all lawns, do not apply phosphorus or potassium if soil test levels are above optimum.
- Make sure spreaders are applying the correct amount of fertilizer and record the pounds of nutrient applied to each lawn.
- All lawn care companies are required to submit the following once per year:
  - Name, address and contact information of lawn care company
  - Five random soil tests
  - Total number of new customers who chose your company due to this program's certification
  - Total area of lawns maintained
- Meet ALL the nitrogen and phosphorus application in the following table.

Table 30: Requirements for Fertilizer Use for the voluntary homeowner education and conmmercial lawn-care certification program

Turfgrass Species	Max Amount of Nitrogen Over Entire Year	Suggested Application Rates and Timings When Using Fertilizer Containing Less than 50% SAN*	Suggested Application Rates and Timings When Using Fertilizer Containing More than 50% SAN	Limitations on Use of Phosphorus
Cool Season Grasses (eg. Tall Fescue, Perennal Rye, Fine Fescue, Kentucky Bluegrass)	3 lbs/1000 ft^2	March/April: 0.5 lbs/1000 ft^2 Sept: 1 lb/1000 ft^2 Oct: 1 lb/1000 ft^2 Nov: 0.5 lb/1000 ft^2	Aug: 1.5 lbs/1000 ft^2 Oct: 1.5 lbs/1000 ft^2	Fertilizer containing 3% or less phosphorus may be used, except if soil test phosphorus level is above optimum
Warm Season Grasses (eg. Bermudagrass, Zoysiagrass)	3 lbs/1000 ft^2	May: 1 lb/1000 ft^2 June: 1 lb/1000 ft^2 July/Aug: 1 lb/1000 ft^2	May: 1.5 lb/1000 ft^2 July: 1.5 lbs/1000 ft^2	

*SAN – Slowly Available Nitrogen

In addition to the requirements outlined above, lawn care companies certified with this program should adhere to the following recommendations:

- Provide a copy of resident's soil test to them so they understand how your lawn care company is fertilizing their lawn based on test results
- New seeding with turf-type tall fescue is recommended
- Use slow release fertilizers

8.2. Accounting for Growth

8.2.1. Projecting Future Growth

Growth is expected to occur across the State and within Delaware's portion of the Chesapeake Bay watershed however when and where growth will occur depends on local land use zoning and ordinances. EPA has provided the jurisdictions with their projections on growth parameters (see Section 6.2 for onsite system projections and 7.2 for developed land projections). To evaluate those projections, DNREC along with the Office of State Planning and Coordination (OSPC) and the University of Delaware are collaborating to produce a build-out analysis of county and local jurisdictions through 2025.

The University of Delaware (UD) Sustainable Coastal Communities (SCC) Program in cooperation with DNREC and OSPC has worked to develop a land use model for the Delaware segment of the Chesapeake Bay Watershed. The model is built upon the *CommunityViz®* platform and will aid officials in visualizing land use issues and understand the consequences of land use policies while working to provide necessary information to implement environmental improvements to in the Delaware portion of the Chesapeake Bay Watershed.

The SCC Land Use Modeling Team was tasked with the land use evaluation and modeling for the over 20 river segments (e.g. subwatershed) of the Chesapeake Bay Watershed within Delaware. The Bay watershed impacts all three Counties within Delaware, with the bulk of watershed located within Sussex County. Based upon Federal requirements, DNREC requested that the model should account for all activities within the watershed statewide. As a result of this requirement, statewide parameters were applied to the model's assumptions and constraints.

The general tasks of this project are described below and the full methodology and preliminary draft results can be found in Appendix E.

- Use the UD Community Land Use Model and *CommunityViz®* GIS platform to apply its 100-Acre grid to the entire Delaware portion of the Chesapeake watershed. The project will utilize the UD's previous work on defining Existing Land Use in Sussex County to expand the study area to the entire Chesapeake watershed within Delaware, showing current and projected land use and population changes through 2025.
- Incorporate small area population projections from the Delaware Population Consortium (DPC)
- Apply statutorily required comprehensive plans from Delaware's three counties and the 14 incorporated municipalities within the watershed for growth considerations.
- Assign the UD's model land use types to growth based on DPC projections for the 2005-2015[1] and 2015-2025 time frame.
- Perform *CommunityViz®* Build-out and Impervious Cover analysis for each of the Delaware Chesapeake Bay subwatersheds.
- Assign current and planned method of wastewater disposal by land use type to the 100A tiles in the subwatershed.

Preliminary results indicate good agreement on the total housing unit estimates from the two models. During Phase II of the WIP, the Land Use and Comprehensive Plan Subcommittee and UD will work with the other Interagency Workgroup Subcommittees, counties, municipalities, wastewater utilities, and development groups to help fine tune the growth projections. This local information will be used to make needed changes to EPA's Land Use and Population Change Model.

This entire analysis will help inform Delaware WIP goals and 2-year milestones. It will also help focus communications strategies and planning efforts on segments and local jurisdictions where future growth will occur and those with the largest gaps and opportunities for improvement. Additionally, the map and CommunityViz model may be used as part of an offset program (see below).

[1] DNREC requested growth projections to 2017 and 2025. DPC small area projections are estimated in five year increments. It was agreed by all parties that the UD would provide growth data for years 2015 and 2025, and that DNREC would extrapolate to year 2017 if necessary.

8.2.2. Targeting and Offsetting Nutrient and Sediment Loads from Future Growth

One of the requirements EPA has identified as a necessary component of WIPs is a method to account for growth. Growth can be addressed in one of two ways: target load for future growth or offset loads resulting from future growth. Since the EPA growth projections were only released in July 2010 and the UD growth assessment is still being finalized, Delaware did not feel it had enough information to target loads for future growth from nonpoint sources in the watershed (Delaware does plan to target loads for wastewater treatment plants (see Section 5). Therefore, Delaware has decided to pursue an offset program.

The only way Delaware can accommodate new or increased loadings of nitrogen, phosphorous, or sediment in this watershed is through a mechanism that allows for quantifiable and accountable offsets of that new or increased load.

In fact, the Sediment and Stormwater Program has already begun working on developing an offset program for their revised stormwater regulations which would apply statewide (See Section 7). Those regulations will have a program based on offsetting the volume of stormwater runoff as well as the associated nutrient and sediment loads in that volume of runoff. Since new loads as a result of new land use changes in the Chesapeake will have to be offset, more than just stormwater will need to be addressed and a program and tracking tool that also looks at land use changes (especially the loss of natural areas like forests and wetlands) and any new loads as a result of onsite wastewater use will need to be developed as well.

Therefore, Delaware plans to pursue two linked tracks. First, the offset program for stormwater proposed in the stormwater regulations will still be developed and go into effect (2011). Second, an offset program for all land use changes within the Chesapeake will be developed and promulgated as a watershed wide regulation around 2012-13. The intention is to link the two offset programs so that there is a single process to ease the workload on the regulated community.

For the stormwater offset program, the Sediment and Stormwater Program uses a tool known as the Delaware Urban Runoff Management Model (DURMM) to calculate the volume and associated nutrient (and soon sediment) loads in runoff. The Program is also currently contracting with the Center for Watershed Protection to develop a recommendation for stormwater offset costs to support a fee-in-lieu process, one component of their offset strategy. They will likely use bioretention as a surrogate to determine the per cubic foot cost for stormwater offsets. The Center has issued a draft proposal that recommends a total in-lieu fee based on cubic foot of treatment volume.

DNREC anticipates spending fee in lieu funds generated by a demonstrated inability for a development project to comply with the stormwater requirements in several ways. The fees would be spent in the same subwatershed as the project. Funds would accomplish similar stormwater runoff reduction and pollutant load reductions that an onsite BMP would achieve. Construction of BMP's elsewhere in the watershed would be augmented by larger restoration projects such as steam restoration, wetland creation and other environmental improvements where there is a demonstrated net benefit to water quality in the watershed.

As an example, DelDOT began aggregating the impervious area that could not be managed for stormwater because of the linear nature of some minor road improvements. They "banked" the value of the BMP construction not expended and utilized these funds for a variety of projects. The Pike Creek stream

restoration project was funded in part by contributions from DelDOT when the upper Pike Creek Road improvements were constructed.

This example can lead to many other common sense approaches to utilization of funds when on site BMP's can't be constructed or simply are not cost effective.

For the land-use change offset program, DNREC plans to use a tool known as the Nutrient Budget Protocol, which was previously developed for a proposed regulation in the Inland Bays watershed. The Protocol compares the loads of a parcel pre- and post-development and determines if the proposed development will achieve local TMDL required nonpoint source reductions. DNREC asked Tetra Tech to review the tool to determine its usefulness in a Chesapeake offset program. Tetra Tech concurred that Nutrient Budget Protocol would be a useful tool in support of Chesapeake Bay WIP with some modifications based on their review of similar tools in use in other parts of the US. Some of the recommendations made by Tetra Tech include changing parameter values for land use loading rates and BMP efficiencies to match the values used in the Chesapeake Bay Program model. This will ensure that Delaware's estimates of total loads and new loads needing to be offset match those calculated by EPA.

DNREC has reviewed Tetra Tech's recommendations and has requested their assistance in executing the proposed modifications so that the Protocol can be the primary tracking tool for the Chesapeake land use change offset program. In addition to the modifications proposed by Tetra Tech, DNREC has also requested that they assist with linking the Sediment and Stormwater Program's DURMM tool to the Protocol so that it replaces the previous stormwater calculations in the Protocol. A scope of work (Appendix F) has been prepared and Tetra Tech is in the process of preparing a budget and schedule; early estimates indicated that the work would take at least six months and $30,000 (work will be supported by contractual hours provided to the jurisdictions by EPA and through EPA's Regulatory and Accountability Grant).

The Department will fully explore the potential of a credit banking or credit exchange program in Delaware. Many barriers to a robust trading program have been identified – most notably, the projected lack of demand for point-source trading and the steep baseline requirements that agricultural operations will have to achieve before they can generate credits. However, there is significant interest from the development community, mitigation bankers and others in engaging the market to help Delaware offset future loads. DNREC has developed a draft timeline for pursuing a program for generating, banking and trading nutrient credits.

December 2010 Determine principles of Delaware offset program, including:

- How the program and incentives will be funded
- Alignment with new statewide stormwater in-lieu fee program
- Legislative requirements
- Define baseline
- Conduct assessment of the 40,000 acres of publicly owned land within the watershed and determine how to incorporate that existing asset into an offset program
- Meeting all other EPA common elements of an offset program
- Elements of a trading program, including
    - Administration and ongoing monitoring

	o Rules and ratios o Banking o Interstate trading with Maryland Eastern Shore o Third-party assistance
Dec-January 2011	Secretary creates working group that includes stakeholders such as Home Builders, Farm Bureau, Realtors, local government representatives, Department of Agriculture, environmental organizations, etc.
January 2011	TetraTech provides draft recommendations to improve Delaware's Nutrient Budget Protocol and make it consistent with Chesapeake modeling assumptions and values
Feb-March 2011	Convene half- or full-day summit in Dover that introduces a larger group of stakeholders to the offset universe, programs in other Chesapeake states, real world lessons learned, actual practitioners
Spring 2011	Enabling legislation to create an offset program developed and introduced
Fall 2011	If proceeding with trading program, issue a Request for Information to consultants, aggregators, bankers, etc., for third-party assistance with establishment
Ongoing 2011	Work with local governments within and outside of their comprehensive planning timetables to provide strategies and tools for avoiding and/or offsetting new loads in the watershed Follow the state's Strategies for Policies and Spending that direct growth away from large-lot development on septic systems to designated growth areas that are or will be sewered Work with Delaware Economic Development Office and Department of Agriculture to develop entrepreneurial strategies – e.g., algal turf scrubbing, aquaculture, banking Refine program rules in accordance with principles
2011-2012	Secure funding sources to support Chesapeake program - Additional cost-share funding - Funding of septic elimination, WWTP improvements
2012-2013	Finalize offset program rules, initiate program

8.3. Gap Analysis

In order to improve water quality and meet TMDL goals, more education and outreach with local governments and affected stakeholder groups needs to occur. This will help communicate the need for including certain conservation elements in comprehensive plans and ordinances. It will also help to explain how the local governments are responsible for achieving and maintaining nutrient and sediment reductions into the future.

Additionally, much of this portion of the strategy focuses on accounting for growth and there is currently no formal trading or offset policy in the State of Delaware. In order to effectively track offsets,and prove to EPA that there is a high level of assurance and accountability, a comprehensive offset program and regulation will need to be developed. The current tool available, the Nutrient Budget Protocol, requires significant modifications in order to produce results that are consistent with Chesapeake Bay Program modeling assumptions.

8.4. Strategy to Fill Gaps

The following are strategies that can and will be used to address the impacts of land use and comprehensive plans on nutrient and sediment loading in the Chesapeake.

- Require buffers as land is developed. Delaware's Inland Bays Pollution Control Strategy requires buffers along primary and secondary water features (which have been mapped in advance) as land is developed. They are not required on existing developed lands or lands being used for agriculture. In that watershed, buffers must be 100 feet wide on primary waters and 60 feet wide on secondary waters. Buffer width can be reduced if combined with other pollution reduction actions. Buffers will exist in community open space and will be managed by homeowners' associations. DNREC encourages planting buffers with trees and other native plants. A similar state regulation can be adopted for the Chesapeake watershed.
- Nutrient offset program with use of the Nutrient Budget Protocol as a tracking tool. The Department views the development of an offset program as a key element in achieving both water quality and quantity goals in this watershed and throughout Delaware. As noted above, our path forward will involve different stages. First, the offset program for stormwater proposed in the stormwater regulations will continue to be developed and go into effect (2011). Second, we will modify the Nutrient Budget Protocol (making the recommendations proposed by Tetra Tech) and tie in the stormwater DURMM tool to replace the existing treatment of stormwater in the Protocol. To make this offset program regulatory within the Chesapeake, a separate set of regulations will have to be promulgated. Promulgating this regulation is not likely to occur until the end of 2011 at the earliest, but more likely 2012. Additionally, DNREC will work with the Office of State Planning Coordination to determine the role of the State's PLUS process in tracking new or increased loads, and how this process can communicate requirements for net improvement offsets.

    i. Nutrient Budget Protocol Tool. Tetra Tech will be refining an internally developed spreadsheet tool for determining the impacts of different land uses and best-management practices on nutrient loads when a parcel changes land use. The goal is to make this a more user-friendly tool that the state, local governments, and developers can use to assess and track nutrient and sediment loading impacts of development projects.
    ii. Credit banking/trading program. DNREC is researching the experiences of other states developing and operating trading programs in the Chesapeake watershed. The Department is also meeting with credit aggregators, mitigation bankers and proponents of trading such as the Pinchot Institute/Bay Bank.
    iii. Assess the potential of publicly owned lands. Approximately 40,000 acres of publicly owned land exists in the Chesapeake watershed, the majority of it managed by DNREC and the Delaware Department of Agriculture (See Section 11). As outlined in Section 10, Ecological Restoration, the department has identified significant restoration opportunities in the watershed, particularly the Nanticoke. One large mitigation bank already exists in that watershed. An option for a credit-trading program could include the generation of credits on state-owned land to finance additional Best Management Practices throughout the watershed.
    iv. Assess the potential of trading with Maryland's Eastern Shore. There has been some initial discussion with Maryland of nonpoint source trading with Eastern Shore farmers to boost the availability and quality of credits. Interstate trading would likely require Delaware to adopt Maryland's nonpoint source trading requirements.

v. Assess the potential of algae technologies to generate credits. Nascent technologies that use algal mats or other algae-based technologies to scrub wastewater effluent, manure and open water of nutrient pollution appear to be a very cost-effective means of offsetting nutrient loads. Moreover, the harvesting of algae can generate energy, fertilizer, feed and other biomass. A demonstration project on Maryland's Eastern Shore with the Caroline County Conservation District, the University of Maryland and the Maryland Department of Agriculture is assessing the ability of algal turf scrubbers to reduce nutrients in agricultural drainage systems and generate solar power.

DNREC would like to develop partnerships with companies that are beginning to successfully commercialize this technology, such as Algae Producers Inc. – the lead commercial partner for a recent $3 million State of Ohio Third Frontier Grant awarded to Ohio University (OTF 10-510, titled *Center for Algal Engineering Research and Commercialization*). The purpose of this grant is to establish a Center of Excellence for the development and commercialization of algae-based technologies, with an emphasis on use of waste nutrients. In terms of its potential, it is the ultimate "green technology." Algae Producers has proposed a demonstration project at a wastewater treatment plant and on a farm in Delaware.

- An overall land-use policy, the Strategies for State Policies and Spending, directs growth to areas already prepared for it in terms of infrastructure, services, and intergovernmental planning. This document, the state's blueprint for growth, has been in existence since 1999 and is about to be updated according to a five-year schedule. Much of the Chesapeake watershed in Delaware, except for the relatively small municipalities, is in non-growth areas where the state would like to limit investment in agriculture and land preservation. The state limits its investment to agribusiness and land preservation in non-growth areas. In other words, it does not invest in schools or roads in these areas. For example, as a matter of policy, the state Department of Transportation does not provide funding for local development outside of designated growth areas.

  i. Align growth strategy, investment and TMDL actions. These should not work at cross purposes, but coordinate to encourage growth in higher-density municipalities, on sewer, rather than large-lot, low-density development on septic. Priorities for investment should include wastewater treatment plant upgrades that enable residential and commercial growth in Seaford, Laurel and Bridgeville. In its draft Watershed Implementation Plan, Maryland cites the imbalance created by nutrient caps on WWTPs without similar constraints on loads from septic systems. Per household, the nutrient load from new development on well and septic is almost 5 times the amount of new loads from sewered areas, Maryland calculated. Delaware faces the same imbalance and the same need for more non-agricultural BMPs to be established.

  ii. More proactive comprehensive planning. Local jurisdictions have not routinely prepared their conservation and wastewater elements of their comprehensive plans "in consultation with" DNREC as required by State law. For the counties and municipalities within the Chesapeake watershed, DNREC will play a more proactive role in communicating TMDL requirements before the comprehensive plan is due, in addition to working with the jurisdiction on a compliance strategy.

  DNREC will meet with jurisdictions a year before their comprehensive plan update is due (Table 31) in order to explain the TMDL requirements and process, the allocation for that particular subwatershed, a toolbox of methods for meeting the pollution reduction goals, and

the consequence of not taking definitive steps toward achieving those goals. DNREC will also provide model TMDL language for local governments to include in their comprehensive plans. If comprehensive plan requirements are not met or the local government has not complied with related laws and violations, the State can withhold certification of a comprehensive plan and – as a last resort – withhold discretionary funding, according to State law.

The Town of Laurel just submitted its draft comprehensive plan for the next five years, The state is requiring the town to include a specific section and detail on how it intends to address water-quality issues and the TMDL. The town has identified several strategies that will help meet water-quality goals, including increasing its tree canopy and adopting protective ordinances such as riparian buffers, land conservation, and limiting floodplain development; DNREC has made additional suggestions for protective ordinances.

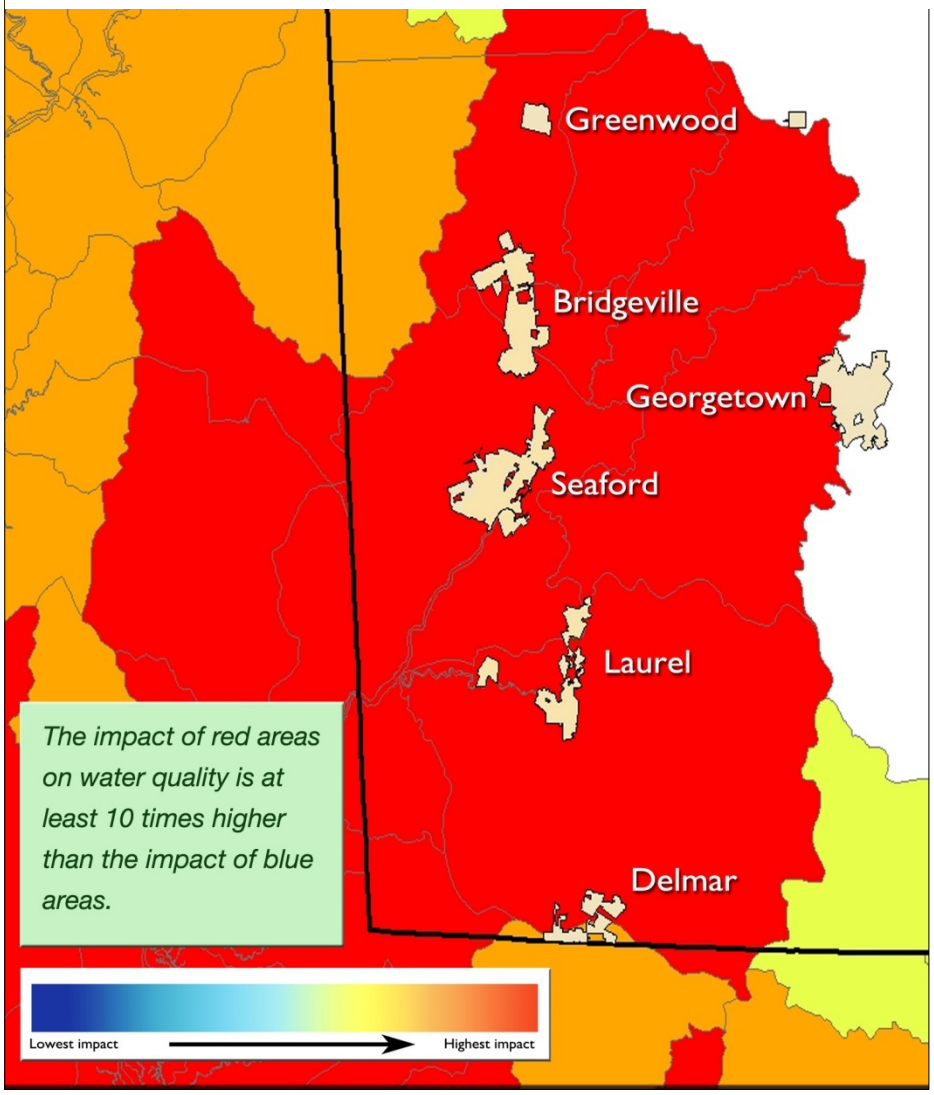
iii. Target actions in the most "effective" areas. The towns in the Nanticoke watershed in Sussex County are in an area with a highly "effective" level of contribution to Bay pollution, according to an October 2009 GIS analysis of nitrogen and phosphorous by EPA (Figure 24) . Targeting this area would have a larger impact on the Bay's water quality than focusing on other areas with both tighter land-use controls and lower potential for pollution impact.

iv. Master plan for Bridgeville-Seaford-Laurel corridor. The Office of State Planning Coordination, DelDOT, DNREC, and DDA have worked with local governments in the three counties to develop Master Plan growth strategies to ensure that infrastructure is available to meet future demands. An opportunity to develop a master plan that focuses on green as well as gray infrastructure to implement BMPs and meet pollution-reduction goals in the Nanticoke watershed could be incentivized with expedited capital spending and discretionary funds. Assistance from EPA technical staff would be greatly appreciated.

County or Municipality	Certification Date	Comments
New Castle County	July 2007	
Kent County	October 2008	
Sussex County	October 2008	Half of the county's land area is in the Chesapeake watershed.
Middletown (New Castle)	March 2010	Watersheds fall within Master Planned Area included in the Comprehensive Land Use Plans in March 2008
Farmington (Kent)	November 2004	Council had no modifications to Comprehensive Land Use Plans and will do complete re-write in November 2013
Harrington (Kent)	March 2004	Draft Comprehensive Land Use Plans is under development by Town Council
Hartly (Kent)	No CLUP at this time	Town has no interest in creation of Comprehensive Land Use Plans at this time
Kenton (Kent)	No CLUP at this time	Town has no interest in creation of Comprehensive Land Use Plans at this time
Bethel (Sussex)	July 2008	
Blades (Sussex)	April 2008	
Bridgeville (Sussex)	September 2006	
Delmar (Sussex)	March 2005	Draft submitted for review and certification through PLUS Process in August 2010
Ellendale (Sussex)	October 2009	
Georgetown (Sussex)	March 2010	
Greenwood (Sussex)	January 2008	
Laurel (Sussex)	March 2004	Draft Comprehensive Land Use Plans Pending before Council
Seaford (Sussex)	March 2010	

Table 31: Municipalities in Delaware's Chesapeake and date each comprehensive plan was last certified

Figure 24: "Effective Areas of the Chesapeake"



- A science- and watershed-based strategy for prioritizing the department's work, called Conservation Opportunity Areas. These will be developed in 2010-2011. They are a means of identifying areas where different departmental and environmental priorities such as habitat, water quality, wetlands protection, and forest preservation overlap to focus limited resources, and build partnerships with local governments, federal agencies, individual landowners and nonprofit organizations.

- Transfer of Development Rights and Purchase of Development Rights as elements of comprehensive plans to direct higher-density development into existing towns but lower impervious cover throughout the watershed. Efforts to create statewide TDR legislation, with a bank, have been unsuccessful, but local governments are already empowered by statute to create their own programs. The State could also provide technical assistance. Kent County's TDR program has been used successfully, and its sending areas (where land would be preserved) include the Chesapeake

watershed portion of the county. Also, the State could more closely align its very successful PDR program and its newer Forest Preservation Program with watershed priorities such as the Nanticoke.

- Wetlands banking and fee in-lieu. DNREC has been approached by several consulting firms interested in creating wetland banks, including one already established that straddles the Nanticoke and Pocomoke watersheds. In addition, the US Army Corps of Engineers has indicated an interest in working with DNREC to set up an in-lieu fee program, which is the department's preferred method of handling wetlands mitigation. We recognize that the state needs a clearly stated and straightforward policy on wetlands mitigation, and that such a policy would be a tool for achieving TMDL goals. We would welcome EPA assistance in this regard.

- Stormwater Utilities are already enabled by state law (Delaware Code Title 7, Chapter 40). Local governments are empowered to establish these utilities to manage stormwater runoff and address water quality and quantity challenges; however, Wilmington is the only municipality to adopt such an ordinance since the law took effect in 1990. A stormwater utility could be a relatively cost-effective means of achieving TMDL targets, especially in the Seaford-Laurel-Bridgeville portion of the Nanticoke watershed. Similarly, Kent County supports the establishment of a countywide stormwater facility maintenance program to increase monitoring of stormwater management and discharge in order to decrease the amount of pollutants reaching water bodies in the county. We can provide education and technical assistance, and perhaps demonstrate that proactive initiatives such as a utility are preferable to more draconian measures.

- Develop strategies for effective communication with local governments and stakeholders (e.g., Home Builders, Sussex County Association of Towns, Farm Bureau, Realtors, environmental advocates, etc.) to:
  - Communicate the percentage of nitrogen, phosphorous, and sediment reductions already achieved and the reductions still needed in the future from the various source sectors by land-river segment
  - Clearly communicate the benefits of achieving water quality goals for economic development, tourism, recreation, and quality of life
  - Clearly communicate the cost of failure
  - Develop effective means of communication with average citizens (video, interactive workshops, Web 2.0 applications, community events, schools, feature-rich website) to gain support for meeting water-quality goals

8.4.1. Best Management Practices

8.4.1.1. Urban Nutrient Management (Residential Fertilizer Use): Members of the agriculture and development communities are interested in pursuing policies and/or regulations that impact residential fertilizer use. In other states, measures have included a ban on phosphorous in residential fertilizers, a fee per bag, seasonal restrictions, training necessary for commercial applicators, and buffer restrictions for application near impaired waterways. There was consensus for pursuing these options in Delaware, so much so that Delaware is setting a goal of having 95% of urban lands covered by an urban nutrient management plan by 2025.
GOAL: 95% of urban lands with urban nutrient management

8.4.1.2. Urban Tree Planting (Urban Tree Canopy): The Delaware Forest Service and the Delaware Office of State Planning and Coordination recognize the importance of tree canopy in communities. Trees help to clean our air and water while enhancing the quality of life for Delaware's residents. The State is working in cooperation with federal partners to implement TMDL requirements through the enhancement of forest resources within cities and towns throughout the Bay watershed. The Delaware Forest Service and DOSPC are doing GIS analyses to determine the current level of urban tree canopy in each municipality across the State. These values are then being compared to canopy cover goals for suburban residential, urban areas, and central business districts (this information will be used to set urban tree planting goals for Phase II of this WIP). Where current levels fall short of goals, the agencies will work the community to incorporate in the comprehensive plans specific recommendations. Recommendations may include acquiring conservation easements to protect existing canopy, developing landscape requirements for new developments, or tree planting along rights-of-way. Currently, there are only 99 acres on record for urban tree planting.
GOAL: Maintain existing 99 acres of urban tree planting; Future TBD

8.4.1.3. Urban Growth Reduction: Delaware does not currently have any data on this practice. The Land Use and Comprehensive Plan Subcommittee will investigate potential goals.
GOAL: TBD.

8.4.1.4. Impervious Urban Surface Reduction: Delaware does not currently have any data on this practice. The Land Use and Comprehensive Plan Subcommittee will investigate potential goals.
GOAL: TBD.

8.4.1.5. Forest Conservation: Delaware does not currently have any data on this practice. The Land Use and Comprehensive Plan Subcommittee will investigate potential goals.
GOAL: TBD.

8.4.1.6. Street Sweeping: Delaware does not currently have any data on this practice. DNREC will communicate with the Department of Transportation, local governments, and local businesses that may use street sweeping services to develop a comprehensive tracking system for this practice. For the time being, a goal of 50% of road areas to be swept annually is being set.

All of the DelDOT Districts do regular street sweeping. Sweeping is a BMP that is required by both its Phase I MS4 Permit in New Castle Co. and our Phase II Permit in the urbanized area around Dover. The Phase I permit currently requires DelDOT to follow a 4:2:1 pattern of sweeping. That is, we sweep primary roads (expressways, interstate, etc.) a minimum of four imes per year, secondary roads two times per year, and tertiary (subdivision and low-traffic) roads at least once per year. Many of the state roadways get swept more frequently than this. DelDOT recently
put out a bid to have GPS units installed on all of its sweepers to provide information on areas and lane miles swept and intends to do some monitoring and modeling to derive accurate estimates.. The material collected includes not only trash, but also large amounts of sediment and organic debris such as leaves and grass clippings.
GOAL: 3,143 acres.

8.5. Contingencies

If the above strategies and strategies from other sectors are unsuccessful, the Land Use and Comprehensive Plan Subcommittee has identified the following action as a contingency.

- Additional MS4 in Seaford-Laurel-Bridgeville corridor after 2020 Census is likely if these towns do not make milestone progress toward achieving TMDL targets.
- Regulating residential fertilizer use. Beyond the voluntary measures outlined in Section 8.1.3, the Department should develop a model fertilizer regulation/ordinance to roll out by a date certain (such as 2017) if quantifiable progress is not being made to reduce nutrient loads from suburban development. Such a regulation should consider elements such as:
  - Fertilization only during certain times of the year
  - Require a soil test before applying fertilizer
  - No phosphorous unless need is indicated by soils test
  - No application with 20 or 25 feet of11/18/2010 4:46:20 PM a waterway
  - More transparent and explicit labeling
  - Fee per bag
  - Required training/licensing fee for commercial residential applicators
  - Limit on golf course applications
  - Limit on number of applications
  - No application when ground is saturated or before runoff-producing rainfall

8.6. Tracking and Reporting Protocols

Tracking and reporting loads related to changes in land use will be done using two tools already under development and undergoing modifications – the Nutrient Budget Protocol and DURMM. DURMM will be used to calculate the volume of stormwater runoff from a proposed development project and the associated nutrient and sediment loads. Information from DURMM will be plugged into the Protocol, which calculates the total loads from a parcel pre and post development. DNREC staff and Tetra Tech contractors have been working with EPA to ensure that loads calculated by these models on a project or parcel scale are compatible with the loads calculated by the Chesapeake Bay Program watershed model. These tools will be incorporated into regulatory offset programs.

As BMPs are installed on new projects, the practices will be recorded in one of the existing databases, whether it is for onsite wastewater or stormwater. Work is underway to extract information regarding onsite system and stormwater BMPs into the National Environmental Information Exchange Network (NEIEN) schema so that data may be directly sent to the Chesapeake Bay Program through network nodes and receive credit in the model. A description of data generation and acquisition, assessment and oversight, and data validation and usability will be provided in Delaware's Nonpoint Source Best Management Practice Implementation Data Quality Assurance Project Plan (Appendix C). The QAPP will be updated to reflect recent changes by April 30, 2011. DNREC staff is also participating in the development of the Bay TMDL Accounting and Tracking System (BayTAS) Version 1.0 to track the TMDL waste load allocations and load allocations and Delaware's progress toward meeting those goals.

SECTION 9. AGRICULTURE

This section of the WIP has been developed by the Agriculture Subcommittee of Delaware's Chesapeake Interagency Workgroup. The Agriculture Subcommittee represents a diverse array of programmatic expertise from active farming operations to environmentally focused organizations. Members come from Delaware Department of Natural Resources and Environmental Control (DNREC); the Delaware Department of Agriculture's (DDA) Nutrient Management Program and Planning Section; Delaware Department of Transportation; the US Department of Agriculture's Natural Resource Conservation Service (NRCS), Farm Service Agency (FSA), and Rural Development; the New Castle, Kent, and Sussex Conservation Districts; the University of Delaware's Cooperative Extension Service; Delaware Farm Bureau; Nutrient Management Commission members; and farmers. A major role of the group is to identify programmatic shortfalls and develop recommendations for meeting the soon to be established Chesapeake Bay TMDLs.

9.1. Current Programs and Capacity

Since the baseline period, the agriculture community in Delaware has reduced a significant amount of nonpoint source nitrogen and phosphorus loading, leading the efforts to curtail nonpoint source nutrient loadings. The existing programs to address conservation efforts and water quality protection on agricultural lands within the State are described below.

9.1.1. Delaware's Nutrient Management Program

Nutrient management is an issue of importance for farmers, nutrient handlers, state officials, federal officials, and the general public. With water quality at stake, accountability for nutrient use is now a heightened concern. In 1999, the Nutrient Management Law, which mandates that all farmers, golf courses, and other nutrient handlers develop and implement phosphorous-limiting nutrient management plans, maintain nutrient handling records, maintain nutrient certification, and submit an annual report, was passed and resulted in the Delaware Nutrient Management Program. The Delaware Nutrient Management Commission (DNMC) was formed to direct the Program and develop regulations pertaining to nutrient management, waste management for Animal Feeding Operations (AFOs), and National Pollutant Discharge Elimination System (NPDES) permits for concentrated animal feeding operations (CAFOs). The Commission is composed of fifteen voting members and four ex-officio members. The voting members include seven full-time farmers, one commercial/agricultural nutrient applicator, one member of the commercial nursery industry, one golf course/lawn care industry representative, two members from one or more environmental advocacy groups, one nutrient consultant, one public citizen, and a representative of DNREC. To clarify, the NPDES CAFO program is administered by DNREC and managed by DDA. The DNMC serves an advisory role.

The DNMC continues to implement agreements with Delaware poultry companies (Allen's, Mountaire, and Perdue), resulting in the incorporation of the phytase enzyme in all feed, which helps poultry digest P and reduces the amount in litter. Phytase and other litter/manure amendments and handling practices have reduced the P content in litter by 20-30% and perhaps up to 40%. Poultry company agreements have also led to increased nutrient management education, certification, and stewardship, and additional funding for the Nutrient Relocation Program. The DNMC covers education credits in addition to agriculture credits.

The DNMC administers the nutrient management training, education and certification program. Both the DNMC and DDA continue to view education as a priority for compliance, protection of water quality and many other nutrient related topics and utilize the University of Delaware Extension and agribusinesses to educate nutrient handlers. It serves as an integral component of our regulatory compliance strategy. As famers and other nutrient handlers become certified and continue to meet educational requirements, better nutrient handling decisions are made. The DNMC has issued over 2,700 certifications since 2004. Currently 1,683 different nutrient management certificates are maintained by the program. Maintenance of nutrient management certification is mandatory for all nutrient generators, handlers, and consultants/planners in Delaware. Certification includes class room instruction and passage of rigorous examinations.

The Nutrient Management Law controls the minimum set of management practices that are included in nutrient management plans. In regard to phosphorus in soils, application of phosphorus is limited on high phosphorus soils, and winter application is not permitted. High phosphorus soils are based on the P Site Index. In the absence of phosphorus data, yield based assessments are conducted using the four highest yield goals out of the last seven years. There are phosphorus and nitrogen limiting plans in place, as well as a manure relocation program aimed at reducing phosphorus in soils. To obtain appropriate agronomic rates for application of manure, biosolids, and organic byproducts, the Nutrient Management Plan incorporates soil testing, manure testing, phosphorus index, and crop needs.

Penalties for noncompliance with the provisions outlined in the Nutrient Management Law are listed within State of Delaware Code Title 3 Chapter 22, Nutrient Management Law Subchapter V. Enforcement, Suits for Enforcement, and Incentives. Fines range from $50 to $1,000 per violation. Final fines and penalties are addressed through the Delaware Nutrient Management Commission. Compliance audits are conducted in response to complaints made to the Delaware Nutrient Management Program.

9.1.1.1. Oversight of AFOs and CAFOs

The Delaware CAFO regulations and program are promulgated and implemented under the authority of DNREC (7 Del.C. 60) and the Nutrient Management Program (3 Del.C. 2200). DNREC is the EPA delegated agency charged with NPDES CAFO oversight. DNREC administers Delaware's CAFO program. The DDA through a Memorandum of Agreement with DNREC primarily manages the CAFO program under the supervision of DNREC. In accordance with the MOA, the DDA is the initial point of contact with the regulated community, reviews and makes initial permit determinations, perform most inspections and enforcement actions if warranted, and reviews and make Nutrient Management Plan (NMP) determinations. In accordance with the MOA, among other activities, DNREC retains supervision and enforcement authority, jointly promulgates CAFO regulations, approves final permit issuance and is the Delaware point of contact with EPA. DDA and DNREC are committed to maintaining and updating an MOA to address the roles and responsibilities of both parties as appropriate for programmatic oversight. DDA and DNREC along with NRCS and other stakeholders worked collaboratively to evaluate federal requirements for state CAFO permits and update state CAFO regulations. Delaware's revised CAFO regulations were published in the State Register of Regulations on November 1, 2010 and became effective November 11, 2010.

In accordance with the new state CAFO regulations, animal feeding operations (AFOs) include any operation in which animals have been, are, or will be stabled or confined, fed, or maintained for a total of 45 days or more in any twelve month period. The confinement area must not sustain crops, vegetation, or

forage growth, and post residues, such as corn stubble left over after a crop is harvested, cannot be sustained in the normal growing season. Two or more animal feeding operations under the same ownership are considered to be one operation if the production areas adjoin each other or if they use a common area or system for the disposal of manure or wastes. Initially, animal feeding operations determine their need to obtain permit coverage in accordance with the State's CAFO regulations. Through inspections, DDA and/or DNREC may also require an AFO to seek a CAFO permit. DNREC and DDA have also made *EPA's CAFO Duty to Apply Guidance* available to the regulated community to help owners and operators assess their need to apply for a CAFO permit.

Table 32: An AFO is considered to be a Large CAFO if the number of animals equals or exceeds:

Quantity	Species
1,000	Cattle other than mature dairy cows or veal calves. Includes but is not limited to heifers, steers, bulls, and cow/calf pairs
700	Mature dairy cattle (whether milked or dry cows)
2,500	Swine each weighing over 55 pounds
10,000	Swine weighing under 55 pounds
500	Horses
10,000	Sheep or lambs
55,000	Turkeys
30,000	Laying hens or broilers, if the AFO uses a liquid manure handling system
125,000	Chickens except laying hens (if other than a liquid manure handling system)
82,000	Laying hens (if other than a liquid manure handling system)
1,000	Veal calves
30,000	Ducks (if the AFO uses other than a liquid manure handling system)
5,000	Ducks (if the AFO uses a liquid manure handling system)

Table 33: An AFO is considered to be a Medium CAFO if the operation does or will directly or indirectly discharge pollutants and the number of animals equals or exceeds:

Quantity	Species
300-999	Cattle other than mature dairy cows or veal calves. Includes but is not limited to heifers, steers, bulls, and cow/calf pairs
200-699	Mature dairy cattle (milked or dry cows)
750-2,499	Swine each weighing over 55 pounds
3,000-9,000	Swine weighing under 55 pounds
150-499	Horses
3,000-9,999	Sheep or lambs
16,500-54,999	Turkeys
9,000-29,000	Laying hens or broilers, if the AFO uses a liquid manure handling system
37,500-124,999	Chickens except laying hens (if other than a liquid manure handling system)
25,000-81,999	Laying hens (if other than a liquid manure handling system)

300-999	Veal calves
10,000-29,999	Ducks (if the AFO uses other than a liquid manure handling system)
1,500-4,999	Ducks (if the AFO uses a liquid manure handling system)

In the late 1990s and early 2000, staff from the Kent and Sussex Conservation Districts did a GIS assessment to identify animal operations across much of the State of Delaware. Delaware's 1997 digital orthophotography was first used as a preliminary visual census to create a shapefile of AFOs and BMPs at a subwatershed scale. Then, the information was field verified through a road survey; the operations and BMPs visible from the road were noted and the shapefile was updated accordingly. Capacity information, for poultry especially, was estimated based on the size of the poultry house. This is currently the only known state-maintained government dataset of animal operations within the First State. There is some concern that the dataset is outdated and incomplete. The number of animal operations falling within the medium and large CAFO designation was determined where data was available, and a summary is displayed in Table 34 below.

Table 34: Chesapeake Bay Animal Operation Summary (*Assume Small AFO)

Animal	Number of Operations	% With Capacity Information	% Without Capacity Information*	Number of Small AFO	Number of Medium CAFO	Number of Large CAFO
Hog	24	13%	88%	23	1	0
Dairy	31	45%	55%	28	2	0
Bovine	48	35%	65%	48	0	0
Equine	76	34%	66%	76	0	0
Poultry	725	96%	4%	188	480	57

In February 2010, Delaware had only twenty-four (24) NPDES CAFO permitted operations. As a result of an extensive educational push by DDA, DNMC, and EPA in the winter/spring of this year, Delaware now has approximately 372 permitted CAFOs, with 240 located in the Chesapeake Bay Watershed. Table 35 provides a breakdown of the types of CAFOs in Delaware. We believe that almost 100% of operations or sources subject to NPDES regulations have permits. Please note that DNREC retains authority under 7 Del.C. Chapter 60 to conduct inspections and enforce these NPDES regulations. In accordance with the Nutrient Management Law, Nutrient Management Plans are valid for no more than 3 years. The Nutrient Management Program, dependent upon staffing levels, has a goal to inspect every facility with a Nutrient Management Plan at least once during its lifecycle, therefore, at a minimum of three years (See Figures 25 and 26). With current staffing levels in place or anticipated by 2011, this is a reasonable and achievable goal. Section 6.1.1.6 of the revised Delaware CAFO regulation states that violations of the terms of the nutrient management plan or animal waste management plan incorporated into the NPDES CAFO permit shall constitute a violation of the NPDES CAFO permit. Section 6.1.1.7.2 requires emergency notification of discharges, which will trigger an inspection or assessment. Nutrient Management Plans revised every three years will be re-evaluated by the Secretary for compliance with permit conditions.

The 2008 federal CAFO rule has ability to assess fines up to $5,000 per violation/day for civil violations or $10,000 per violation per day. Delaware law would need to be changed in order to meet these minimum fine requirements.

Table 35: Number of Delaware CAFO Permits, 2010

Total active CAFO permits	372
Poultry-broiler farms	356
Dairy farms	9
Horse farms	4
Beef farm	1
Swine farm	1
Poultry-layer farm	1
Total inactive CAFO permits	5
Number of poultry farms over 125k capacity	51
Permit coverage within the Chesapeake Bay	
Poultry farm	240
Beef farm	1
Dairy farm	2
Complete CAFO files	245
Incomplete CAFO files	127
Manure generation and exported	94
Manure generation and land applied	151

Delaware Nutrient Management Program

Farm Name: _____
Mailing Address: _____
_____
Telephone No: _____
Nutrient Consultant: _____
Evaluator: _____ Date: _____

Nutrient Management Supplemental CAFO Audit Report

A=Adequate I=Inadequate N/A=Non-Applicable

Chemical Handling:
Are chemicals properly managed to ensure they do not contaminate manure, litter, process waste water or storm water. ___ A ___ I ___ N/A

Application Area Setbacks, Buffers, or Alternative:
___ 100 foot set back
___ 35 foot vegetative buffer
___ Alternative approved practice
___ No setback, buffer or approved practice in place
___ No manure land applied

Water Diversion:
Diversion of clean water and or storm water from the production area to ensure it does not contact animals. ___ A ___ I ___ N/A

Diversion of clean water and or storm water from the production area to ensure it does not contact manure or litter. ___ A ___ I ___ N/A

Animals kept from contact with water. ___ A ___ I ___ N/A

Manure, litter or process waste water management:

Application rates in the nutrient management plan. ___ A ___ I ___ N/A

Timing of applications in the nutrient management plan. ___ A ___ I ___ N/A

Method of manure application described in plan. ___ A ___ I ___ N/A

Annual manure test in plan. ___ A ___ I ___ N/A

Generation of manure estimate in plan. ___ A ___ I ___ N/A

Method(s) to indicate storage is full (liquid systems) ___ A ___ I ___ N/A

Documentation of manure export amounts and receiver information.
___ A ___ I ___ N/A

Discharge Information:
Summary of any discharges from the production area in the past 12 months, along with action taken to prevent discharge from recurring. ___ A ___ I ___ N/A

Comments:

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Figure 25: Nutrient Management Supplemental CAFO Audit Report

Delaware
Nutrient
Management
Program

Farm Name: _____
Mailing Address: _____
_____
Telephone No: _____
Nutrient Consultant: _____
Evaluator: _____ Date: _____

Nutrient Management Evaluation Report

A=Adequate I=Inadequate N/A=Non-Applicable

A. Nutrient Management Certification
1. Operator name_____
2. Nutrient Management Certification ___Nutrient Generator ___Private Handler ___Commercial Handler ___Nutrient Consultant
3. Certification Holder Name_____ Number_____

B. Nutrient Management Record Keeping Log
1. Crop Year _____
2. Amount and dates of manure applied to land ___A ___I ___N/A
3. Amount and dates of commercial fertilizer applied ___A ___I ___N/A
4. Acreage of application ___A ___I ___N/A
5. Amount and dates of manure exportation and contact information ___A ___I ___N/A
6. Nutrient management plan, crops planted and crop yields ___A ___I ___N/A
7. If commercial applicator utilized name of contractor _____

C. Nutrient Management Plan Evaluation
1. Plan Id
   a. Nutrient consultant's name and company ___A ___I ___N/A
      Address and telephone number ___A ___I ___N/A
      Nutrient Management Consultant Certification Number ___A ___I ___N/A
      Date of plan and duration of plan (not to exceed 3 years) ___A ___I ___N/A
   b. Description of agricultural commodities produced within the operation ___A ___I ___N/A
   c. Certification statement, signed by the operator, documenting the intention of nutrient management plan (NMP) or animal waste management plan implementation ___A ___I ___N/A
2. Field maps and aerial photographs that include
   a. Individual field identification and boundaries ___A ___I ___N/A
   b. Copy of soil survey map showing all soil types on each field or the soil texture identification of all pertinent soils ___A ___I ___N/A
   c. Location of all surface waters including drainage ditches, streams, ponds, etc. ___A ___I ___N/A
   d. Irrigation systems where applicable___A ___I ___N/A
3. Crop and Nutrient Information
   a. Total number and type of animals and annual waste generation estimation and handling methods ___A ___I ___N/A
   b. Budget of intended manure disposition identifying amounts for land application, exportation from farm, or other use ___A ___I ___N/A
   c. Total acres represented by this nutrient management plan and summary of needed nutrients ___A ___I ___N/A
   d. Realistic yield goal determined (average yield for the best 4 of the last 7 years) ___A ___I ___N/A
   e. Without yield records or with yield goals higher than average, use soil productivity classes with written justification ___A ___I ___N/A
   f. Soil test (no older than 3 years) from an agronomic laboratory approved by DNMC ___A ___I ___N/A
   g. Current and planned crop rotation ___A ___I ___N/A
   h. Determine nitrogen rate based on expected crop yield of crop(s) to be grown ___A ___I ___N/A
   i. Phosphorus application is limited to 3-year crop removal rate in soils with a Fertility Index Value (FIV) of 150 or higher. Optionally, a University of Delaware Phosphorus Site Index (PSI) may be performed and Phosphorus may be added as recommended by the PSI value. Application rates limited to a 3-year crop removal may be exceeded in unforeseen situations and must be justified in writing by a certified nutrient consultant. ___A ___I ___N/A
   j. Manure analysis results or a nutrient value estimate with written justification ___A ___I ___N/A
   k. Estimate residual nitrogen (organic nutrients, fertilizer, or legume crops from prior year) ___A ___I ___N/A
   l. Nutrient source(s) selected, rates, and approximate timing of applications(s) ___A ___I ___N/A

D. Best Management Practices and On Farm Assessment
1. Are animal mortalities properly managed ___A ___I ___N/A
2. Animal mortality disposal method ___composter ___renderer ___incinerator ___Other(see comments)
3. Storage for manure
   Covered structure ___A ___I ___N/A
   Tanks ___A ___I ___N/A
   Other ___A ___I ___N/A
   Temporary Storage ___A ___I ___N/A
4. Commercial Fertilizer Storage ___A ___I ___N/A
5. Feed storage ___A ___I ___N/A

E. Assessment and Recommendations
1. Utilization of Nutrient Management Plan ___A ___I
2. Best Management Practices Implementation ___A ___I
3. Record Keeping ___A ___I
4. Certification ___A ___I
5. In general is the nutrient management adequate in preventing the over application of nutrients ___A ___I
6. Practices to prevent runoff and erosion (recommendations noted below) Roof runoff ___ stormwater control___ pasture stream fencing___ cover crops___ grass waterways___ timely manure incorporation___ windbreaks for erosion/odor___ Other _____

Comments:
_____
_____
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Document No. 65-01-2003-12-01

Figure 26: Nutrient Management Evaluation Report

9.1.1.2. Nutrient Planning Program

Agency: Delaware Department of Agriculture
Contact: Larry Towle
Title: Nutrient Management Coordinator
Address: 2320 South DuPont Highway
Dover, Delaware 19901
Phone: Ph: (302) 698-4500
Type of Program: Funding, Technical Services, Outreach/Education
Number of Technical Staff: 2
Number of Administrative Staff: 1

Program Description: Proper application of nutrients to farmland and urban turf areas is vital to prevent the runoff of excess nutrients into the waters of Delaware. The Nutrient Planning Program provides financial reimbursement to farmers and property managers for the writing of nutrient management plans for farms, golf courses and urban turf facilities. The application process validates eligible nutrient applicators and plan writers. Since 2007, all farms requiring a nutrient management plan now have one and implementation levels will be maintained into the future.

Agriculture BMPS Offered: Nutrient Planning by a Certified Plan Writer.

Compliance Rates: Nutrient Management Plans are required for those who control the application of nutrients to 10 acres or greater and/or for those who manage AFOs with greater than eight animal units, whether CAFO permitted or not. Compliance rates for nutrient management planning are estimated to be at 100%. This estimate is based on comparing cost share enrollment for nutrient management planning over a three-year period (plans are to be done at least once every three years) to the total available acreage of agricultural lands. Audits are performed for operations that receive a complaint within the previous 12 months. CAFO regulated facilities will be audited at random with up to eight audits conducted each year. If an audit is performed and farm is found to not have a plan or using an out-of-date plan, education and outreach our first used to bring them back into compliance and then enforcement action will be used. Fines range from $50 to $1,000 per violation. Final fines and penalties are addressed through the Delaware Nutrient Management Commission.

Chesapeake Bay Annual Accomplishments (2009): In 2009, the program provided reimbursement for 130 nutrient management plans written by private consultants. Such plans covered 76,828 acres. In addition, plans written in previous years and still in effect (current) covered another 215,744 acres for a total of 292,572 acres. In 2009, $553,230 was spent on nutrient management planning in the Chesapeake. This represents a significant commitment by the State and industry to proper nutrient handling and water quality.

Chesapeake Bay Annual Budget: $172,436

9.1.1.3. Nutrient Relocation Program

Agency: Delaware Department of Agriculture
Contact: Larry Towle
Title: Nutrient Management Coordinator
Address: 2320 South DuPont Highway
Dover, Delaware 19901
Phone: Ph: (302) 698-4500
Type of Program: Funding, Technical Services, Outreach/Education

Number of Technical Staff: 2
Number of Administrative Staff: 1
Program Description: The Delaware Relocation Program moves poultry litter/manure from farms with insufficient land or high soil phosphorus levels to farms with nutrient needs or to alternative use facilities. This has resulted in relocating almost all of the excess litter in Delaware; most comes from Chesapeake Bay watersheds. The Relocation Program provides financial reimbursement to farmers, brokers, and trucking businesses for the transportation cost of relocating litter from a Delaware farm to an alternative use project or another farm for land application. The application process validates eligible senders, receivers, truckers, and alternative use projects. Excess litter continues to be transported for land application throughout Delaware as well as Maryland, New Jersey, and Virginia. Litter application is limited in Delaware to acreage that does not exceed 150 on the P Site Index. Alternative use projects are also essential for managing excess poultry litter.
Agriculture BMPS Offered: Nutrient Relocation
Compliance Rates: The Manure relocation program is a cost-share option for any farm that has manure in excess of what can be spread on their lands, at agronomic rates (using the P Index). For the results of the DE nutrient budget from 1996-2006, we use Dr. Sims' (University of Delaware) statewide nutrient mass balance. Excess manure is determined through taking manure samples and nutrient management planning. As a result of the incentives offered through the relocation program, excess litter is not likely being applied anywhere in Delaware.
Chesapeake Bay Annual Accomplishments (2009): In 2009, 96,435 tons of excess poultry litter were relocated (47,862 tons from the Chesapeake alone in 2009), for a nine year total of over 655,000 tons. Over 50% of the excess litter goes to alternative use projects, such as the Perdue AgriRecycle fertilizer plant in Blades, DE. The plant processed over 35,000 tons in 2009, 17,000 tons being Delaware-generated. In total, 80% of the litter relocated in the Chesapeake went to either alternative use projects or was completely relocated out of the Chesapeake watershed. Approximately 4% was relocated within the Chesapeake in Delaware and 16% was relocated within the Chesapeake in other states. In 2009, approximately, $286,529 was spent on the Nutrient Relocation Program in the Chesapeake.
Chesapeake Bay Annual Budget: $286,529

9.1.2. Kent Conservation District Cost-Share Program

Agency: Kent Conservation District
Contact: Timothy M. Riley
Title: District Coordinator
Address: 800 Bay Road, Suite 2, Dover, DE 19901
Phone: (302) 741-2600 ext 3
Type of Program: Cost-Share funding, Technical Assistance, Outreach/Education
Number of Technical Staff: 3 Conservation Planners, 1 Survey Technician plus a cooperative agreement with the USDA-NRCS for work with Kent County District Conservationist, 2 Conservationists, and an NRCS Survey Technician
Number of Administrative Staff: 3
Program Description: The Kent Conservation District (KCD) Cost-Share Program assists landowners and land managers with the design and installation of site-specific conservation practices on their property within Kent County, Delaware. A site visit by a KCD planner, a completed application, and approval from the Board of Supervisors is required prior to construction. The cost-share rates and limitations vary according to the practice; cost-share rates range from 25-75%.

Agriculture BMPS Offered: KCD's cost-share program can provide financial and/or technical assistance for any agricultural best management practice as approved by the KCD's Board of Supervisors. In addition to USDA-NRCS BMPs, the KCD supports State cost-share BMP practices that are determined to have the greatest nutrient and sediment reduction benefits and are cost effective. Examples of these BMPs include, but are not limited to:

Water Management Practices

- Open Ditching
- Tile Drainage
- Land Grading and/or Smoothing

Animal & Agricultural Waste Management Systems

- Poultry Composter
- Poultry Manure Storage Structure
- Dairy Waste Systems
- Equine Manure Storage Structure
- Animal & Agricultural Waste Handling Equipment
- Heavy Use Area Protection (Concrete Pads) for Poultry
- Equine Manure Dump Wagons
- Spray Irrigation Equipment
- Heavy Use Area Protection for Dairy

Water Quality Practices

- Drainage Ditch Impoundments
- Ponds – NRCS Type 3 CRP, CP3A & CP23

Erosion and Sediment Control Practices

- Water and Sediment Control Basins
- Critical Area Treatment
- Erosion and Sediment Control Structures
- Sod Waterways
- Windbreaks

Agriculture Lands

- Cover Crops
- Nutrient Management Planning

Compliance Rates: The Kent Conservation District conducts inspections of all BMPs installed within the county. Each BMP still within the established maintenance agreement are inspected annually. When a landowner is found to be out of compliance, the inspector begins an education process. If the landowner refuses to bring the practice into compliance, then a series of letters are sent out requiring repayment of cost-share and informing the participant that they will not be able to participate in future programs.

Chesapeake Bay Annual Accomplishments (2009): For FY-2009 KCD received $865,000 total funding for Cost-Share practices, an additional $25,900 in Chesapeake Bay Funds and $50,000 in USDA-NRCS funding for Cover Crops. Of this, an approximate total of $458,318 was spent in the Chesapeake Bay Watershed. The budget breakdown is:

$149,992 - Cover Crops
10,263 - Water Management Practices
231,347 - Animal & Agricultural Waste Management Systems
3,500 - Water Quality Practices
0 - Erosion and Sediment Control Practices
63,216 - Administrative & Technical Assistance

Chesapeake Bay Annual Budget: For FY-2010 KCD received $485,000 total funding for Cost-Share practices, and expect $35,000 in Chesapeake Bay Funds and $50,000 in USDA-NRCS funding for Cover Crops. Of this, an approximate total of $287,856 will be spent in the Chesapeake Bay Watershed. The budget breakdown is:

$136,600 - Cover Crops
7,968 - Water Management Practices
100,264 - Animal & Agricultural Waste Management Systems
1,328 - Water Quality Practices
1,992 - Erosion and Sediment Control Practices
39,704 - Administrative & Technical Assistance

9.1.3. Sussex Conservation District Cost-Share Program

Agency:	Sussex Conservation District
Contact:	Debbie Absher
Title:	District Coordinator
Address:	21315 Berlin Road, Unit 4 Georgetown, Delaware 19947
Phone:	(302) 856-3990, ext. 110
Type of Program:	Cost-share funding, technical assistance, outreach and education
Number of Technical Staff:	6 technical staff (5 planners and 1 compliance inspector)
Number of Administrative Staff:	3

Program Description: The Sussex Conservation District (SCD) Cost-Share Program provides financial assistance to landowners to implement best management practices to improve or enhance water quality and other natural resource concerns. A conservation planner will conduct an on-farm visit to assess the resource concerns on the farm. The planner will then develop a conservation plan and make recommendations on how to address those concerns. The SCD holds a sign-up for usually two weeks during the month of August. Once the applications for cost-share assistance are received, the applications are ranked and presented to the Board of Supervisors for approval. Cost-Share approval must be received before construction or implementation of the conservation practice can begin. When the practice is completed, the landowner will bring in the bills for reimbursement. The cost-share rates range from 50% to 75% depending on the practice.

Agriculture BMPS Offered: The SCD can provide financial assistance for the following best management practices as approved by the SCD Board of Supervisors and the Director of the Division of Watershed Stewardship:

A. Erosion Control
   - Permanent Vegetative Cover
   - Field Terraces
   - Diversions
   - Field Windbreak
   - Critical Area Plantings
   - Water and Sediment Control Basins
   - Grade Stabilization Structures
   - Grassed Waterways
   - Poultry Windbreaks
   - Shoreline Stabilization

B. Animal Waste Systems
- Agricultural Waste Control Systems
- Roofed Animal Waste Structures
- Ag Composting Facilities
- Poultry Incinerators
- Heavy Use Area Protections
- Additions to Existing Structures
- Access Roads
- Roof Runoff Structure

C. Water Management
- Water Control Structures

D. Wildlife Habitat Development
- Wildlife Plantings
- Wildlife Ponds
- Constructed Wetlands

E. Agriculture Lands
- Cover Crops
- Nutrient Management Planning

Compliance Rates: The SCD has a compliance inspector on staff to conduct inspections of all BMPs in the county. Structural BMPs are inspected annually and are conducted on a watershed basis. The inspector begins in the Delaware Bay Watershed and works his way down to the Inland Bays Watershed. It takes approximately one year to complete all of the inspections. The compliance inspector goes out and to inspect BMPs when complaints are received, and follows up with BMPs that are out of compliance. Staff also inspects 100% of the cover crop acres planted and destroyed. Conservation district staff members inspect each field to ensure the crop is planted, and insert a sign on certain fields, indicating participation in the cover crop program for those with high visibility. The sign reads: "*Delaware Cover Crop Participant. Protecting our bays and environment.*"

Since hiring this inspector, program compliance has increased significantly. The compliance rate is estimated to be about 85% for the conservation practices within the lifespan of the contract. When a landowner is found to be out of compliance, the inspector begins an education process. If the landowner refuses to bring the practice into compliance, then a series of letters are sent out requiring repayment of cost-share and informing the participant that they will not be able to participate in future programs.

Chesapeake Bay Annual Accomplishments (2009): SCD cost-shared on the following practices in the Chesapeake Bay Watershed during calendar year 2009:

Conservation Practice	Number	Cost-Share
Cover Crops	15080 acres	$ 510,088.00
HUAPs	31	$ 144,500.00
Access Road	1	$ 3,005.00
Poultry Windbreak	2	$ 2,893.50
Vegetative Shoreline Stabilization	4	$ 14,602.00
Poultry Manure Structures	4	$ 108,022.50
Poultry Composters	2	$ 13,236.20
Wildlife Pond	1	$ 5,000.00
Wildlife Planting	1	$ 2,500.00
Feeding Pad	1	$ 1,564.16
Total		$ 805,411.36

Chesapeake Bay Annual Budget: The SCD had $157,500 earmarked specifically for cover crops in the Chesapeake Bay Watershed. County-wide, SCD had over $1.35 million allocated in which a portion of that also went to the Chesapeake Bay.

9.1.4. New Castle Conservation District Cost-Share Program

Agency: New Castle Conservation District
Contact: Kevin C. Donnelly
Title: District Coordinator
Address: 2430 Old County Road, Newark, DE 19702
Phone: 302-832-3100 ext 125
Type of Program: Cost-share funding, Technical assistance, Outreach/Education,
Number of Technical Staff: 1 field inspection & 1 field planner plus cooperative agreement with USDA-NRCS for work with NC District Conservationist & Conservationist
Number of Administrative Staff: 1

Program Description: The New Castle Conservation District (NCD) Cost-Share Program assists landowners and land managers do design and install site-specific conservation practices on their property within New Castle County. A site visit by a NCCD planner, a completed application, and approval from the Board of Supervisors is required prior to construction. The cost-share rates and limitations vary according to the practice; cost-share rates range from 30-75%.

Agriculture BMPS Offered: NCCD's cost-share program can provide financial and/or technical assistance for any agricultural best management practice as approved by the NCCD's Board of Supervisors. Examples of these BMPs include, but are not limited to:

- Critical Area Treatment Manure Storage Ponds
- Manure Storage Structures
- Composters
- Winter Cover Crops
- Riparian Forest Buffer
- Filter Strips
- Roof Water Management
- Fencing

- Wetland Creation
- Ponds construction (agricultural only)
- Upland Wildlife Habitat Plantings
- Wetland Wildlife Habitat Plantings (agricultural only)
- Tree planting
- Hedgerows
- Windbreaks
- Woodland Improvement
- Wetland Creation or Restoration (agricultural only
- Grassed Waterways
- Terraces
- Grade Control Structures
- Water and Sediment Control Basins
- Streambank Protection

Compliance Rates: The New Castle County Conservation District conducts inspections of BMPs installed within the county. Inspections are conducted by USDA NRCS staff. When a landowner is found to be out of compliance, the inspector begins an education process. If the landowner refuses to bring the practice into compliance, then a series of letters are sent out requiring repayment of cost-share and informing the participant that they will not be able to participate in future programs.
Chesapeake Bay Annual Accomplishments (2009): NCCD's list of completed and/or planned 2009 BMPs will be provided by USDA-NRCS's state office submission.
Chesapeake Bay Annual Budget: $150,000

9.1.5. Agricultural Management Assistance (AMA) Program

Agency:	USDA, NRCS
Contact:	Tim Garrahan
Title:	Program Specialist
Address:	1221 College Park Drive, Suite 100 Dover De 19904
Phone:	(301) 678-4260
Type of Program:	Financial assistance (cost share) and technical assistance
Number of Technical Staff:	0.1
Number of Administrative Staff:	0.1

Program Description: The Agricultural Management Assistance (AMA) Program provides cost share assistance to agricultural producers to voluntarily address issues such as water management, water quality, and erosion control by incorporating conservation into their farming operations.

USDA's Natural Resources Conservation Service (NRCS) has leadership for the conservation provisions of AMA. The Agricultural Marketing Service (AMS) is responsible for an organic certification cost-share program and the Risk Management Agency (RMA) is responsible for mitigation of financial risk.
Agriculture BMPS Offered:

- Manure transport
- Agricultural Nutrient Management Applications
- Ammonia Emissions Reductions - Litter treatments
- Tree planting – Agricultural and Urban

- Conservation Tillage
- Stream Protection with Fencing
- Carbon Sequestration/Alternative Crops
- Continuous No-Till
- Precision Agriculture
- Agricultural Enhanced Nutrient Management
- Conservation Plans
- Cover Crops and Commodity Small Grain Enhancement
- Stream Protection without Fencing – Grazing Management Systems - Watering system alone
- Stream protection fencing and Prescribed Grazing – Grazing Management Systems - Exclusion plus upland grazing management
- Upland Rotational or Prescribed Grazing
- Barnyard Runoff Control/Loafing Lot Management
- Mortality Composters
- Horse Pasture Management
- Forest Harvesting Practices
- Riparian Forest Buffer
- Riparian Grass Buffer
- Wetland Restoration and Creation

Compliance Rates: All practices are applied according to NRCS standards and specifications. Practice maintenance is the responsibility of the landowner. Annual status reviews and spot checks are used to monitor practice maintenance. The NRCS randomly choose 5% of applied practices for spot check. Status reviews. They are done on all contracts to assure compliance with contract requirements. Penalties for non compliance can result in repayment of cost share dollars. Noncompliance at time of new program sign-up results in the producer being ineligible to apply for cost-share that year.

Chesapeake Bay Annual Budget: $60,000

Chesapeake Bay Annual Accomplishments (2009): In 2009, only planning occurred and actual implementation occurred.

9.1.6. Wetland Reserve Program (WRP)

Agency:	USDA, NRCS
Contact:	Jayme Arthurs
Title:	Program Specialist
Address:	1221 College Park Drive, Suite 100 Dover De 19904
Phone:	(301) 678-4191
Type of Program:	Financial assistance (cost share) and technical assistance
Number of Technical Staff:	3.3
Number of Administrative Staff:	0.2

Program Description: The Wetlands Reserve Program (WRP) provides an opportunity for landowners to receive financial assistance to protect, restore and enhance wetlands on their property. These wetlands provide food and shelter for migratory birds and other wetland dependent species, including state and federally listed species, and species of concern. In addition to providing wildlife benefits, WRP helps to

reduce flooding, improve water quality by filtering sediment and chemicals, recharge groundwater and more.

The program offers three enrollment options:

1. Permanent Easement is a conservation easement in perpetuity. USDA pays 100% of the easement value and up to 100% of the restoration costs.
2. 30-Year Easement is an easement that expires after 30 years. USDA pays up to 75% of the easement value and up to 75% of the restoration costs. For both permanent and 30-year easements, USDA pays all costs associated with recording the easement in the local land records office, including recording fees, charges for abstracts, survey and appraisal fees, and title insurance.
3. Restoration Cost-Share Agreement is an agreement to restore or enhance the wetland functions and values without placing an easement on the enrolled acres. USDA pays up to 75% of the restoration costs.

Agriculture BMPS Offered:

- Riparian Forest Buffer
- Riparian Grass Buffer
- Wetland Restoration and Creation

Compliance Rates: All practices are applied according to NRCS standards and specifications. Restoration areas are visited every two years and needed repairs or additional treatment is initiated.

Chesapeake Bay Annual Accomplishments (2009):

Practice	Amount Installed	Cost
Wetland Restoration (657)	130 acres	$46,585

Chesapeake Bay Annual Budget: $215,000

9.1.7. Wildlife Habitat Incentives program (WHIP)

Agency: USDA, NRCS
Contact: Tim Garrahan
Title: Program Specialist
Address: 1221 College Park Drive, Suite 100
Dover De 19904
Phone: (301) 678-4260
Type of Program: Financial assistance (cost share) and technical assistance
Number of Technical Staff: 0.2
Number of Administrative Staff: 0.1

Program Description: The Wildlife Habitat Incentive Program (WHIP) is a voluntary program for conservation-minded landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Indian land. The Food, Conservation, and Energy Act of 2008 reauthorized WHIP as a voluntary approach to improving wildlife habitat in our Nation. The Natural Resources Conservation Service administers WHIP to provide both technical assistance and up to 75% cost-share assistance to establish and improve fish and wildlife habitat. WHIP cost-share agreements between NRCS and the participant generally last from one year after the last conservation practice is implemented but not more than 10 years from the date the agreement is signed. In Delaware, WHIP priorities are:

- Restore and manage upland grassland habitat to benefit ground-nesting birds and associated wildlife.

This priority was identified because the loss of undisturbed herbaceous cover (grasses and other non-woody plants) has resulted in declining populations of grassland nesting birds such as quail, meadowlarks, field sparrows, goldfinches, and pheasants, as well as other small animals such as rabbits. Since 1975, for example, the Delaware Breeding Bird Survey has shown a 72% decrease in bobwhite quail populations, while ring-necked pheasants have declined more than 95% in the same time period. This decline has been attributed to habitat loss through urbanization and more intensive agricultural production.
Practices eligible for cost-sharing include field borders as well as whole-field plantings of grasses, legumes, and wildflowers, with management schedules that will benefit ground-nesting birds and other wildlife. Additional practices may include plantings of trees and shrubs where needed for woody cover.
• Control of invasive species.
This priority was identified because thousands of acres of Delaware's wildlife habitat have been invaded by invasive species. These species are replacing Delaware's native plant species that provide quality wildlife habitat.
One of the biggest invasive species problems in Delaware is phragmites, or common reed, covering over 20,000 acres of fresh and tidal wetland in our state. Phragmites is both fast growing and extremely hardy. It has taken over large areas of Delaware wetlands by displacing native plants that provide better wildlife food and cover. Its extensive root system holds dormant reeds in place during the winter, which causes a fire hazard.
Agriculture BMPS Offered:

- Forest Conservation
- Riparian Forest Buffer
- Riparian Grass Buffer
- Wetland Restoration and Creation

Compliance Rates: All practices are applied according to NRCS standards and specifications. Practice maintenance is the responsibility of the landowner. Annual status reviews and spot checks are used to monitor practice maintenance.
Chesapeake Bay Annual Accomplishments (2009):

Practice	Amount Installed	Cost
Wetland Restoration (657)	430	$23,332
Tree and Shrub establishment (612)	9	$2,142
Shallow Water Development (646)	5	$10,500
Conservation Cover (327)	15	$7,395

Chesapeake Bay Annual Budget: $100,000

9.1.8. Environmental Quality Incentives Program (EQIP)

Agency:	USDA, NRCS
Contact:	Tim Garrahan
Title:	Program Specialist
Address:	1221 College Park Drive, Suite 100 Dover De 19904
Phone:	(301) 678-4260
Type of Program:	Financial assistance (cost share) and technical assistance
Number of Technical Staff:	3.3
Number of Administrative Staff:	0.2

Program Description: The Environmental Quality Incentives Program (EQIP) was reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) to provide a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land.

EQIP offers contracts with a minimum term that ends one year after the implementation of the last scheduled practices and a maximum term of ten years. These contracts provide incentive payments and cost-shares to implement conservation practices. Landowners and operators who are engaged in livestock or agricultural production on eligible land may participate in the EQIP program. EQIP activities are carried out according to an environmental quality incentives program plan of operations. The plan is developed in conjunction with the producer and identifies the appropriate conservation practice or practices to address the resource concerns. All EQIP conservation practices are subject to NRCS technical standards in the Field Office Technical Guide (FOTG) that are adapted to Delaware conditions.

EQIP provides payments up to 75% of the incurred costs and income foregone of certain conservation practices and activities. However certain historically underserved producers (Limited resource farmers/ranchers, beginning farmers/ranchers, socially disadvantaged producers) may be eligible for payments up to 90% of the estimated incurred costs and income foregone. Farmers and ranchers may elect to use a certified Technical Service Provider (TSP) for technical assistance needed for certain eligible activities and services. The new Farm Bill established a new payment limitation for individuals or legal entity participants who may not receive, directly or indirectly, payments that, in the aggregate, exceed $300,000 for all program contracts entered during any six year period. Projects determined as having special environmental significance may, with approval of the NRCS Chief, have the payment limitation raised to a maximum of $450,000.

Agriculture BMPS Offered:

- Manure transport
- Agricultural Nutrient Management Applications
- Ammonia Emissions Reductions - Litter treatment
- Tree planting – agricultural and urban
- Conservation Tillage
- Stream protection with fencing - Exclusion alone
- Carbon sequestration/alternative crops
- Continuous No-till
- Precision Agriculture
- Agricultural Enhanced Nutrient Management
- Cover Crops and Commodity Small Grain Enhancement
- Stream Protection without Fencing –Watering system alone
- Stream Protection Fencing Prescribed Grazing –Exclusion plus upland grazing management
- Upland Rotational or Prescribed Grazing
- Barnyard Runoff Control/Loafing Lot Management
- Mortality Composters
- Horse Pasture Management
- Forest Harvesting Practices
- Riparian Forest Buffer
- Riparian Grass Buffer
- Wetland Restoration and Creation

Compliance Rates: All practices are applied according to NRCS standards and specifications. Practice maintenance is the responsibility of the landowner. Annual status reviews and spot checks are used to monitor practice maintenance.

Chesapeake Bay Annual Accomplishments (2009):

Practice	Amount Installed	Cost
Amendments for the Treatment of Ag Waste (591)	23 animal units	$126,060
Composters (317)	2 no	$7,000
Conservation Cover (327)	23 ac	$11,339
Cover Crop (340)	432 ac	$15,984
Forage Harvest Management (511)	109 ac	$1,232
HUAPS (561)	3 ac	$330,721
Nutrient management (590)	6200 ac	$105,400
Waste Storage Facility – (313)	6 no	$166,610

Chesapeake Bay Annual Budget: $1,787,055 million

9.1.9. Chesapeake Bay Watershed Initiative (CBWI)

Agency: USDA, NRCS
Contact: Tim Garrahan
Title: Program Specialist
Address: 1221 College Park Drive, Suite 100
Dover De 19904
Phone: (301) 678-4260
Type of Program: Financial assistance (cost share) and technical assistance
Number of Technical Staff: 2
Number of Administrative Staff: 0.1

Program Description: The 2008 Farm Bill will provide $188 million through the Chesapeake Bay Watershed Initiative (CBWI) over the next four years to support restoration of the Chesapeake Bay and its watershed, which represents one of the largest single federal investments in the clean-up effort and an unprecedented targeting of Farm Bill resources to a specific watershed. Congressionally authorized future funding levels are $43 million in 2010, $72 million in 2011 and $50 million in 2012.

Supported agricultural conservation practices such as nutrient management, cover crops, crop residue management and vegetative buffers will improve water quality, preserve and enhance natural resources, and reduce the pollutants flowing into the streams and rivers that feed the Chesapeake Bay.

Under the CBWI, eligible landowners can use available technical and financial assistance to address excess nutrients in streams and waterways, as well as other related natural resource concerns. CBWI cost share funds are available to all landowners in the Delaware portion of the Chesapeake Bay watershed. The program is run exactly like the regular EQIP program, with the only difference being that caps on units and acreage are removed on select practices, and unlimited units are available for producers. EQIP has offered the practice of Alternative Manure Use for the past two program years. For the practice, EQIP first looks at the quantity of manure that the nutrient management plan, which is P based, allows the producer to apply to his or her cropland, and, second, pays producers to refrain from applying manure to their lands. Any excess manure must be transported to an approved watershed and approved field with

phosphorus FIVs equal to less than 150. The excess manure can also be used for programs like Perdue Recycling, or to assist mushroom growers.

There is some concern over the high amount of CBWI funding that is going to heavy use area pads for poultry operations. In many cases, pads are a part of a system, and cannot stand alone. The installation of pads often completes the waste management system. Discussion has currently focused on limiting the dollars spent on pads when other applications of higher priority are available. Delaware is investigating the nutrient benefit of pads. Windrowing is also an issue of concern; NRCS state office is in discussions with their National Office and surrounding states to resolve it.

Agriculture BMPS Offered:

- Manure transport
- Agricultural Nutrient Management Applications
- Ammonia Emission Reductions - Litter treatment
- Tree planting – agricultural and urban
- Conservation Tillage
- Stream protection with fencing
- Carbon sequestration/alternative crops
- Continuous No-till
- Precision Agriculture
- Agricultural Enhanced Nutrient Management
- Cover Crops and Commodity Small Grain Enhancement
- Stream Protection without Fencing
- Stream Protection Fencing Prescribed Grazing – Exclusion plus upland grazing management
- Upland Rotational or Prescribed grazing – no exclusion, just upland grazing management
- Barnyard Runoff Control/Loafing Lot Management
- Mortality Composters
- Horse Pasture Management
- Forest Harvesting Practices
- Riparian Forest Buffer
- Riparian Grass Buffer
- Wetland Restoration and Creation

Compliance Rates: All practices are applied according to NRCS standards and specifications. Practice maintenance is the responsibility of the landowner. Annual status reviews and spot checks are used to monitor practice maintenance.

Chesapeake Bay Annual Accomplishments (2009):

Practice	Amount Installed	Cost
Waste Storage Facility (313)	2 no	$45,098

Remaining BMPS to be installed after FY 2009

Chesapeake Bay Annual Budget: $1,020,093

9.1.10. Delaware Conservation Reserve Enhancement Program (CREP)

Agency: Delaware Department of Natural Resources and Environmental Control
Contact: Dale Churchey
Title: CREP Program Coordinator
Address: 89 Kings Highway

Dover, Delaware 19901
Phone: 302-242-9943
Type of Program: Funding, Technical Services, Outreach/Education
Number of Technical Staff: 1
Number of Administrative Staff: 0
Program Description: The Delaware Conservation Reserve Enhancement Program (CREP) is a State-Federal partnership that provides financial incentives to landowners willing to voluntarily implement conservation measures on marginal agricultural land rather than continue the land in agricultural production. The resulting stream buffers and restored wetlands reduce nutrient and sediment runoff, provide increased wildlife habitat, and help protect Delaware's valuable waterbodies.

The program is voluntary and incentive-based and pays farmers and landowners for putting their least productive lands under a 10 or 15 year contract that requires the land to be put into the conservation practice the landowner chooses. Landowners can establish forest, native warm-season grasses, or cool season grasses. In return the landowner receives cost-share, annual rental payments, and generous bonus payments.

One of the major requirements to determine eligibility for enrollment in the Delaware CREP Program is the selected agricultural land must be adjacent to ditches, streams or channels that ultimately lead to waterbodies identified as impaired. All of Delaware's waterbodies are identified as impaired per Section 303(d) of the Clean Water Act due to excessive nutrient and bacteria, low dissolved oxygen, degradation of biology and habitat.

Agriculture BMPS Offered: The Delaware CREP Program had an initial goal to remove environmentally sensitive or marginal agricultural land from production and enroll the acreage in eligible conservation oriented BMPs, as defined under the Conservation Reserve Program, includes the following:

- CP21 - Grassed Filter Strips
- CP22 - Riparian Buffers
- CP23 - Wetlands Restoration Floodplain
- CP3A - Hardwood Tree Planting
- CP4D - Permanent Wildlife Habitat
- CP9 - Shallow Water Areas for Wildlife
- CP23A - Wetlands Restoration, Non-Floodplain

Delaware initially set a goal of establishing 6,000 acres of selected practices to meet the goals of the CREP Program. To date over 6,000 acres have been installed under contracts of 10 and 15 year terms.

Currently the USDA Farm Service Agency (FSA) pays 50% of installation costs for CREP practices and the State of Delaware pays 37.5% of the costs. On practices CP21, CP9 and CP4D FSA pays 64% of the incentive payments and Delaware pays 36%. On practices CP22, CP23, CP23A and CP3A FSA pays 73% and Delaware pays 27%.

Compliance Rates: Recently, the Delaware CREP Program has increased the monitoring component of the program. As such, 10 to 20% of the active contracts are reviewed annually. Inspections are conducted in response to received complaints or through recommendations from the FSA filed offices. When a landowner is found to be out of compliance, the inspector begins an education process. If the landowner refuses to bring the practice into compliance, then a series of letters are sent out requiring repayment of cost-share and informing the participant that they will be ineligible to participate in the Delaware CREP Program.

Chesapeake Bay Annual Accomplishments (2009):

CP3A Acres	CP4D Acres	CP9	CP21 Acres	Total	Rental Cost State	Cost Share State	Chesapeake Bay	Private

				Acres			Watershed Contracts	Contributions
84.5	14.7	14.2	10	124	$6,309.19	$4,760.23	15	$1,725.86

Chesapeake Bay Annual Budget:
1 FTE = $62,000
State Cost Share Rental Rate: $10,490
State Cost Share: $20,857

9.1.11. Conservation Reserve Program (CRP)

Agency: USDA—Delaware Farm Service Agency
Contact: Lynn Manges
Title: Program Specialist
Address: 1221 College Park Dr. Suite 201
Dover, DE 19904
Phones: 302-678-4253
Type of Program: Funding, outreach, education
Technical and Administrative Staff: FSA administers CRP, while technical support functions are provided by USDA's Natural Resources Conservation Service, USDA's Cooperative Extension Service, State forestry agencies, local soil and water conservation districts and other non-Federal providers of technical assistance. FSA has a state program specialist, and each county has staff that administers CRP.
Program Description: The CRP is a voluntary program available to agricultural producers to help them safeguard environmentally sensitive land. Producers enrolled in CRP plant long-term, resource-conserving covers to improve the quality of water, control soil erosion, and enhance wildlife habitat. CRP is a major contributor to increased wildlife populations. CRP also protects groundwater and helps improve the condition of lakes, rivers, ponds and streams by reducing water runoff and sedimentation.
Participants and the offered land must be certain eligibility requirements for land to be enrolled. FSA provides participants with payments on contracts with a duration of 10 and 15 years.
CRP payments consist of an annual rental payment that is based on the relative productivity of the soils and the average dryland cash rent, cost-share assistance of not more than 50% of the participants' costs in establishing approved practices, and other incentives where the payment amount is based on the practice.
There are two signup types.

- General Signup---This is a designated sign-up period and is a competitive bid process during which producers may offer eligible land to be enrolled into CRP. Each offer is ranked in comparison to all other offers and selections made from that ranking. FSA uses Environmental Benefits Index factors to assess the environmental benefits for the land offered. Producers may offer land at the calculated rental rate or offer a lower rate to increase the likelihood that the offer will be accepted.
- Continuous Signup---Environmentally desirable land devoted to certain conservation practices may be enrolled at any time under CRP continuous sign-up. Offers are not subject to competitive bidding.

Chesapeake Bay Accomplishments: There are currently 237.8 acres of CRP enrolled in the Chesapeake Bay watershed. 2009 annual rental payments totaled $17,353.00.
Annual Budget: The annual budget for CRP is controlled at the federal level.

9.2. Accounting for Growth

Growth will be accounted for and discussed under Section 8 – Land Use. It should be noted that many studies show land conversions from agriculture to development result in increases in nutrient loads. To that end, please note that Delaware maintains a very successful state operated farmland preservation program. Currently, approximately 100,000 acres of Delaware prime farmland is permanently preserved through the States easement program at a cost of $174,739,304. (Nearly one fifth of Delaware's farmland is now permanently preserved.) Including the land owner discount for those easements, they are valued at $378,342,577. This represents a significant commitment on the part of Delaware citizens to the agricultural economy in the First State. Delawareans understand the importance of viable farmland as an economic driver, wildlife habitat, and scenic vistas. The Delaware Department of Agriculture (DDA) does not expect the number of poultry operations in the Chesapeake to increase between now and 2025 and they may actually decrease.

9.3. Gap Analysis

9.3.1. Delaware's Nutrient Management Program

The number of DDA Nutrient Management Program staff has increased by hiring two new positions. One position resulted from transferring a vacant position from another section within DDA and then reclassifying that position. Another position was made possible through the Regulatory and Accountability Grant funds. Since previous funding was cut, resources will be needed to administer the new CAFO regulations and help support additional BMP implementations. DDA plans to further utilize existing staff in other operational sections to assist with implementation of the nutrient management related operations including CAFO. This job sharing or resource sharing strategy will result in a 1.5 position equivalent increase. Once the CAFO regulations are finalized, any remaining gaps and methods to fill those gaps will be identified in Phase II of this WIP.

9.3.2. Oversight of AFOs and CAFOs

Although the CAFO regulation is recently promulgated, there is full nutrient management compliance. Compliance is assessed through a comparison of the land area enrolled in cost share for NM planning with the acreage in agriculture. Please note that Nutrient Management regulations are also being modified to match stockpiling and staging requirements of CAFO regulations. These are currently running about two months behind the CAFO process. These new regulations will be effective in January 2011.

As discussed in the previous section, only one state maintained data set containing information about animal containment location is available. Agriculture across the State has changed over the past ten years leading to concern that the data set is outdated. Additionally, many of the livestock operations do not contain information regarding capacity information and the number of AFO versus CAFO cannot be determined. DNREC, DDA and the Agriculture Subcommittee are working with the Delmarva Poultry Industry (DPI) to see if a current snap shot of poultry operations in the Chesapeake can be determined through a survey process. The current plan is for poultry-company employed flock supervisors will fill out a form during regular visits to operations in Fall 2010. This will determine the current number of operations in the Chesapeake, and the extent that BMPs are being implemented. Additionally, Conservation District staff will update inspection forms in order to assemble a complete assessment of BMPs in use on operations. It is hoped that both these approaches will result in a complete database of BMPs, whether or not those practices were cost shared. These forms will also provide opportunities for additional implementation concerns that arise as they carry out inspections.

9.3.3. Nutrient Planning Program

Currently 100% of Delaware farmland is required to have a nutrient management plan written by a certified plan writer. Further reductions in nutrient runoff may be achieved by continued research into manure application and handling as well as increased outreach to help farmers implement their plans. Furthermore, the development and implementation of additional and new BMPs are expected to improve nutrient use efficiency and lessen nutrient runoff. Under EPA direction, DDA is spearheading an effort to assess and re-draft when necessary the State Technical Standards (BMPs) for nutrient handing and environmentally conscience farm operation.

9.3.4. Nutrient Relocation Program

This program is dependent on funding and it is impossible to have too much funding for this program. If there are funds, manure will be moved. Funding sources have already been diversified. If more stringent phosphorus manure application recommendations or requirements are developed in the State, this could limit the ability to transport and apply manure to other agricultural lands in the Chesapeake portion of the State and may require that more is transported out of Chesapeake watershed or to alternative uses, which could be more expensive. The Delaware Nutrient Management Commission currently monitors application rates and will be in the position to continue monitoring any change recommendations or requirements for application rates in the future.

9.3.5. Kent Conservation District Cost-Share Program

KCD will continue to promote its Cost Share Program to all of Kent County, including the Chesapeake Bay watershed. Currently, cover crops are the number one priority of the KCD Cost Share Program. Sign-ups for cover crops are offered for two weeks in August since they are only planted during the fall. All other cost share applications are accepted throughout the year. These producers go on a waiting list and once all cover crop requests are funded, if there is cost share funding remaining, District staff call the producers on the waiting list to determine if they are still interested in the BMP. Due to this process, it is difficult to quantify the funding gap(s) for the KCD Cost Share Program, but this waiting list which has been present for at least the past 7 years, demonstrates that more BMPs are requested than funding allows for installation. This list and BMPs requests varies and at any given time, the waiting list can contain requests for $3,500 to $425,000 in total cost share requests. If additional funds are available, the time spent on the waiting list will shorten and more implementation will occur.

9.3.6. Sussex Conservation District Cost-Share Program

In order to achieve the Chesapeake Bay Watershed TMDL targets, additional funding will be needed. If funding were not an issue, the Sussex Conservation District could spend the following (based on our FY 2010 cost-share enrollment):

Conservation Practice	Additional Number Requested*	Additional Funding Needed*
Cover Crops	52,437	$2,528,177
HUAPs	89	$429,696
Poultry Manure Structures	5	$118,656

Poultry Composters	4	$27,885
Wildlife Ponds	2	$10,000
Animal Waste Facility	1	$46,305
Poultry Windbreak	1	$3,982
Total		$3,164,701

*Compared to data table Current Programs and Capacity section.

9.3.7. New Castle Conservation District Cost-Share Program

Increased participation in a cover crop program targeted at the Chesapeake Bay watershed will require additional funding. Overall, producer participation in government sponsored cost-share programs may be constrained because of the high percentage of tillable land within the Bay watershed that belongs to absentee owners. Additional effort will be made to educate these landowners of the available NCCD managed programs.

9.3.8. Agricultural Management Assistance (AMA) Program

Additional reductions within our current capacity will be difficult to achieve.

9.3.9. Wetland Reserve Program (WRP)

Additional reductions within our current capacity will be difficult to achieve.

9.3.10. Wildlife Habitat Incentives program (WHIP)

Additional reductions within our current capacity will be difficult to achieve.

9.3.11. Environmental Quality Incentives Program (EQIP)

Additional reductions within our current capacity will be difficult to achieve. There is no current plan to increase capacity because funding is to expire in two years. The workload will be handled by existing staff, which includes a new planner in Sussex County.

9.3.12. Chesapeake Bay Watershed Initiative (CBWI)

Additional reductions within our current capacity will be difficult to achieve. In the last funding cycle, 123 applications went unfunded. If all were funded (using $31,550 as the average cost of funded contract), the total cost of these additional projects would have been $3,880,665. Only $1,020,093 was available, therefore, funding could be quadrupled. Long term funding is not guaranteed, making it difficult to add fulltime staff beyond the two years remaining on the funding cycle. NRCS has contribution agreements with conservation districts, allowing for more capacity to deal with workload issues. The 2010 increase and subsequent decrease in funding in 2012 will be dealt with by existing staff and district staff.

9.3.13. Delaware Conservation Reserve Enhancement Program (CREP)

The Delaware CREP partners are working together to ensure a successful and continuing future for CREP in Delaware. Improved water quality and wildlife habitat will continue to be the focus of their efforts. In 2006, the partners proposed revisions to the Delaware CREP Agreement. In 2007 the Revised Agreement was approved and the following list of changes expanded the program to improve its viability to participants:

1. Added practice CP23A Wetland Restoration (non- floodplain)
2. Added practice CP9 Shallow Wildlife Pond
3. Modified practice CP4D to increase acreage allowable per Farm Tract to 10 acres or 10% of cropland instead of the current 5 acres or 5%.
4. Added an area of coastal plain in eastern Kent County previously not included in program area.
5. Increase total CREP acreage to 10,000 acres.

CREP partners will continue to enhance out-reach and education efforts to reach farmland owners and operators. One new effort ongoing is working with Public Tax Ditch managers and their constituents to encourage the establishment of grassed filter strips. More grassed filter strips along the many miles of channels in cropland would reduce sediment loads, reduce maintenance costs and aid farmers in meeting their nutrient management and conservation objectives.

9.3.14. Conservation Reserve Program (CRP)

It is anticipated that there will be a general signup in the fall of 2010. Land rents have increased substantially in Delaware, making the rental rate offered for CRP not as competitive as in the past. Currently, due to the increased payment rate for acreage enrolled in CREP, every effort is made to encourage producers to take advantage of that program if possible.

9.3.15. General Data Gaps

Need to do outreach to Amish communities in Delaware's portion of the Chesapeake Bay Watershed because there is currently no record of BMPs on these lands. Interactions with Amish farmers in other parts of the state have revealed that they often do indeed implement nutrient and sediment reducing practices and these practices should receive credit.

9.4. Strategy to Fill Gaps

Delaware's strategy to fill gaps within the Agriculture Sector will focus on three distinct and separate BMP practice categories. The first of these will focus on BMP implementation on Private Lands. Responsibilities include: Financing, implementing, and maintaining best management practices to address site specific nutrient and sediment issues on their property and lands they own or lease. The second priority for BMP implementation will be on Public Lands owned or managed by State Government Agencies. Responsibilities include: Provide staff, technical resources and funding to Soil Conservation Districts for technical assistance to farmers and landowners for the implementation of best management practices. The last focus will be on new or emerging BMPs. These are practices that are new in the BMP suite and there is a potential they may achieve greater nutrient or sediment reductions at lower cost, more quickly, and/or more verifiably. The Bay model does not, at this time, have the capability to accurately represent all of these approaches. As such, Delaware is committed to working closely with the Chesapeake Bay Program to assure the BMPs recommended herein will be adequately reflected within the Chesapeake Bay Model.

For each of the recommendations that follow, a specific goal will be recommended for the time periods of 2011, 2012 through 2017, and 2025. Where applicable, potential Funding Mechanism recommendations are made detailing the programmatic interests of parties that may have some responsibility or availability for future increased funding. See Appendix G for a table of this information.

Realizing a significant boost in funding will be warranted for full implementation, it is imperative Delaware pursue increased funding through State programs such as the State of Delaware Conservation Cost Share Program, Delaware CREP Program, Delaware Nutrient Relocation, Delaware CAFO, and Delaware Nutrient Management Programs. Likewise, it is essential Federal Programs, such as EQIP and the Chesapeake Bay Program Grant, be expanded or re-prioritized within the Chesapeake Bay Watershed to account for additional funding needs. Through the Delaware Conservation Partnership, responsible agencies meet quarterly to discuss issues or targeted or prioritized efforts, needs and funding. The Partnership is made up of representatives from NRCS, DDA, DNREC, US Fish and Wildlife, the Conservation Districts, Nutrient Planning Companies, and others. An example of recent NRCS funding change that resulted from the Conservation Partnership is an amendment of the EQIP funding of the cover crop cost share program to an annual contract rather than through a three year contract. This simple amendment made the program more attractive to participants and garnered additional interest in 2010 cover crop planting. Through the Conservation Partnership, additional resources will be pursued to accommodate the increased goal of BMP implementation within the Chesapeake Watershed as highlighted within this document.

As additional funding needs will certainly be warranted, private grants and/or exploratory grants will be additionally pursued. Lastly, to accommodate easier land owner participation by Private Landowners, the State of Delaware, Revolving Loan Fund Program should be review and expanded to allow additional BMP funding as applicable.

9.4.1. Regulatory Programs for Private Lands

The following suite of BMPs represents both regulatory requirements and voluntary activities recommended for Private landowners.

9.4.1.1. Nutrient Management Program

Delaware is already working with partners and has a fully funded and successful nutrient management handler certification program that requires a minimum amount of credit hours for all nutrient handlers, including generators, applicators, consultants, and planners. The Delaware Nutrient Management Commission (DNMC) is highly respected in the agricultural community, and facilitates partnerships among all applicable state and local agencies as well as academic institutions and land grant universities. The NMC engages in full public information initiatives for all nutrient handlers, not just agricultural handlers. Agriculture Week (Ag Week) consolidates farm-based educational meetings while recognizing and celebrating the industry's importance. The University of Delaware Cooperative Extension, Delaware State University Cooperative Extension, and Delaware Department of Agriculture are cooperating with many partners to organize the week of agriculture related events.

To address historical phosphorus accumulation in soils that will contribute future loads to the Bay, Delaware is considering prohibiting phosphorus from high phosphorus soils. Among other options, Delaware is looking into modifications of methods for determining appropriate agronomic rates for the

application of manure, biosolids, and/or organic byproducts, including, for CAFOs, state technical standards developed in accordance with 40 CFR 123.36.

9.4.1.2. Oversight of AFOs and CAFOs

Delaware will identify the number of animals confined in CAFOs by county. Almost the entire population of animals in CAFOs has NPDES permits; there are 372 that are currently permitted statewide, and 125 of them are large poultry farms. The DDA does not expect the number of poultry operations in the Chesapeake to increase between now and 2025.

The DDA, the DNMC, and DNREC have been working with EPA over the last year to prepare for modifying the State's current CAFO regulations in response to changes in the federal regulations. The regulations are now final are currently available for review on DDA's and DNREC's websites. The regulations will result in a higher level of management for permitted CAFOs, almost identical to federal regulations. As a result of the modified regulations, medium-sized CAFOs and poorly managed AFOs of any size will also be covered under the CAFO regulations. Animals confined by CAFOs that currently do not have NPDES permits will be permitted soon. Permits will be reviewed once every five years, with the attached NMP required to be reviewed every three years at a minimum.

Additional controls may also be required. State Technical Standards, BMP manuals, permitting strategies, minimum practice requirements within a nutrient management plan, and/or contract conditions for receiving cost-share assistance are currently being modified. The State Technical Standards have been modified and are currently under EPA review. To assure that adequate resources are available for the rewriting of State Technical Standards, Delaware will rely on EPA and USDA grants to provide additional necessary funds. Two new positions for the nutrient management program will benefit from these funds, as well as from restoration of state general funds for nutrient planning reimbursements.

Since 2000, all DE Nutrient Management Plans (NMP) are required to be P based. Delaware is proposing to use the NRCS Nutrient Management Code 590 within the nutrient management plan requirements. This standard provides information on managing the amount, source, placement, form, and timing of the application of nutrients and soil amendments. Code 590 serves multiple purposes: to budget and supply nutrients for plant production, to properly utilize manure or organic by-products as a plant nutrient source, to minimize agricultural non-point source pollution of surface and ground water resources, and to maintain or improve the physical, chemical, and biological condition of soil. The use of Code 590 is new, and augments the Nutrient Management Law on CAFOs, which does not cover the elements in as great of detail. Delaware uses an animal waste management plan that includes the nine elements required by EPA for nutrient management planning. Additionally, Delaware will support the development of a revise Phosphorus Site Index that incorporates the best available science in an effort to more appropriately identify the risk for phosphorus loss from agricultural lands. The revised Phosphorus Site Index will offer site-specific management options for reducing off-site phosphorus transport. The process of revising the current Phosphorus Site Index will conducted in conjunction with the University of Delaware and will mirror the national NRCS standard as is currently under development.

To verify that controls are installed and maintained, CAFO permits will be monitored at a frequency that will be determined soon. It is anticipated that (1) compliance inspections of all permitted CAFOs will occur at least once every five years, (2) CAFO determination inspections of all unpermitted large CAFOs and all

medium AFOs will be conducted as complaints warrant, and based on the Secretary of Agriculture's yet to be determined schedule and (3) on-site visits of AFOs for the purpose of evaluating criteria for designation will be conducted as warranted. The Nutrient Management Program, dependent upon staffing levels, has a goal to inspect every facility with a Nutrient Management Plan at least once during its lifecycle, therefore, at a minimum, once every three years. With current staffing levels in place or anticipated by 2011, this is a reasonable and achievable goal. The Nutrient Management Program staff will perform all compliance inspections of AFOs and most inspections of permitted and unpermitted CAFOs as warranted. Like DNREC, the DDA NM Program staff follows an education program before regulating the compliance strategy. When fines and or penalties are warranted and appropriate, Del. C., Title 7, Chapter 60 sets out the schedule.

Information regarding the CAFO program will be updated when the regulations are finalized in the Fall of 2010; following the promulgation of the regulations, information such as the number of Notice of Intents (NOIs) submitted for CAFO permits can be reported.

9.4.2. Best Management Practices for Private Lands

9.4.2.1. Cover Crops – Traditional: Cover crops are small grains such as wheat, rye, or barley that are planted in the fall after the harvest of corn, soybeans, and/or other summer crops to absorb residual fertilizer that may remain in the soil. Cover crops provide a ground cover that prevents winter soil erosion. They are a popular BMP in Delaware, although their implementation rates can be increased. Due to weather and cropping patterns, area agriculture representatives feel that the most realistic goal for cover crops in any given year is 50% of the crop land. To accomplish this goal, several strategies should be adopted:

1. Obtain additional funding for cover crop incentive payments. Incentive rates need to be raised to cover the farmers' costs plus provide enough of an incentive to entice the farmer to plant the cover crop. Some fields are small with wet soils and the farmers don't want the hassle with these field conditions. This is more the case in the Inland Bays, but it can happen in the Chesapeake too.
2. Obtain extra funds to increase the caps so more farmers will plant more acreage. Now some farmers only plant enough to reach the cap.
3. Continue to allow harvesting of the crops-turning a cover crop into a commodity cover crop. Harvesting removes the nitrogen from the fields as well as stretches the cost-share money since only partial payments are made to those harvesting cover crops. The current programs that allow harvesting do not allow fertilization until after March 1st.
4. Modify cost-share programs to further incentive early plantings of the most efficient species.
5. FSA is working on creating a code for farmers to report cover crops to help with tracking voluntary acreage. Delaware would appreciate assistance from EPA to ensure that the information on design, implementation, and maintenance collected is sufficient to allow proper crediting in the model.
6. Utilize a targeted approach and develop different recommendations for different watersheds.

Funding for cover crops is provided through the State of Delaware Cost Share Program, CWA-Section 319 Grant, Chesapeake Bay Program Grant, and USDA's Environmental Quality Incentive Program.

GOAL: There are currently 16,600 acres of traditional cover crops; Delaware's goal is to expand this number to 19,920 acres for 2010-2011. Additional funding in the range of $15 - $30 per acre, or $49,800 -

$99,600 is needed. For the time period of 2012-2017, 19,920 additional acres will be added, at a rate of 3,320 acres per year, bringing the total to 39,840 acres. By 2025, Delaware's goal is to expand this practice to 66,400 acres. The projected cost for full implementation will be $1,002,000 - $2,004,000 annually.

FUNDING MECHANISM: Cost share funding to offset the costs if implementation to the landowners is available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs. Additional funding is provided through the Chesapeake Bay Grant and the CWA Section 319 Program. Additional sources will be pursued to allow for the increased BMP implementation schedule. For example, additional funding requests will be made through the State of Delaware Legislative Budget development process to increase contributions to the State of Delaware Conservation Cost Share Program

9.4.2.2. Cover Crops – Commodity: Cover crops are small grains such as wheat, rye, or barley that are planted in the fall after the harvest of corn, soybeans, and/or other summer crops to absorb residual fertilizer that may remain in the soil. Cover crops provide a ground cover that prevents winter soil erosion.

This data has not been reported in Delaware in the past. Several cost share programs allow harvesting of cover crops after March 15th, with fertilizer or manure applications allowed after March 1st. This information has not been captured in reporting systems in the past, so it is difficult to establish a goal at this time. The appropriate data fields are being added to data systems so that this can be determined. Additionally, FSA is working on adding cover crops to their list of crops reported by farmers each year, so this will help capture cover crops that are done voluntarily and without assistance of cost share programs.

Funding for cover crops is provided through the State of Delaware Cost Share Program, CWA-Section 319 Grant, Chesapeake Bay Program Grant, and USDA's Environmental Quality Incentive Program.

GOAL: There are currently 6,595 acres of early planted commodity cover crops; Delaware's goal is to expand this number to 7,913 acres for 2010-2011. Additional funding in the range of $35 - $50 per acre, or $46,130 - $65,900 is needed. For the time period of 2012-2017, 7,908 additional acres will be added, at a rate of 1,318 acres per year, bringing the total to 15,821 acres. By 2025, Delaware's goal is to expand this practice to 26,365 acres. The projected cost for full implementation will be $922,775 - $1,318,250 annually.

FUNDING MECHANISM: Cost share funding to offset the costs if implementation to the landowners is available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs. Additional funding is provided through the Chesapeake Bay Grant and the CWA Section 319 Program. Additional sources will be pursued to allow for the increased BMP implementation schedule. For example, additional funding requests will be made through the State of Delaware Legislative Budget development process to increase contributions to the State of Delaware Conservation Cost Share Program.

9.4.2.3. Nutrient Management Compliance: Land owners must submit Nutrient Management Plans to demonstrate that they efficiently use manure or fertilizer to grow healthy crops, and significantly minimize the application of excessive nutrients that could be lost to the environment. The State of Delaware Nutrient Management Commission conducts Nutrient Management Compliance Desk Audits on all submitted Nutrient Management Annual Reports representing the entire 216,290 acres annually (see above Figures 24 and 25).

GOAL: There are currently 216,290 acres of land under Nutrient Management Compliance; Delaware's goal is to maintain this amount for through 2025. We do not know the amount of additional funding needed in order to maintain our current Compliance.

FUNDING MECHANISM: Regulatory requirement. Plan development reimbursement funding is provided programmatically through the Delaware Nutrient Management Commission.

9.4.2.4. Soil Conservation and Water Quality Plans: These plans will address natural resource management on agricultural lands and recommend best management practices that control sediment loss resulting from erosion, and control nutrient runoff.

GOAL: There are currently 194,666 acres of land under Soil Conservation and Water Quality Plans. Delaware's goal is to maintain this amount through 2025.

FUNDING MECHANISM: Cost share funding to offset the costs if implementation to the landowners is available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs. Additional funding is provided through the Chesapeake Bay Grant and the CWA Section 319 Program. Additional sources will be pursued to allow for the increased BMP implementation schedule. For example, additional funding requests will be made through the State of Delaware Legislative Budget development process to increase contributions to the State of Delaware Conservation Cost Share Program.

9.4.2.5. Conservation Tillage: Conservation tillage involves planting and growing crops with minimal disturbance of the surface soil. No-till farming, a form of conservation tillage, is used to seed the crop directly into vegetative cover crop residue with no disturbance to the soil surface. Minimal tillage farming involves some disturbance of the soil, but uses tillage equipment that leaves much of the vegetative cover or crop residue on the surface.

Delaware has reported acres of conservation tillage where the residue is 15% or greater based on USDA NRCS data at a county scale. This most likely does not represent all agricultural producers, just the total for those who participate in USDA programs. There is room for better reporting and possibly increased implementation.

GOAL: There are currently 197,799 acres of conservation tillage; Delaware's goal is to expand this by 6,000 additional acres annually. Additional funding of $13/acre is needed. By 2025, Delaware's goal is to have Conservation Tillage cover 227,008 acres, bringing the cost of full implementation to $3,279,770.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.2.6. Continuous No-Tillage Conservation: For Continuous No-Till, the seed is applied into a vegetative cover or crop residue with no disturbance to the surface soil. Conservation tillage involves planting and growing crops with minimal disturbance of the surface soil. No-till farming, a form of conservation tillage, is used to seed the crop directly into vegetative cover crop residue with no disturbance to the soil surface. Minimal tillage farming involves some disturbance of the soil, but uses tillage equipment that leaves much of the vegetative cover or crop residue on the surface.

The NRCS has a practice called long term no-till which they consider a carbon sequestration practice. EPA modelers have indicated that this would instead fall under continuous no-till. Approximately 3,527 acres of this practice has been implemented since 2005 and the NRCS has set a goal of an additional 1,000 acres per year between now and 2025.

GOAL: There are currently 23,159 acres of Continuous No-Till Conservation; Delaware's goal is to expand this by 1,000 acres annually. Additional funding of $40/acre is needed. By 2025, Continuous No-Till Conservation will cover over 36,159 acres, bringing the cost of full implementation to $1,446,360.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.2.7. Decision/Precision Agriculture: Precision agriculture seeks to maximize the efficiency of nutrient application to cropland in order to minimize waste and nutrient runoff.

This data has not been reported in Delaware in the past. According to EPA, decision agriculture comes from the NRCS practice of precision agriculture, which is information and technology based management system that is site specific and uses one or more of the following sources of data: soils, crops, nutrients, pests, moisture, or yield, for optimum profitability, sustainability, and protection of the environment. .

GOAL: There are currently 103,186 acres of land following Decision Agriculture protocols; Delaware's goal is to expand this by 20,637 acres annually. Additional funding of $30/acre is needed. By 2017, Decision Agriculture will cover 227,008 acres, bringing the cost of full implementation to $6,810,240.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.2.8. Heavy Use Poultry Area Pads: Establishing a pad structure stabilizes areas frequently and intensively used by people, animal, or equipment to prevent nutrient movement into surface and groundwater.

Cost-share funds are available for the installation of these structures through the State of Delaware Cost-Share program and USDA's Environmental Quality Incentives Program.

GOAL: There are currently 227 structures of Heavy Use Poultry Area Pads; Delaware's goal is to expand this by 45 additional structures annually. Additional funding of $4,661/unit is needed. By 2025, there will be 857 Pads, requiring an additional funding amount or $2,936,430 to achieve full implementation.

FUNDING MECHANISM: Cost share funding to offset the costs if implementation to the landowners is available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs. Additional funding is provided through the Chesapeake Bay Grant and the CWA Section 319 Program. Additional sources will be pursued to allow for the increased BMP implementation schedule. For example, additional funding requests will be made through the State of Delaware Legislative Budget development process to increase contributions to the State of Delaware Conservation Cost Share Program.

9.4.2.9. Livestock Waste Structures: Animal waste is stored in structures to protect it from the weather until it can be used as a crop fertilizer when conditions are appropriate for transport to another location.

Cost-share funds are available for the installation of these structures through the State of Delaware Cost Share Program and USDA's Environmental Quality Incentives Program.

GOAL: There are currently 3 swine, 7 equine, 4 dairy, 10 dairy waste, and 3 bovine structures; Delaware's goal is to expand this to 4 swine, 10 equine, 5 dairy, 12 dairy waste, and 4 bovine structures for 2010-2011. Additional funding of $25,000 for the swine structure, $15,000 for the equine structure, $60,000 for the dairy structure, and $50,000 for the bovine structure is needed. By 2025, there will be 10 swine, 28 equine, 11 dairy, 24 dairy waste, and 10 bovine structures, requiring $250,000 for swine, $420,000 for equine, $1,440,000 for dairy, and $200,000 for bovine to achieve full implementation.

FUNDING MECHANISM: Cost share funding to offset the costs if implementation to the landowners is available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs. Additional funding is provided through the Chesapeake Bay Grant and the CWA Section 319 Program. Additional sources will be pursued to allow for the increased BMP implementation schedule. For example, additional funding requests will be made through the State of Delaware Legislative Budget development process to increase contributions to the State of Delaware Conservation Cost Share Program.

9.4.2.10. Water Control Structures: These structures are used in constructed drainage systems to control water depth and flow rates. They also increase water retention and decrease the quantity and quality of pollutants downstream.

Cost-share funds are available for the installation of these structures through the State of Delaware Cost-Share program and USDA's Environmental Quality Incentives Program and USDA's Environmental Quality Incentives Program.

GOAL: There are currently 50 units for 8,343 acres; Delaware's goal is to increase to 51 units for 2010-2011. Additional funding of $5,000 per unit is needed. By 2025, there will be 65 total structures, requiring $75,000 to achieve full implementation.

FUNDING MECHANISM: Cost share funding to offset the costs if implementation to the landowners is available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs. Additional funding is provided through the Chesapeake Bay Grant and the CWA Section 319 Program. Additional sources will be pursued to allow for the increased BMP implementation schedule. For example, additional funding requests will be made through the State of Delaware Legislative Budget development process to increase contributions to the State of Delaware Conservation Cost Share Program.

9.4.2.11. Stream Protection with Fencing: Pasture fencing keeps farm animals out of streams and prevents stream bank erosion.

Cost-share funds are available for the installation of these structures through the State of Delaware Cost-Share program and USDA's Environmental Quality Incentives Program and USDA's Environmental Quality Incentives Program.

GOAL: There are currently 108 acres of Stream Protection with Fencing; Delaware's goal is to increase this to 118 acres for 2010-2012. Additional funding of $20 at a rate of $2/ft is needed. By 2025, there will be 258 total acres.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.2.12. Stream Protection without Fencing: Watering troughs provide a safe, reliable source of water from livestock that is away from streams. The troughs help protect stream banks from erosion that may be caused by farm animals.

Cost-share funds are available for the installation of these structures through the State of Delaware Cost-Share program and USDA's Environmental Quality Incentives Program and USDA's Environmental Quality Incentives Program.

GOAL: There are currently no acres of Stream Protection without Fencing; Delaware's goal is to increase this to 25 acres for 2010-2012. Additional funding of $700/each is needed for each installed system. By 2025, there will be 325 total acres, bringing the cost of full implementation to $227,500.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.2.13. Upland Prescribed Grazing: This data has not been reported in Delaware in the past. NRCS maintains a data set which indicates that there are 214 acres of prescribed grazing in the Chesapeake.

GOAL: Increase implementation to 1,134 acres.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.2.14. Manure Relocation: Excess manure is transported away from farms with high phosphorus levels to other farms or locations that can use the manure safely.

The Nutrient Relocation Program is already fully implemented. Currently, 80% of the manure that is relocated from Delaware's Chesapeake watersheds is sent out of the Chesapeake watershed or to alternative uses. Approximately 4% is relocated to other Chesapeake watersheds in the state and 16% to other Chesapeake watersheds in other states.

Delaware will investigate increasing the annual quantity of manure relocated out of the Chesapeake watershed or put into an alternative use. DNMC's cost-share program for manure relocation will provide outreach in order to gain more participants in the relocation program. The Perdue Agri-recycle facilities will continue to take excess manure for their plant as well. This relocation goal would be achieved on an annual basis. The DNMC tracks the manure that is relocated and reports that data such that progress towards the goal may be tracked.

Funds for the relocation program come from CWA Section -319 Grant, Delaware Cost Share Program, Chesapeake Bay Program Grant, USDA's Environmental Quality Incentives Program, and Delaware's Poultry Integrators.

GOAL: There are currently 48,757 tons of manure in the Manure Relocation Program; Delaware's goal is to increase this by an additional 4,000 tons annually for a total annual relocation of 52.757 tons by 2012. Additional funding of $17,280 is needed, at a rate of $4.32/ton. By 2025, there will be 110,757 tons relocated annually, bringing the annual cost of full implementation to $478,470.

FUNDING MECHANISM: Cost share funding to offset the costs if implementation to the landowners is available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs. Additional funding is provided through the Chesapeake Bay Grant and the CWA Section 319 Program. Additional sources will be pursued to allow for the increased BMP implementation schedule. For example, additional funding requests will be made through the State of Delaware Legislative Budget development process to increase contributions to the State of Delaware Conservation Cost Share Program.

9.4.2.15. Poultry Waste Structures: These structures protect poultry waste from rain so that it can be used as a crop fertilizer when conditions are appropriate for transport to another location.

Cost-share funds are available for the installation of these structures through the State of Delaware Cost-Share program and USDA's Environmental Quality Incentives Program and USDA's Environmental Quality Incentives Program.

GOAL: There are currently 444 structures of Poultry Waste Structures; Delaware's goal is to increase this by 20% to 723 structures by 2025. Additional funding of $7,534,395 at a rate of $27,005/each is needed.

FUNDING MECHANISM: Cost share funding to offset the costs if implementation to the landowners is available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs. Additional funding is provided through the Chesapeake Bay Grant and the CWA Section 319 Program. Additional sources will be pursued to allow for the increased BMP implementation schedule. For example, additional funding requests will be made through the State of Delaware Legislative Budget development process to increase contributions to the State of Delaware Conservation Cost Share Program.

9.4.2.16. Run-Off Control Systems: Run-Off Control Systems use a variety of techniques to direct rainwater to places where it will not cause nutrient runoff or soil erosion. Gutters and downspouts on barns and grading of the land are examples of ways to direct runoff from rainfall.

Cost-share funds are available for the installation of these structures through the State of Delaware Cost-Share program and USDA's Environmental Quality Incentives Program and USDA's Environmental Quality Incentives Program.

GOAL: There are currently no Run-Off Control Systems; Delaware's goal is to increase this to 8 systems for 2010-2012. Additional funding of $84,000 at a rate of $10,500/each is needed. By 2025, there will be an additional 10 systems installed annually for a total of 120 total systems. Annually, 10 additional systems will cost $105,000.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.2.17. Phytase Utilization: With the advent of phytase addition to the diet and feed for all poultry in Delaware, we have noticed a steady reduction in the phosphorus levels in poultry manure. Research demonstrates that a 30-40% reduction is achievable.

GOAL: As is currently realized, continue with a full utilization of Phytase within all feed components used within the Chesapeake Bay Watershed. Recent research has indicated a 33% reduction is achievable. With further research and development, higher reductions will be realized by 2025.

FUNDING MECHANISM: None

9.4.2.18. Mortality Composters: Require dead bird composters/incinerators on all poultry operations for bird mortality. Dead bird composters have been cost shared and promoted in Delaware, however, there is likely room to increase this implementation rate. The Delmarva Poultry Industry (DPI) is investigating an on-farm assessment of Delaware poultry farms to determine current BMP status and future needs.

GOAL: Increase implementation of Mortality Composters: for small operations (AFOs), at least 50% of operations in each sub-watershed should have these practices; for medium and large operations (CAFOs), 100% of operations should have these practices. There are currently 449 Mortality Composters; Delaware's goal is to increase this to 539 composters for 2010-2012. Additional funding of $595,620 is needed. By 2025, there will be 723 structures, bringing the additional cost of full implementation to $1,217,712.

FUNDING MECHANISM: Cost share funding to offset the costs if implementation to the landowners is available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs. Additional funding is provided through the Chesapeake Bay Grant and the CWA Section 319 Program. Additional sources will be pursued to allow for the increased BMP implementation schedule. For example, additional funding requests will be made through the State of Delaware Legislative Budget development process to increase contributions to the State of Delaware Conservation Cost Share Program.

9.4.2.19. Large Animal Mortality Program: Offer large animal mortality handling for operations with large animals. Program will assure off-site transport for large animal mortality.

GOAL: There are currently 110 animals annually; current cost is $175 to $250 per animal depending on distance of transportation. Delaware's goal is to maintain this for 2010-2012 and 2012-2017. Continued annual funding of approximately $60,000 is needed to continue this practice.

FUNDING MECHANISM: Cost share funding to offset the costs if implementation to the landowners is available from the State of Delaware Conservation Cost Share Program. Additional sources will be pursued to allow for the increased BMP implementation schedule. For example, additional funding requests will be made through the State of Delaware Legislative Budget development process to increase contributions to the State of Delaware Conservation Cost Share Program.

9.4.2.20. Streamside Grass Buffers: Grasses planted next to waterways filter and take up nutrients from run-off, stabilize the soil, and provide wildlife habitat.

Cost share funds are available for the implementation of grass buffers on private agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDA's Conservation Reserve Enhancement Program. Costs are based on a 10 year contract agreement.

GOAL: There are currently 699 acres; Delaware's goal is to increase by 69 acres to 768 acres for 2010-2011 on private lands. Additional funding of $300/acre for installation, $65/acre/year land rental, and $35.17/acre/year interest is needed. For the 2012-2017 time period, there will be 1,113 total acres, bringing the cost of partial implementation to $124,200 installation cost + $269,100 rental + $145,604 = $538,904. By 2025, Delaware's goal is to increase the streamside grass buffer acreage to 1,734 acres.

FUNDING MECHANISM: Cost share funding to offset the costs of implementation are available for the implementation of grass buffers on private agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDA's Conservation Reserve Enhancement Program.

9.4.2.21. Streamside Forest Buffers: Trees planted next to waterways filter and take up nutrients from run-off, stabilize the soil, and provide wildlife habitat.

Cost share funds are available for the implementation of grasses buffers on private agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program. Costs are based on a 10 year contract agreement.

GOAL: There are currently 2,226 acres of Streamside Forest Buffers; Delaware's goal is to increase by 223 acres to 2,449 acres for 2010-2011 on private lands. Additional funding of $425/acre average for installation, $138/acre/year land rental, $35.60/acre/year interest, and $5 acre/year maintenance is needed. For the 2012-2017 time period, there will be 3,564 total acres, bringing the cost of partial implementation to $568,650 installation cost + $1,846,440 rental + $476,328 interest + $66,900 maintenance = $538,904. By 2025, Delaware's goal is to increase the streamside forest buffer acreage to 5,571 acres.

FUNDING MECHANISM: Cost share funding to offset the costs of implementation are available for the implementation of grass buffers on private agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDA's Conservation Reserve Enhancement Program.

9.4.2.22. Wetland Restoration: A wetland is an area of land where the soil is wet or covered with water. Wetlands can be in the form of bogs, swamps, or marshes.

Cost share funds are available for the implementation of wetland restoration on private agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program. Funding for wetland creation, restoration, and enhancement is also available from various federal sources, State and local government and nonprofit organizations. Costs are based on a 10 year contract agreement.

GOAL: There are currently 286 acres of Wetland Restoration; Delaware's goal is to increase by 29 acres to 315 acres for 2010-2011 on private lands. Additional funding of $1.072/acre average for installation, $138/acre/year land rental, and $5 acre/year maintenance is needed. For 2012-2017, there will be 460 acres of restored wetlands, bringing the cost of partial implementation to $2,961,148 installation cost + $240,120 rental + $8,700 maintenance = $3,209,968. By 2025, Delaware's goal is to increase the wetland restoration acreage to 721 acres.

FUNDING MECHANISM: Cost share funding to offset the costs of implementation are available for the implementation of Wetland Restoration on private agricultural lands through the Delaware Conservation

Reserve Enhancement Program and USDA's Conservation Reserve Enhancement Program. Funding for wetland creation, restoration, and enhancement is also available from various federal sources, State and local government and nonprofit organizations.

9.4.2.23. Shoreline Erosion Control: Shore stabilization projects on private agricultural land that reduces erosion and stabilizes shorelines. Mitigation options to protect shorelines provide nutrient and sediment reductions.

GOAL: To date, there 33 shoreline stabilization projects have been permitted in the Chesapeake Bay Watershed. This represents 6,343 feet of shoreline protect (4,953 feet of the protected shoreline is privately owned and 1,390 feet of the protected shoreline is publicly owned). Delaware's goal is to protect an additional 600 feet annually through 2025 for a total of additional shoreline erosion control goal of 15,343 feet protected shoreline.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs. Funding for shoreline stabilization is also available from various federal sources, State and local government and nonprofit organizations.

9.4.2.24. Retire Highly Erodible Land: Land that is especially vulnerable to erosion is removed from crop or hay production and planted in either grass or forest. This land is not usually disturbed for at least 10 years. Cost share funds are available for the retirement of highly erodible agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDA's Conservation Reserve Enhancement Program.

GOAL: Delaware's goal is to retire 277 acres of highly erodible land for 2010-2011. Additional funding of $300/acre average cost is needed. By 2025, there will be an increase of 300 acres/year of Highly Erodible Land, for a total of 697 acres.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.2.25. Land Retirement: Land retirement influences multiple environmental concerns beyond reducing soil erosion, such as improving water quality and protecting wildlife habitat. Land retirement programs include NRCS Conservation Reserve Program and, to a lesser extent, the Wetland Reserve Program.

GOAL: Maintain existing 416 acres of land retirement. Land retirement removes acreage from crop or hay production and is planted in either grass or forest. This land usually is not disturbed for at least 10 years. Cost share funds are available for the retirement of highly erodible agricultural lands through the USDAs Conservation Reserve Program or the Wetland Reserve Program.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.2.26. Forest Harvesting Practices: Data on forest harvesting practices is tracked by the Delaware Forest Service. The acreage reported represents the areas that underwent timber harvest, either cleacutting or selective harvest. The Delaware Forest Service is the permitting agency for any logging operations that are 1 acre or larger if the land is to remain as forest afterwards. If it is to be converted for

development or agriculture, it passes to DNREC/Conservation District/COE jurisdiction. The Forest Service approves or disapproves permits as they are submitted and makes sure the BMP laws are adhered to during and after harvest through field inspections. The primary laws enforced are water quality BMPs (all harvests) and adequate regeneration of commercial tree species (only when the Seed Tree Law is triggered by a harvest that is at least 10 acres, at least 25% pine and/or yellow-poplar, and not to be converted to a non-forest land use).

GOAL: Maintain existing 2,070 acres. Clear-cut acreage since 2005 is 1,050. Averaging 31 acres per clear cutting permit (34 permits). Track forest harvesting BMPs for 210 acres annually through 2025.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.3. Best Management Practices for Public Lands

The following suite of BMPs represents voluntary activities recommended for Government agencies owning Public Lands.

9.4.3.1. Tree Planting: Delaware does not have extensive data on public land Tree Planting previous to 2005.

GOAL: The current amount of Tree Planting varies by year; Delaware's goal is to increase the amount annually. Additional funding of up to $400/acre is needed. By 2025, there will be 108 additional acres planted.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.3.2. Wetland Restoration: Construct 7 acres of Wetland Restoration on Public Lands. A wetland is an area of land where the soil is wet or covered with water. Wetlands can be in the form of bogs, swamps, or marshes. Cost share funds are available for the implementation of wetland restoration on agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program. Funding for wetland creation, restoration, and enhancement is also available from various federal sources, State and local government and nonprofit organizations.

GOAL: The current amount of Wetland Restoration varies by year; Delaware's goal is to increase the amount annually. Additional funding of up to $1,702/acre is needed. For 2012-2017, there will be 7 additional acres planted, bringing the cost of full implementation to $11,914. By 2025, Delaware's goal is to increase the Wetland Restoration acreage on public lands to 15 acres.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.3.3. Streamside Forest Buffers: Plant 14 acres of Streamside Forest Buffers on Public Lands. Trees planted next to waterways filter and take up nutrients from run-off, stabilize the soil, and provide wildlife habitat. Cost share funds are available for the implementation of streamside forest buffers on agricultural

lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program.

GOAL: The current amount of Streamside Forest Buffers varies by year; Delaware's goal is to increase the amount annually. Additional funding of up to $425/acre is needed. For 2012-2017, there will be 14 additional acres planted, bringing the cost of partial implementation to $5,950. By 2025, Delaware's goal is to increase the Streamside Forest Buffer acreage on public lands to 30 acres.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.3.4. Streamside Grass Buffers: Plant 185 acres of Streamside Grass Buffers on Public Lands. Grasses planted next to waterways filter and take up nutrients from run-off, stabilize the soil, and provide wildlife habitat. Cost share funds are available for the implementation of streamside grass buffers on agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program.

GOAL: The current amount of Streamside Grass Buffers is established at 110 acres; Delaware's goal is to increase the amount annually by 5 acres. Additional funding of up to $300/acre is needed. For 2011, Delaware's goal is to add 5 acres. For 2012-2017, there will be 30 additional acres planted. By 2025, Delaware will plant 185 acres of Streamside Grass Buffers on Public Lands. The cost of full implementation is $22,500 for the additional 75 acres.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.3.5. Agriculture Strategies on DNREC/DDA Lands: Agriculture strategies include adopting applicable actions and practices from the Chesapeake Bay Executive Order Section 502, including cover crops, on Publicly Lands owned and maintained by DNREC, DDA and DelDOT.

GOAL: There are currently no acres of DNREC/DDA lands utilizing Agriculture Strategies; Delaware's goal is to expand this to 422 acres by 2010-2011. Additional funding is dependent on the type of BMP. By 2025, there will be 4,226 acres, with the cost of full implementation reliant on the type of BMP.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.3.6. Natural Filters on Other Public Lands: Delaware will increase partnerships with local governments, nonprofits, universities, other State of Delaware agencies to implement natural filters on Public Lands.

GOAL: There are currently evolving BMPs; Delaware's goal is to expand this by 50 additional acres. Additional funding of $300/acre is needed. For the time period of 2012-2017, natural filters will cover 450 acres, bringing the cost of full implementation to $135,000. By 2025, Delaware's goal is to increase the Natural Filters on public lands to 750 acres.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs.

9.4.4. New Farming Practices

9.4.4.1 CAFO Setbacks: Manure application setbacks to be implemented on the CAFO operations in accordance with State Technical Standards.

GOAL: There are currently no acres of CAFO Setbacks; Delaware's goal is to expand this by 250 additional acres annually. Additional funding is reliant on regulatory conditions. By 2025, CAFO Setbacks will cover 1,750 acres, with the cost of full implementation dependent on regulatory conditions.

FUNDING MECHANISM: Regulation

9.4.4.2. Cropland Irrigation Management: Crop irrigation is used to decrease climate variability and maximize crop yields. This results in a decrease in runoff and an increase in the crop's ability to uptake nutrients therefore less available for nutrient runoff. Yields are estimated at 20% to 25% higher than non-irrigated fields. Nutrient uptake or irrigated acres are greater, resulting in less residual nutrients remaining in the soil for runoff.

GOAL: There are currently 60,000 acres of Cropland Irrigation Management; Delaware's goal is to expand this to 65,000 additional acres annually. No additional funding is needed. For the time period of 2012-2017, Cropland Irrigation Management will cover 70,000 acres. By 2025, Delaware's goal is to increase Cropland Irrigation Management to 135,000 acres.

FUNDING MECHANISM: No public incentive support needed, farmers will adopt based on increase yields and cost effectiveness.

9.4.4.3. Vegetative Environmental Buffers: A vegetative environmental buffer is the strategic planting of combinations or trees and shrubs around poultry houses to address environmental, production, and public relations issues by providing a vegetative filter to lower emissions of ammonia, dust, odor, feathers, and noise on a potential of 82 operations. In addition to offering a practical, efficient, and cost effective means of capturing emissions, a properly designed vegetative environmental buffer program can help to conserve energy and reduce air borne pathogens by offering shade and slowing wind speeds, as well as create a more attractive landscape and screen routine operations from view.

GOAL: There are currently 72 Vegetative Environmental Buffers; Delaware's goal is to expand this to 82 additional acres for 2010-2011. Additional funding of $4,000 per system is needed, $40,000 total. For the time period of 2012-2017, Vegetative Environmental Buffers will reach 142 operations, bringing the cost of partial implementation to $240,000. By 2025, Delaware's goal is to Vegetative Environmental Buffers to 222 operations.

FUNDING MECHANISM: Cost share funding to offset the costs could be available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs. Programmatic support is offered through the Delmarva Poultry Industry, Inc.

9.4.4.4. Streamside/Tax Ditch Restoration: A suite of innovative alternative practices designed to enhance the removable of nutrients once they leave the field. These include increasing vegetative buffers that

protect ditches from sediment and nutrient runoff. This may include reengineering of drainage channels to reestablish floodplains or redirect storm flows to wetland areas.

GOAL: There are currently 17,700 linear feet of streamside/tax ditch restoration practices within the Chesapeake Bay Watershed; Delaware's goal is to expand this to 6,000 additional linear feet for 2010-2011. Additional funding of $75 per linear foot is needed, $450,000 total. For the time period of 2012-2017, an additional 1,250 linear feet will be implemented annually for a total of 31,200 linear feet total, bringing the cost of partial implementation to $1,012,500. By 2025, Delaware's goal is to increase Streamside/Tax Ditch Restoration to 41,200 linear feet.

FUNDING MECHANISM: Cost share funding to offset the costs of Streamside/Tax Ditch Restoration projects is available from the State of Delaware Conservation Cost Share Program and the various Farm Bill programs. Potential funding could be provided through the Chesapeake Bay Grant and the CWA Section 319 Program. Additional sources will be pursued to allow for the increased BMP implementation schedule.

Evolving Practices

9.4.4.5. 5, 10 and 35 Foot Riparian Buffer Setback: Land conversions and buffers are a good way to achieve nutrient and sediment goals. However, enough funding needs to be available to convince farmers to take land out of production. Buffers are not a popular practice among Delaware farmers as land is taken out of production and forested buffers are said to shade crops and attract wildlife that destroys the crop. Therefore, the Agriculture Subcommittee is reluctant to recommend this practice at substantially increased implementation rates. The Subcommittee at this time only recommends narrow grass buffers as this may be more marketable. A GIS analysis has been done to determine the location, length, and acreage potentially available for additional buffers on agricultural lands in the Chesapeake (See Figures 22, 23, and 24). To do this analysis, the NHDFlowline layer was clipped to the agriculture portion of the 2007 Delaware land use and land cover layer (where agricultural lands were identified by codes 211, 212, 213, 240, and 290). Table 21 shows the stream length available to buffer on agricultural lands in the Chesapeake within Delaware and the acres available to buffer if the buffer is 5 feet, 10 feet, or 35 feet wide. The potential for implementation is 852 acres with a 5 foot buffer, 1,706 with a 10 foot buffer, and 5,930 with a 35 foot buffer.

GOAL: There are currently evolving BMPs; Delaware's goal is to expand Riparian Buffer Setbacks to 250 acres annually. Additional funding is to be determined. For the time period of 2012-2017, Riparian Buffer Setbacks will cover 5,750 acres.

FUNDING MECHANISM: Private or exploratory grants.

9.4.4.6. Phosphorus-sorbing Materials: "Phosphorous-sorbing" materials soak up dissolved phosphorus keeping it from flowing downstream. Engineered systems in which drainage water passes through phosphorus-sorbing materials, such as gypsum, drinking water residuals, or acid mine drainage residuals, can potentially remove large percentages of phosphorus as well as sediment, heavy metals, and other pollutants.

GOAL: As this practice unfolds and becomes an acceptable use, implementation potential will be evaluated and installed on a trial scale.

FUNDING MECHANISM: Private or exploratory grants.

9.4.4.7. Poultry Litter Treatment: A surface application of alum, an acidifier, is added to poultry litter to acidify poultry litter and maintain ammonia in the no-volatile ionized form (ammonium). If fully utilized, a potential of 50,000 tons could be treated annually. There is limited funding available.

GOAL: As this practice unfolds and becomes an acceptable use, implementation potential will be evaluated and installed on a trial scale.

FUNDING MECHANISM: Private or exploratory grants.

9.4.4.8. In-House Poultry Ammonia Emission Control: Ammonia emission reduction could be achieved by constructing and retrofitting poultry houses with flooring that helps reduce the creation of ammonia. Companies are researching new ventilated plenum flooring (patent pending) for poultry houses that will result in drier litter and smaller waste by using less bedding material and lower ammonia emissions, helping chickens grow faster and healthier.

GOAL: As this practice unfolds and becomes an acceptable use, implementation potential will be evaluated and installed on a trial scale.

FUNDING MECHANISM: Private or exploratory grants.

9.4.4.9. Agronomic Improvements: New seed varieties are being developed for additional nutrient efficiency. Current seed varieties are 40% to 50% efficient at utilization and up-take of nutrients. Current test varieties of some new seeds will provide up to 60% efficiency in utilizing available fertilizer.

GOAL: Delaware will consider FY 2010 as a baseline for Agronomic Improvements; as such, Delaware's goal is to expand this annually until the full realization of 227,008 acres is achieved in 2017. Additional funding is to be determined.

FUNDING MECHANISM: No public incentive support needed, farmers will adopt based on increase yields and cost effectiveness.

9.4.4.10. Voluntary Practices: A program to conduct farm assessments and inventory of voluntary conservation practices that have been installed but farmers and landowners, since 2005, but are not part of current data inventories.

Capture voluntary practices by hiring someone to collect the data and analyze it. Credit needs to be given for what is already being accomplished. Delaware will work with EPA to ensure that the appropriate data is collected so that it can receive credit in the model. Delaware understands that practices that have been implemented since 2005 and meet EPA protocols can receive credit as progress toward goals and practices implemented prior to that date can be credited when the model is recalibrated. The State will also work to ensure that double counting does not occur. See Appendix H for the form that was used as a case study basis in the Choptank watershed for a performance based Nutrient Management Annual Report, which in the future may be used as a method of capturing voluntary practices.

GOAL: Evolving BMP. As this practice unfolds and becomes an acceptable use, implementation potential will be evaluated and installed on a trial scale.

FUNDING MECHANISM: No public incentive support needed, farmers will adopt based on increase yields and cost effectiveness.

9.4.4.11. Carbon Sequestration/Alternative Crops: The NRCS has a practice called long term no-till which they consider a carbon sequestration practice. EPA modelers have indicated that this would instead fall under continuous no-till. Thus, there does not currently appear to be any cost-shared programs that contain this practice.

GOAL: Evolving BMP. As this practice unfolds and becomes an acceptable use, implementation potential will be evaluated and installed on a trial scale.

FUNDING MECHANISM: Private or exploratory grants.

9.4.4.12. Alternative Use of Manure: Livestock Manure (primarily poultry litter) generated on Delaware farms is currently applied as fertilizer to Delaware crop fields or transported to areas of need through DDA's Nutrient Relocation Program. A small percentage is pelletized and sold as an organic fertilizer for residential and commercial use through Perdue AgriRecycle. Developing alternative uses for manure produced in the Chesapeake Bay Watershed represents a large opportunity for area farmers. One potential use for the region's excess manure is energy generation. Using excess manure to feed energy generation systems could potentially result in a reduced nutrient load to the Chesapeake Bay, thus improving water quality. The Delaware Nutrient Management Program is committed to seeking out and approving alternative uses of manure provided they prove effective in use and cost efficient in application. Gasification is one example that has recently come to light. The Delaware Nutrient Management Commission will consider this and other options as they become significant and viable.

GOAL: There are currently 48,757 tons of managed by the Delaware Department of Agriculture's Nutrient Relocation Program. Three potential alternative uses are approved: Perdue AgriRecycle, mushroom facilities, and manure for steam generation process. The Delaware Nutrient Management Program is committed to seeking out and approving alternative uses of manure provided they prove effective in use and cost efficient in application.

FUNDING MECHANISM: Private or exploratory grants.

9.4.4.13. Revised Phosphorus-Index for Nutrient Management Planning: The Phosphorus Site Index is a site-specific assessment tool that identifies the relative risk for phosphorus losses from agriculture production fields to nearby bodies or water. The Phosphorus Site Index is currently used in the development of agriculture nutrient management plans. Delaware will support development of a revise Phosphorus Site Index that incorporates the best available science in an effort to more appropriately identify the risk for phosphorus loss from agricultural lands. The revised Phosphorus Site Index will offer site-specific management options for reducing off-site phosphorus transport. The process of revising the current Phosphorus Site Index will conducted in conjunction with the University of Delaware and will mirror the NRCS standard as is currently under development.

GOAL: The current acreage under the Revised Phosphorus-Index is currently not quantified. Delaware's goal is to expand the use of the Revised Phosphorus-Index to cover 100,000 acres by 2017.

FUNDING MECHANISM: Private or exploratory grants.

9.4.4.14. Dairy Manure Incorporation Technology: Dairy manure is incorporated into the soil at the time of application utilizing low disturbance technology. Ammonia loss from incorporation will be reduced up to 95% compared to surface application.

GOAL: The current acreage under Dairy Manure Incorporation Technology is currently not quantified. The practice will be evaluated and recommended as more information becomes available.

FUNDING MECHANISM: Private or exploratory grants.

9.4.4.15. Poultry Manure Incorporation Technology: Poultry litter is incorporated into the soil at the time of application utilizing minimum disturbance technology which significantly reduces ammonia loss.

GOAL: The current acreage under Poultry Manure Incorporation Technology is currently not quantified. The practice will be evaluated and recommended as more information becomes available.

FUNDING MECHANISM: Private or exploratory grants.

9.4.4.16. Windrowing: This is a relatively new practice being pushed by integrators for poultry growers which appears to reduce the amount of poultry litter produced in a year, thus reduces the amount of manure available for field application. The Delaware NRCS cost shares on this practice. The Delaware Nutrient Management Commission is reviewing the implications of this recommendation. As manure generation rates can decrease, the practice is worthy of consideration and further review. The Agriculture Subcommittee is working to quantify the use of this practice and its relative effectiveness so that it can be reflected in the model. Delaware also understands that a representative from the NRCS East Tech Center is reviewing this practice and investigating the potential for additional ammonia emissions. The Agriculture Subcommittee would appreciate reviewing this analysis prior to a determination on the net nutrient benefits of this practice.

- Data exists for one chicken farm regarding the impact of in-house, between-flock recycling of chicken litter. This grower, with a 66,000 bird capacity farm, had 350 tons of litter to remove the year before he started windrowing. In the first year of using the practice, his litter removal amounted to 160 tons and in the second year it was 155 tons. That is a significant reduction that causes the potential of litter-caused nutrients from reaching the waters of the state. DPI has asked the chicken companies to share information about their experiences with windrowing litter reductions.

GOAL: Receive credit for the 9 acres currently implemented; expand BMP as warranted.

FUNDING MECHANISM: Private or exploratory grants.

9.4.4.17. Poultry House Remediation: NRCS has begun cost sharing on this practice which decommissions abandoned poultry houses. The roofing of abandoned houses is often removed as scrap metal and when it rains, the nutrient rich floors leach into groundwater. The amount of legacy nutrients under poultry houses is sizable. This practice removes and composts the wood materials and soil below

the house to eliminate this pollutant source. Research by the University of Delaware is currently being conducted to quantify the benefits of this practice so that it can be added to the Bay Program Model. Agriculture Subcommittee representatives are eager to work with EPA to factor this practice into the model.

GOAL: Receive credit for the 6 houses remediated in the Chesapeake; expand BMP as warranted.

FUNDING MECHANISM: Private or exploratory grants.

9.4.5. Beyond BMP Recommendations

The following items are examples of programs that are recommendations that include BMPs but, additionally, reach beyond the traditional scope. They are ways of rewarding BMP implementation, thereby, encouraging additional participation by landowners. This section also includes mechanisms to expand programs that protect or encourage active agricultural lands within the Chesapeake Bay Watershed.

9.4.5.1. BMP Matrix: A points-assigned matrix to demonstrate "on farm" load reductions for land owners should be developed. The types of agriculture and combinations thereof should be classified and minimum requirement should be established for each. One of the current problems is the Chinese menu of BMPs to pick and choose from. Instead, the most cost-effective practices should be selected and include those in a smaller menu designed to meet the minimum requirements. The next step should then be geographic targeting (e.g., high N in groundwater and surface water or saturate a manageable area with BMPs) and a cost-share structure that will encourage use of the minimum requirement BMPs.

Other points/considerations:

- Develop a suite of practices for different types of agricultural operations that, if implemented, could reduce regulatory burden form some select regulatory actions.

9.4.5.2. Cost Share Program Modifications

1. Investigate ways to streamline paperwork required for application and payment.
2. Piggy back existing cost share programs to increase cost share rates on key BMPs to 80-85%.
3. Discuss with NRCS about the possibility to raise ceiling if appropriate/needed and allow repeat acres to get EQIP cost share on practices that are economically infeasible for farmers without cost share.
4. Provide for increased financial incentives to producers willing to commit to utilizing targeted BMPs over a longer period of time. Cost share rates would increase as the number of years of a contract increases. A one year commitment to utilize a BMP would be funded at a lower rate than a five year commitment to utilize a BMP.
5. Investigate programmatic changes to provide flexibility for producers who participate in cost share programs. Producers do not like to enter into long term contracts because it limits their ability to respond to changes in commodity markets. Providing flexibility without penalty could increase participation.
6. Increase the level of technical assistance used to do follow-up with producers that have existing contracts. If staff spends time with producers who have contacts, there is an increased probability that those producers will fully implement their contract.

7. Increase/target information and education activities that stress the importance of improving water quality in communities where producers live. Convincing producers that the water quality where they live can be improved by implementing BMPs will aid in increasing participation. Additionally, the economic benefits of these practices should be communicated so that implementation may occur voluntarily and not rely on cost-share programs.
8. Identify ways to increase funds available for cost-share programs.

9.4.5.3. Property Taxes: Use increased education and outreach to remind poultry growers that might be reluctant to install certain structural BMPs on farms that the value of those structures is not included in county and school district property taxes. House Bill 470 exempts from taxation "any lands, buildings, and improvements upon which are situated, or which are in active use as, structures and facilities which are required by, and used for the purposes of nutrient storage, disposal, or management pursuant to, a nutrient management plan required pursuant to 3 Del. C. Chapter 22." To receive an exemption, a poultry grower must notify the county of the existence of the qualifying land, buildings, or improvements and request the exemption. Lower assessments will be effective for county property tax bills prepared in 2005, but they are not automatic. Property owners must apply for the reduced assessments.

- In Sussex County, growers can seek the exemption by calling the Assessment Office at 855-7824. A county employee will check the use of the building before an exemption is approved.
- Kent County poultry growers need to send a letter seeking the exemption to the Kent County Assessment Office, 414 Federal Street, Dover, Delaware 19901.
- In New Castle County, letters should be mailed to Andrew Marinelli, Department of Finance, Assessment Division, 87 Read's Way, New Castle, Delaware 19720.

The Agriculture Subcommittee will also explore if there is a way to automate this process so that the burden will not be on the farmer to apply.

9.4.5.4. Cost-Share as Income: Under the Internal Revenue Code (IRC), some cost share payments are considered to be income to farmers and therefore subject to federal income tax. Because Delaware and most other states "piggyback" on the IRC, these cost share payments would also be taxable at the state level. In light of their tax consequences, the inclusion of these payments as taxable income may discourage some chicken growers from installing BMPs. Likewise, excluding cost share payments from taxable income might encourage more cost share participation. The most effective means – both in terms of environmental effectiveness and ease of tax administration – would be to amend the IRC to specifically exclude cost share payments from the definition of taxable income. This is true because it would:

1. Extend the reach of the incentive to all states in the region that piggyback on the IRC;
2. Eliminate the need to pass bills in multiple, cash-strapped states; and
3. Eliminate the need to establish duplicative tax processing regimes in multiple states.

9.4.5.5. Expand Farm Preservation: Keeping working farms as working farms is a good way to prevent additional pollution from developed property. Expanding state farmland preservation money could help some farmers permanently extinguish their development rights.

Other points/considerations:

- Should also establish a young farmer program
- There's an estate tax for passing down a farm. It sunsets this year.
- Maryland allows a longer time for a family to figure out what to do with the farm (3 years vs. 9 months); Gives the family time to weigh options, save for taxes, etc.

9.5. Minimize Funding Gaps

Since most of the lands within the Chesapeake in Delaware are agriculture, there is a need to increase BMPs on these lands, and therefore, there is a need to increase the funding sources for BMP programs. Various alternatives to filling this funding gap should be considered. Realizing a significant boost in funding will be warranted for full implementation, it is imperative Delaware pursue increased funding through State programs such as the State of Delaware Conservation Cost Share, Delaware CREP, Delaware Nutrient Relocation, Delaware CAFO, and Delaware Nutrient Management Programs. Likewise, it is essential Federal Programs, such as EQIP and the Chesapeake Bay Program Grant, be expanded or re-prioritized within the Chesapeake Bay Watershed to account for additional funding needs. Delaware is committed to working closely with USDA Programs (NRCS, FSA, Rural Development), EPA, US Energy Department, US Fish and Wildlife, and Army Corp of Engineers to assure additional Federal resources will be available to accommodate the BMP recommendations made within the contents of this document. As additional funding needs will certainly be warranted, private grants and/or exploratory grants should be additionally pursued. Lastly, to accommodate easier land owner participation by Private Landowners, the State of Delaware, Revolving Loan Fund should be review and expanded to allow additional BMP funding as applicable.

As additional staff needs increase in order reach the BMP implementation rates as recommended in this document, Delaware is committed to pursuing the additional staffing level needs.

9.6. Contingencies

If delays in adoption of new or revised legislation, regulations, local ordinances, and/or permit issuance occur, Delaware will consider the following actions related to agriculture:

- Delaware commits to review and evaluate the pace and progress of Ag BMP implementation at the end of 2013. If needed, Delaware will enact new policy measures and explore mandatory BMP compliance options in a timely manner to ensure that water quality commitments will be met.
- Consult with University of Delaware, other academic institutions, DDA, USDA and DNREC to examine the possibility and implications of prohibiting manure-source phosphorus application on high phosphorus soils.
- Delaware commits to convene a committee of experts to conduct a science-based review of the Phosphorus Site Index and will take actions to amend, if needed.
- If participation rates with voluntary, incentive-based programs are not achieved with respect to CAFO regulations, when EPA modifies the federal regulations for CAFOs, DE will review for gaps.
- If compliance rates with regulatory programs are not achieved, the contingency plan is to increase educational efforts for voluntary programs if also necessary.

9.7. Tracking and Reporting Protocols

The Farm Service Agency has signed an agreement with the USGS to directly report data to the Chesapeake Bay Program Model. A similar agreement between the NRCS and USGS is imminent. The majority of agriculture data in Delaware gets reported to these two USDA programs. For the data that is not reported through these programs, DNREC will continue to work with partner agencies to make changes to

existing collection, reporting, and verification procedures through fall of 2010. When BMPs are reported, efforts are taken to make sure practices and programs are consistent with EPA-approved definitions of BMPs used in Scenario Builder and the Chesapeake Bay Program Watershed Model Phase 5.3. Implementing agencies are reviewing database systems for potential improvements to gather any information that is currently missing. To ensure that practices reported as "new" did not previously exist, Delaware will review aerial photography and records to establish the implementing year as best as possible.

Work is underway to extract non-USDA reported agriculture BMPs into the National Environmental Information Exchange Network (NEIEN) schema so that data may be directly sent to the Chesapeake Bay Program through network nodes and receive credit in the model. A description of data generation and acquisition, assessment and oversight, and data validation and usability will be provided in Delaware's Nonpoint Source Best Management Practice Implementation Data Quality Assurance Project Plan (Appendix C). The QAPP will be updated to reflect recent changes by April 30, 2011. DNREC staff is also participating in the development of the Bay TMDL Accounting and Tracking System (BayTAS) Version 1.0 to track the TMDL waste load allocations and load allocations and Delaware's progress toward meeting those goals.

SECTION 10. RESTORATION

The Restoration Subcommittee was assembled to address the eight Elements identified within the Chesapeake Bay Watershed Implantation Plan (WIP) as they relate to restoration activities in Delaware. The Restoration Subcommittee represents a diverse array of programmatic expertise from both federal and state agencies that are actively involved in ecological restoration in the State of Delaware. In addition to members from DRNEC (Watershed Assessment Section, Drainage Program, and Division of Fish and Wildlife), representatives from the DDA's Forestry Program, DelDOT, and the US Fish and Wildlife Program were involved in this subcommittee. They focused on identifying existing ecological restoration projects within the Chesapeake Basin of Delaware, developing an ecological restoration database that can be used to track and identify potential restoration projects, and devising recommendations and ecological restoration goals to help achieve the soon to be established Chesapeake Bay TMDLs. The Subcommittee has met three times since February in 2010 and has regularly corresponded by email to accomplish its tasks.

Approximately 30% of Delaware is covered by wetlands, with over 350,000 acres of inventoried wetlands. About one third of the wetland area is tidal and two thirds is non-tidal. The U.S. Fish and Wildlife Service (USFWS) used photos and soil mapping to determine that Delaware has lost close to 54% of its wetlands since the 1780s. From 1980 to 1992, significant acres of wooded wetlands were lost because of agricultural activities. Recent wetland losses have resulted from conversion of wetlands to urban lands.

10.1. Current Programs and Capacity

10.1.1. Department of Natural Resources and Environmental Control

Ecological restoration efforts by DNREC in the early 1990s began with the conversion of a few marginal agricultural fields into wetlands. Most of this restoration was initiated by landowners interested in carrying out restoration projects on their properties, and a few of these restoration projects are permitted within the State. Since then, efforts have expanded to include the restoration of tidal and fresh water wetlands, streams, man-made drainage channels (tax ditches), and riparian corridors (the area within and adjacent to a stream). DNREC's Secretary Hughes established the Ecological Restoration and Protection Team in the fall of 2003 and made it responsible for implementing stream and wetland restoration projects throughout the state. The team brought together expertise and resources from various agencies within and outside DNREC; however, in the past few years the Team has not been functioning. Delaware has several other State agencies, such as DelDOT, as well as federal agencies, including the USFWS and NRCS that have assumed the role the Ecological Restoration and Protection Team had in implementing restoration projects for Delaware's wetlands, streams, ditches and upland forest.

10.1.1.1. The Watershed Assessment Section

Using the numerous BMP applications and DNREC's wetlands assessment activities within the Nanticoke Watershed led by the Watershed Assessment Section, a Nanticoke Restoration Plan was developed by a multi-disciplinary working group made up of state and federal agencies, as well as non-profits, to identify priority areas for restoration in the watershed. Much of the restoration plan's goals were formed based on the knowledge gained from the watershed's wetland assessment. The results from the sites sampled for wetland condition determined that 17% of the non-tidal wetlands are considered minimally or not stressed. Of the remaining wetlands, 48% were moderately stressed, and 35% were highly stressed. Dominant stressors impacting wetlands and lowering their conditions were hydrology alterations due to ditching and

vegetative alterations caused by forestry practices, which alter species' structure and composition. The Nanticoke Watershed Condition Report recommends that wetland restoration and protection activities need to be integrated into larger landscape level plans to ensure that wetlands can perform functions and provide ecosystem services, as well as support sustainable restoration activities. The Nanticoke Restoration Plan is to be the basis for Delaware's initial implementation goals for the Chesapeake Bay Watershed Implementation Plan (WIP). The Restoration Subcommittee used the best available science and diverse expertise of participants to identify conservation targets and locate these targets on the ground. Priority areas were indentified for each conservation target based on different program goals, including: habitat restoration, water quality improvement, and stream biology/ habitat improvement. The restoration plan is to be updated and refined on a regular basis so that new information can be incorporated, and optimal areas for restoration found. The conservation targets that had the highest priority were:

Conservation Target	Identified for potential restoration	Goal with CB implementation grant (2010-2013)
Headwater forests/ large forest blocks – enhancement	35,739 acres (14,463 ha) Wetland	* could count as part of the wetland re-establishment goal
	30,087 acres (12,176 ha) Upland	* could count as part of upland re-establishment goal
Headwater forests/ large forest blocks – re-establishment	40,489 acres (16,385 ha) Wetland	80 acres
	51,998 acres (21,042 ha) Upland	264 acres
Restoration of channelized streams	1,015 miles (1, 634 km)	
Riparian and tidal wetland buffers	45,106 acres (18,254 ha) Riparian buffers	* could count as part of upland forest re-establishment
	736 acres (298 ha) tidal wetland buffers	

Table 36: Conservation Targets with Highest Priority

The Nanticoke Restoration Plan identified priority areas for restoration, and instituted a workgroup to assist restoration activities. The Chesapeake Bay Program Implementation Grant provided DNREC with funds for staff to implement these prioritized projects. Specifically, the grant funds a coordinator to facilitate the process, develop a database of potential projects, track landowner contacts and accomplishments, and report acreage of restoration within each conservation target to the appropriate groups in the CBP. This grant, and the Division of Fish and Wildlife Landowner Incentive Program (DELIP) funded the coordinator to support the facilitation and implementation of restoration projects with the Nanticoke.

10.1.1.2. Drainage Program

Delaware has 228 individual tax ditch organizations, ranging in size from 56,000 acres in Marshyhope Creek Tax Ditch in southern Delaware, to a two-acre system in Wilmington. These organizations manage over 2,000 miles of channels and provide benefits to over 100,000 people and almost one-half of the state-

maintained roads. Tax ditch channels range in size from six to 80 feet wide and two to 14 feet deep. The dimensions depend on the acreage being drained, and the topography.

Most of Delaware's tax ditch channels have been listed on Delaware's Clean Water Act 303 (d) impaired waters list, and are included in State developed nitrogen and phosphorus TMDLs. Within Delaware's Chesapeake basin, there are 206 tax ditch organizations containing approximately 1,500 miles of drainage channels. These channels were established to manage water resources from 64% of the basin area. It is estimated that an additional 1,500 miles of private channels exist throughout the basin. These drainage channels are maintained to manage soil and water resources for efficient farming operations as well as resolve drainage and flooding problems for cities, towns, roads, and urban areas. These drainage channels have been linked to the contributions of excess sediment and nutrient problems in streams, rivers, and estuaries of the Chesapeake Bay as they transport nutrient and sediment enriched waters downstream.

During the early 1990s, DNREC focused on constructing environmentally friendly water management projects that minimized environmental impacts from the construction and maintenance of tax ditches. This list has evolved into Delaware's Tax Ditch BMPs. Some of the highly significant practices are to:

- Perform one-sided construction
- Minimize clearing widths through forested areas
- Relocate channels around sensitive and significant habitat or wetland areas
- Minimize construction of downstream outlets
- Block off old channels that drain only wetland areas

To ensure implementation of these BMPs, DNREC routinely provides wetland/environmental training sessions for both technical and administrative staff members. DNREC has constructed many projects incorporating these BMPs to test their effectiveness. These projects have resulted in the establishment of demonstration and education sites that have show how drainage and environment quality do not have to be mutually exclusive.

10.1.1.3. Delaware Landowner Incentive Program

DELIP offers private landowners, technical and financial incentives to protect, enhance and/or restore habitat to benefit Species of Greatest Conservation Need (SGCN). The program's focus is on wildlife habitat for SGCNs. Some water quality benefits may result from these habitat restoration projects, depending on the practice and its location on the landscape. Practices range from creating shallow water wetland habitats for migratory shorebirds, and controlling invasive species in bog turtle habitats, to establishing native warm season grasses for upland sandpipers, and planting trees for the Delmarva fox squirrel. Other eligible practices include wetland restoration and enhancement, riparian forest and grass buffer establishment, upland early successional habitat enhancement, reforestation, selective thinning and invasive species control which will directly benefit SGCN. Administered by the Division of Fish and Wildlife, this program will pay qualifying landowners 75-100% cost-share. In return, the landowner must sign a conservation agreement to manage and maintain the restoration for a period of five or ten years. In addition, landowners may receive $148/acre/year for practices established on agricultural lands.

10.1.2. Forest Service

Annually, Delaware Department of Agriculture, Forest Service has State funds available for forestry practices Statewide. Half of these funds are allocated toward urban forestry practices, including tree planting sub-grants and tree maintenance sub-grants. The other half is allocated to rural forestry projects. Sub-grant recipients are required to match with non-State funds at a 1:1 ratio. The Program is available Statewide, with no special considerations based on watershed.

The Forest Service completed a comprehensive five-year strategic plan in 2008 with assistance from 40 participants representing a variety of stakeholders, including other public (state, federal, local) agencies, landowners, nongovernmental organizations, consultant foresters, forest industry, and recreationists. Through this effort, the stakeholders identified the critical issues facing Delaware's forests and then defined goals and objectives for the DFS to address in the subsequent five years (2009-2013). Second, Delaware's Forest Stewardship Committee participated in a facilitated process in 2009 to identify the issues, threats, and opportunities facing the State's forests. Beginning with the issues from the strategic planning process, the committee identified additional issues, and then outlined specific threats and opportunities. The result was very similar to the outcomes of the strategic planning process. Four issues were identified: (1) Forest Health and Functionality; (2) Forest Markets; (3) Sustainable Forest Management; and (4) Public Awareness and Appreciation of Forests.

10.1.3. Delaware Department of Transportation

DelDOT mitigates for some ecological impacts, primarily to wetlands, caused by its road building activities. DelDOT wants to integrate its mitigation projects within the framework of the State's Chesapeake WIP and Delaware's existing TMDLs in other parts of the State, which are implemented though a Pollution Control Strategy in order to improve water quality and make optimal use of existing state funds.

10.1.4. US Fish and Wildlife Service and Natural Resource Conservation Service

The US Fish and Wildlife Service's program in Delaware assists NRCS in the implementation of Farm Bill programs primarily through the Wetland Reserve Program and Conservation Reserve Program. The BMPs are the same for NRCS: wetland restoration, ditch plugs, warm season grass buffers, and tree planting. The USFWS has contributed approximately $40,000 toward restoration projects in Delaware over the past three years, primarily in the form of acquiring tree seedlings for CREP projects.

10.1.5. Clean Water State Revolving Fund Land Conservation Loan Program

An innovative financing approach is being developed to fund land conservation easements and possible fee simple land purchases with Clean Water State Revolving Fund (CWSRF) municipal loans. A five-year pilot program has been approved (up to $5.0 million per year subject to funding availability) to fund a CWSRF Land Conservation Loan Program. Annually, municipalities that have wastewater projects on the CWSRF Project Priority List (PPL) can enter into sponsorship agreements with implementing partners such as the Delaware Department of Agriculture's (DDA) Forestland Conservation Program, Agricultural Lands Preservation Program, and DNREC's administrated State Open Space and Wetland Conservation Programs, to conserve forestland, open space, and wetlands. Funded land conservation easements and/or fee simple land purchases must have demonstrated water quality improvement benefits, be managed in perpetuity, and be purchased at a significant discount to their appraised value.

The CWSRF program will provide funding for traditional wastewater projects loans in addition to loan dollars for forestland, open space, and wetlands land conservation easement projects with discounted interest rates. These loans will be designed to ensure that municipalities will not pay any additional loan debt service payments annually or over the life of twenty (20) year wastewater project loans by borrowing additional funds for land conservation projects. EPA has acknowledged that fee simple land purchases in addition to easements are eligible as well under the program.

10.2. Accounting for Growth

With the exception of DelDOT mitigation projects, most restoration projects occur on a volunteer basis, so they are scattered throughout the State. In recent years, there has been some coordination between the agencies in implementing these restoration projects. This coordination, however, has not resulted in an influx of new projects. EPA's desire to delist impaired water bodies within the State has caused a concerted effort to work in smaller subwatersheds, most of which lie outside the Chesapeake Basin.

Since most of the restoration projects within State were the result of willing property owners and not the result of regulatory actions, increasing restoration actions as a result of growth within in the Chesapeake Watershed will require some interagency coordination and cooperation. The Restoration Subcommittee is working on developing a plan or guidelines to integrate ecological restoration projects into state-wide objectives on a watershed basis. The Subcommittee is incorporating the recommendations from the Nanticoke Wetland Restoration Strategy and the Department of Agriculture's Statewide Forest Assessment Report into the WIP.

The Restoration Subcommittee is verifying existing wetland restoration sites and will enhance an existing database for tracking restoration throughout the state, not just the Chesapeake Bay portion of Delaware. The existing database does not serve the needs of every program and needs to be re-vamped. Each agency has evaluated their data within the database to determine if their restoration data is accurate for their projects and also determine if any projects were left out.

Once the above activities are complete, a revised restoration database will be developed which will list and help prioritize potential restoration projects. As funds from grants and other sources become available, agencies can consult the database to find a suitable project within a specified watershed.

The Restoration Subcommittee does not think that their proposed restoration goals will be completely met by regulatory wetland mitigation actions resulting from ditching activities and/or state transportation projects. When the new storm water regulations are promulgated (see Section 7), there will be an offset or trading program developed for those projects that cannot meet water quality requirements of the new storm water regulations, likewise for when the land use change offset program is developed (See Section 8). In addition, there may be some offsets resulting from the State's issuance of National Pollutant Discharge Elimination System (NDPES) permits. Regardless of whether regulatory processes result in additional restoration projects, the State wants to more aggressively pursue ditch, stream, and wetland restoration projects. These priority projects will be chosen from the list of projects in the Nanticoke Restoration Plan and the Department of Agriculture's Statewide Forest Assessment Report and will result in quantifiable nutrient and sediment reductions.

10.3. Gap Analysis

To achieve additional nutrient and sediment reductions through restoration activities, there are data and funding gaps that must be closed first.

10.3.1. Data Gaps

In the Coastal Plain for a constructed or restored (emergent to forested) freshwater wetland, when the functionality of the wetland is established, nutrients that enter the wetland could be reduced 25% for nitrogen, 50% for phosphorus, and 15% for sediment. The estimated total nitrogen load reduction for a two to five acre wetland ranges from 88.2 to 220.5 pounds of total nitrogen per year. The estimated total phosphorous load reduction for a similar sized wetland ranged from 3.4 to 8.4 pounds of total phosphorous per year. Using the database that DNREC developed to track restoration projects, since the 1990's, 4092 acres (205 acres per year) have been restored and 590 acres (30 acres per year) of wetlands have been created within the Chesapeake Basin in Delaware. Using this acreage, the existing ecological restoration projects in the Basin reduced nutrient loads to the Basin by 1,990 pounds of nitrogen and 351 pounds of phosphorus per year. No sediment reduction calculations have been conducted for the above reported acreages.

The database had additional untracked projects, but due to insufficient information on geo-referencing, acres restored or created, and/or type of project, the reported number of projects is an underestimate. In addition, there were other types of projects, such as phragmites removal, and reconnection of ditched streams to their floodplain. During the spring of 2010 some projects were not reported because they lacked efficiency reductions.

The State has not previously reported reforestation resulting from post-harvesting or afforestation of cropland to the Bay Program, but has initiated discussion on reporting these two practices. Since 2008 these practices have been tracked and geo-referenced which allows the State to calculate acres of the practice at the HUC 12 watershed level. Since 2008, there has been 900 acres (300 acres per year) of reforestation and 74 acres (25 acres per year) of reforestation with the Chesapeake Basin of Delaware.

Therefore, there are still data gaps and needs for quantifying the nutrient and sediment reductions associated with other types of restoration activities.

10.3.2. Funding Gaps

The DELIP program conducts compliance checks in the fall of every year. To date the DELIP program had one landowner who was not in compliance with the guidelines of the program. Unfortunately, funding for DELIP has been eliminated from the federal budget, forcing the program to use funds from grants that have been received in the past. Funding for on-the-ground restoration is almost expended; however, Division of Fish and Wildlife is still providing technical assistance to landowners interested in enhancing wildlife habitat for SGCNs. DELIP practices have been track in the existing restoration data base, but some of the non-federal projects may not have been reported to the Bay Program.

Additionally, early in 2010, the State submitted a National Fish and Wildlife Chesapeake Bay Innovative Nutrient and Sediment Reduction Grant. Delaware proposed a collaborative and multi-prong approach to reduce nutrient and sediment issues in the Chesapeake Bay Watershed from urban and rural nonpoint

sources concentrating on three diverse tasks. The grant was to identify and prioritize urban sources and develop a registry of potential improvements for implementation, then implement up to five demonstration projects from the registry. This portion of the watershed has experienced significant growth in recent years and has experienced additional development pressure. In addition, the State proposed working with private property owners, including farmers, within targeted sub-watersheds to restore riparian areas by establishing or enhancing buffers, restoring channelized ditches by reconnecting floodplains, and restoring or enhancing freshwater wetlands to reduce loads from agriculture and urban areas primarily located in the Nanticoke watershed, but not limited to that area.

The pre-proposal was well received and the State was requested to submit a full proposal. The National Fish and Wildlife Chesapeake Bay Innovative Nutrient and Sediment Reduction Grant required a 50% match. We requested this match from communities within the Nanticoke watershed and also proposed some in-kind match. Due the present economy, the state could not meet the grant match required and consequently lost the chance at those funds, which would have placed water quality improvement practices in the Chesapeake basin of Delaware.

10.4. Strategy to Fill Gaps

10.4.1 Best Management Practices

The Restoration Subcommittee used existing geo-referenced wetlands, forestry practices, and best professional judgment to propose restoration goals to meet WIP goals. Table 23 contains the proposed interim goals for ecological restoration. The goals focus on restoration activities in the watershed that improve and maintain the ecological integrity of species and habitats and the functions and services they provide. Based upon the Nanticoke Restoration Plan, the conservation targets with the highest priority were:

1. Headwater forests
2. Large forest tracts
3. Channelized streams
4. Corridor and riparian buffers
5. Tidal wetland buffers

Thus, the proposed WIP ecological restoration goals reflect these priorities. The proposed WIP goals will be tracked at HUC 12 watersheds level. See the See Section 9 – Agriculture for additional information and goals on these types of practices.

Conservation Target	Interim WIP Goal	Goal by 2025	Total Goal (includes existing acres on the ground and goals from the Agriculture Subcommittee)
Headwater forests (Wetland Restoration)	125 acres per year	1,875 acres	5,725 acres
Large forest tracts (Wetland Restoration)	173 acres per year	2,595 acres	
Channelized streams (Stream Restoration)	0.8 miles per year	12 miles (63,202 feet)	63,202 feet
Corridor and riparian buffers (Forest Buffers)	82 acres per year	1,230 acres	7,020 acres
Tidal Wetland Buffers (Grass Buffers)	35 acre per year	525 acres	8,297 acres
Reforestation of Erodible Crop and Pastureland*	450 acre per year	6,750 acres	NA
Afforestation* (Tree Planting)	35 acres per year	525 acres	930 acres

Table 37: Proposed interim restoration goals for the Chesapeake Basin of Delaware

*The reforestation and afforestation goals were based upon actual implementation numbers from Delaware Department of Agriculture from 2008 to spring of 2010 and goals reflect achievable implementation goals for forestry practices in Chesapeake basin of Delaware.

Additionally, the Restoration Subcommittee will investigate goals for restoration in the developed environment (Urban Forest Buffers, Urban Grass Buffers, and Urban Stream Restoration). A GIS analysis has been done to determine the acreage available for buffering in each of the municipalities within the Chesapeake. Table 38 shows the breakdown of land use types existing with a 50 foot buffer in each of the towns in the Chesapeake. Lands that are currently agriculture could be planted with riparian vegetation while site visits would be required to determine if those that are already developed could have a buffer installed.

Acres	Agriculture	Developed	Existing Natural Land Uses
Bethel	2	3	33
Blades	-	25	13
Bridgeville	298	32	71
Delmar	24	12	40
Ellendale	-	0	-
Georgetown	22	44	16
Greenwood	7	15	5
Hartly	1	2	0
Laurel	87	66	81
Middletown	18	10	37
Seaford	66	65	103
Total	526	275	398

Table 38: Potential buffer acreage for lands within municipalities

10.4.2. Other Strategies

Two contractors through the Kent Conservation District have been making contacts with landowners to determine eligible restoration and conservation projects. Numerous projects on state lands and some on private lands have been identified. Most of the private lands projects are being completed by the NRCS using their cost-share funding programs. In order to fully utilize NRCS CREP funds and Wetland Reserve Program (WRP) funds an, aggressive outreach must be undertaken in reinvigorate interests in ecological restoration within the State and Chesapeake Basin. Because of the loss of interest, NRCS CREP funds are not used for practices that will have the greatest water quality benefits. The maintenance crew at Redden state forest will be completing the construction for the projects on state lands, which will be supported by Delaware's CBP Implementation Grant during the 2010-2011 budget period.

As stated previously, the interim WIP goals proposed for ecological restoration will not be met by regulatory actions alone. Nevertheless, the State will need a list of potential projects that could be chosen when either funding becomes available for ecological restoration or if there is a need for a project that will fulfill regulatory requirements. The new ecological restoration database will allow the state to track projects by geo-referencing potential projects to any watershed basin, sub-watershed or stream segment. The existing restoration data base will be transferred into the new database and any incomplete data will be added, completed or verified. In the past, agencies and non-profits doing the implementation did not consistently track the implementation projects or have the staff to manage or maintain the database. The purpose of the new restoration database must be clearly defined as must the necessary parameters that must be entered. It will be necessary to have a commitment to track all restoration projects within the state by all agency and non-profits that are involved in ecological restoration. The Restoration Subcommittee has talked about

developing a memorandum of understanding that will formalize an agreement to track restoration projects for state and federal regulatory and non-regulatory programs.

In order to keep the database accurate and up-to-date there must be one individual responsible to oversee its development and data input. Due to the present economic conditions, sufficient funds are unavailable to hire a database manager. The state intends to rely on existing staff to address the database input and maintenance.

Finally, the State must develop a funding mechanism to consistently have non-federal funds available for grant match as well as a way to cost share on projects that will improve the health of the State's environment whether in or out of the Chesapeake basin.

10.5. Contingencies

Until the Bay Program finalizes the Chesapeake Bay TMDL target loads, it is difficult to assess possible impacts the interim goals for ecological restoration will have on target load reductions within Delaware.

10.6. Tracking and Reporting Protocols

Tracking and assessment of restoration BMP implementation data is necessary to fully reflect impacts from on-the-ground activities that reduce nutrient and sediment pollution. Work is underway to first modify the existing database to be more complete and comprehensive. This data will then be extracted into the National Environmental Information Exchange Network (NEIEN) schema so that data may be directly sent to the Chesapeake Bay Program through network nodes and receive credit in the model. A description of data generation and acquisition, assessment and oversight, and data validation and usability will be provided in Delaware's Nonpoint Source Best Management Practice Implementation Data Quality Assurance Project Plan (Appendix C). The QAPP will be updated to reflect recent changes by April 30, 2011. DNREC staff is also participating in the development of the Bay TMDL Accounting and Tracking System (BayTAS) Version 1.0 to track the TMDL waste load allocations and load allocations and Delaware's progress toward meeting those goals.

SECTION 11. PUBLIC LANDS

Through the Executive Order for the Chesapeake Bay, the federal government is going to lead by example and change land management practices and increase implementation on federally owned lands throughout the Chesapeake. The Public Lands Subcommittee has the goal of doing the same with publicly owned lands, beginning with State-owned lands, in Delaware's portion of the Chesapeake. The Public Lands Subcommittee is made up of members from DNREC's Land Preservation Office, Environmental Stewardship Program, Watershed Assessment Section, and Wildlife Administrators and Regional Managers from the Division of Fish and Wildlife. Additionally, there are also representatives from the Department of Agriculture and their State Forestry Program, and DelDOT on the Subcommittee. As this WIP is implemented over time, the Subcommittee will reach out to other public land owners, whether they be other state agencies (schools, etc.), county or local governments, or potentially even nonprofit agencies.

11.1. Current Programs and Capacity

Most of the public lands owned within the Chesapeake Bay watershed are managed by two state departments: Department of Natural Resources and Environmental Control (Division of Fish and Wildlife; Division of Parks; Division of Recreation) and Delaware Department of Agriculture (Delaware Forest Service; Figures 27-29). These agencies manage land for fish and wildlife habitat, recreational opportunities, forest resource management, ecosystem services, demonstration areas, cultural resource protection, environmental education and conservation of open space. Not all of the lands are open to the public; some are closed to protect specific resources. Some of these public lands are leased for agricultural purposes with varying best management practices.

The Division of Fish and Wildlife manages over 20,000 acres in the watershed, including 7 wildlife areas and 10 millponds. Land use and land characteristics vary region to region. In New Castle County the Division administers the federal Chesapeake & Delaware Canal lands for hunting, dog training, hiking, and biking. The area was created with the dredging of the Canal resulting in a terraced, mainly open, non-forested landscape. In Kent County the Division has 2 wildlife areas and a public millpond. These sites contain headwater forests and streams, mixed hardwood forest blocks, farmland, and ditched waterways and are primarily managed for hunting and general wildlife habitat. In Sussex County the Division has 4 wildlife areas and 9 public millponds. These sites contain headwater forests and streams, mixed hardwood forest blocks, former pine plantation forests, natural and channelized riparian corridors, forested riverine systems, farmland, and ditched waterways. These lands are managed for hunting, fishing, general wildlife habitat, rare plant and animal protection, unique natural communities, and agriculture.

The Delaware Forest Service in the Department of Agriculture manages over 14,000 acres of state-owned land containing all or part of 3 state forests. Each of the forests is maintained for long-term forest management which includes varying harvesting regimes and demonstration sites. Blackbird State Forest, almost entirely in New Castle County, contains mixed hardwood forests, coastal plain ponds, and headwater forests and streams. It also has an environmental education center and provides hunting, hiking and primitive camping opportunities. Taber State Forest in Kent County is mixed pine-hardwood forestland, farmland, and ditched waterways and provides hunting areas. Redden State Forest in Sussex County has headwater forests and streams, pine and hardwood forest blocks, former pine plantation forests, farmland, and ditched waterways. An environmental education center and overnight lodge accommodations are available, as well as hunting and hiking opportunities.

The Division of Parks and Recreation manages over 3,300 acres of land and 4 millponds at Trap Pond State Park, the James Branch Nature Preserve and the Nanticoke River Nature Preserve, all in Sussex County. Trap Pond State Park contains pine-hardwood forest blocks, former pine plantations, bald cypress wetlands and stream corridors, headwater forests and streams, farmland, and ditched waterways. It also has a campground, nature center, hiking and biking trails, and canoeing/kayaking options. The James Branch Nature Preserve protects headwater forests and streams and bald cypress riparian corridors containing rare plants and animals and unique natural communities. The Nanticoke River Nature Preserve protects a small hardwood forest and Atlantic white cedar wetlands and has a hiking trail.

11.2. Accounting for Growth

As growth occurs in the Chesapeake, there may be opportunities to either increase the acreage of publicly owned lands or the level of BMP implementation on these lands through offset programs. The Public Lands Subcommittee will coordinate with acquisition and protection programs to help direct land use through targeted fee simple purchases and conservation easements.

11.3. Gap Analysis

Funding may be critical as it relates to various aspects of BMP implementation on public lands. Acquisition of money for key open space parcels is limited. If major retrofits of significant features such as stormwater facilities are required, current budgets will not cover such expenditures.

Technical assistance will be necessary to critically analyze on-the-ground management activities in relation to the Watershed Implementation Plan goals. Education and outreach to the land managers will be needed to show the probable necessity of revising current land use activities. This outreach would extend beyond just state wildlife areas, parks and forests. Additionally, funding and other support means will be crucial to implementing any needed actions.

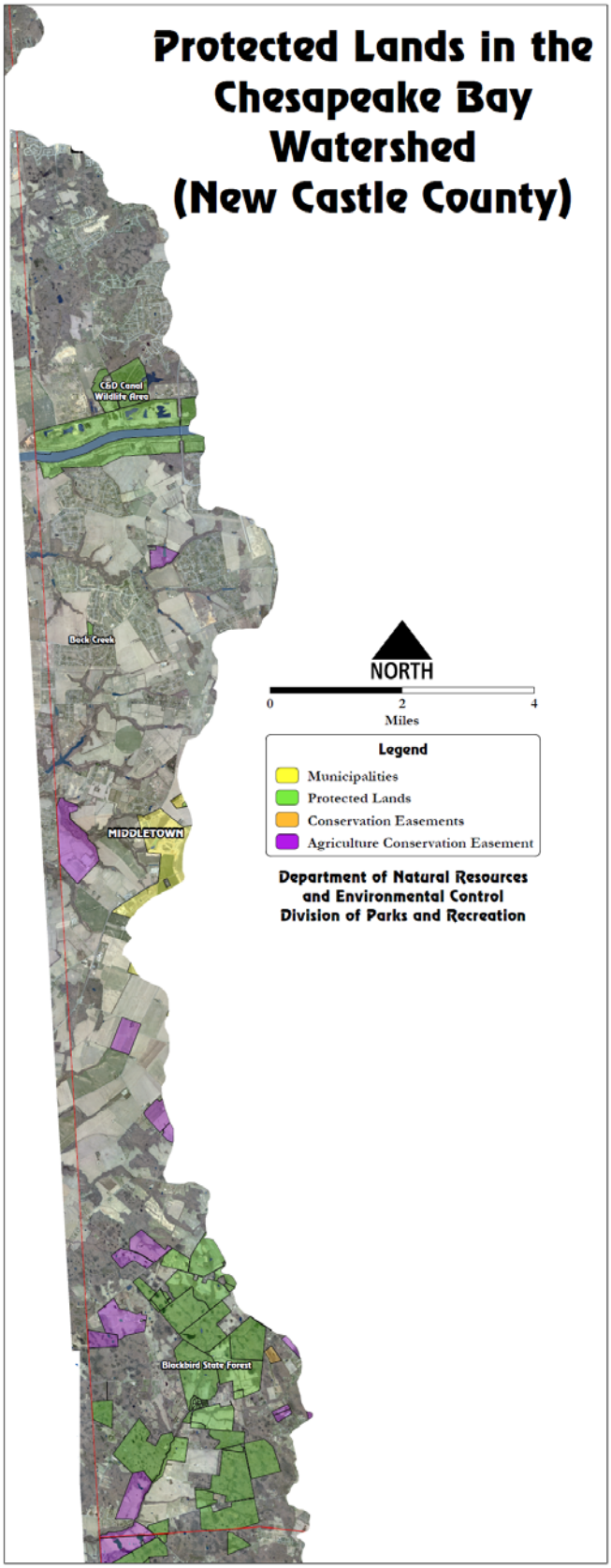

Figure 27: Chesapeake Protected Lands - New Castle

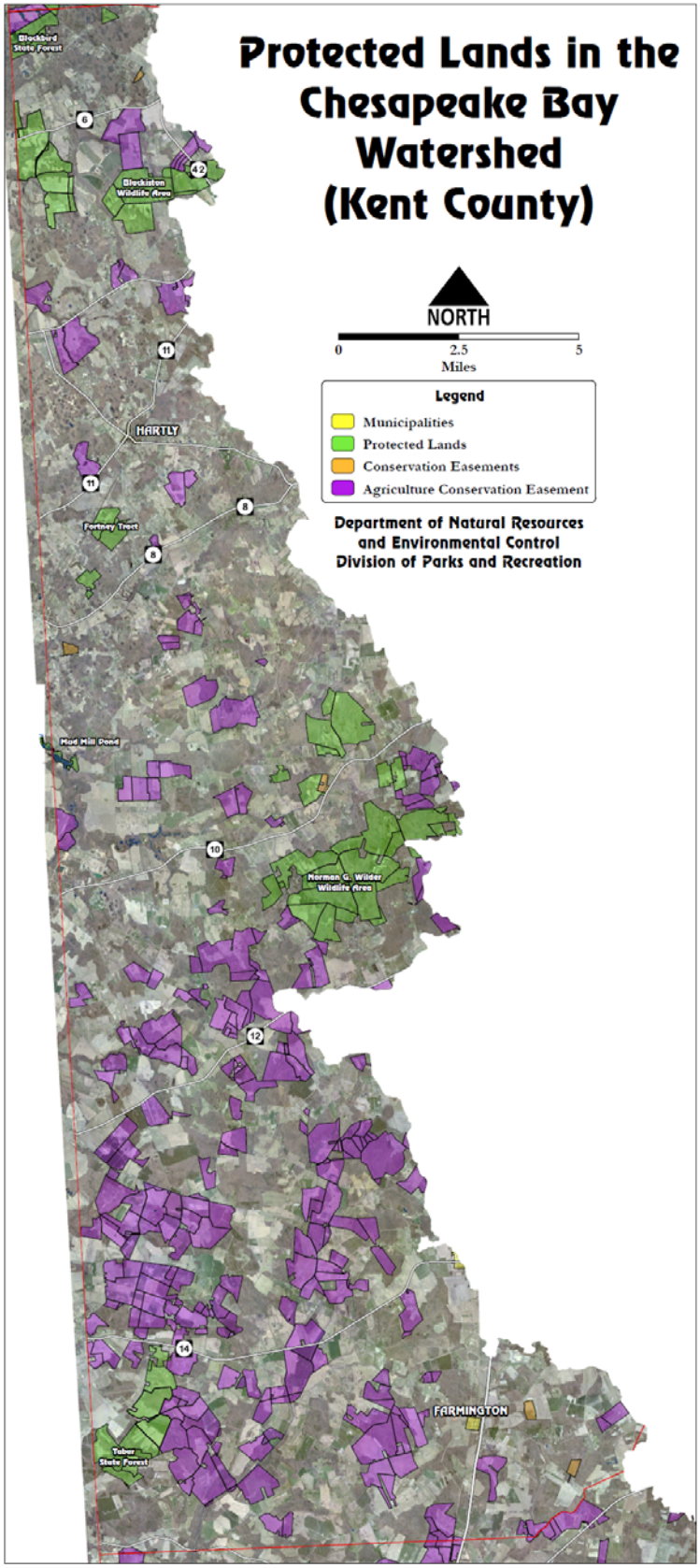

Figure 28: Chesapeake Protected Lands - Kent

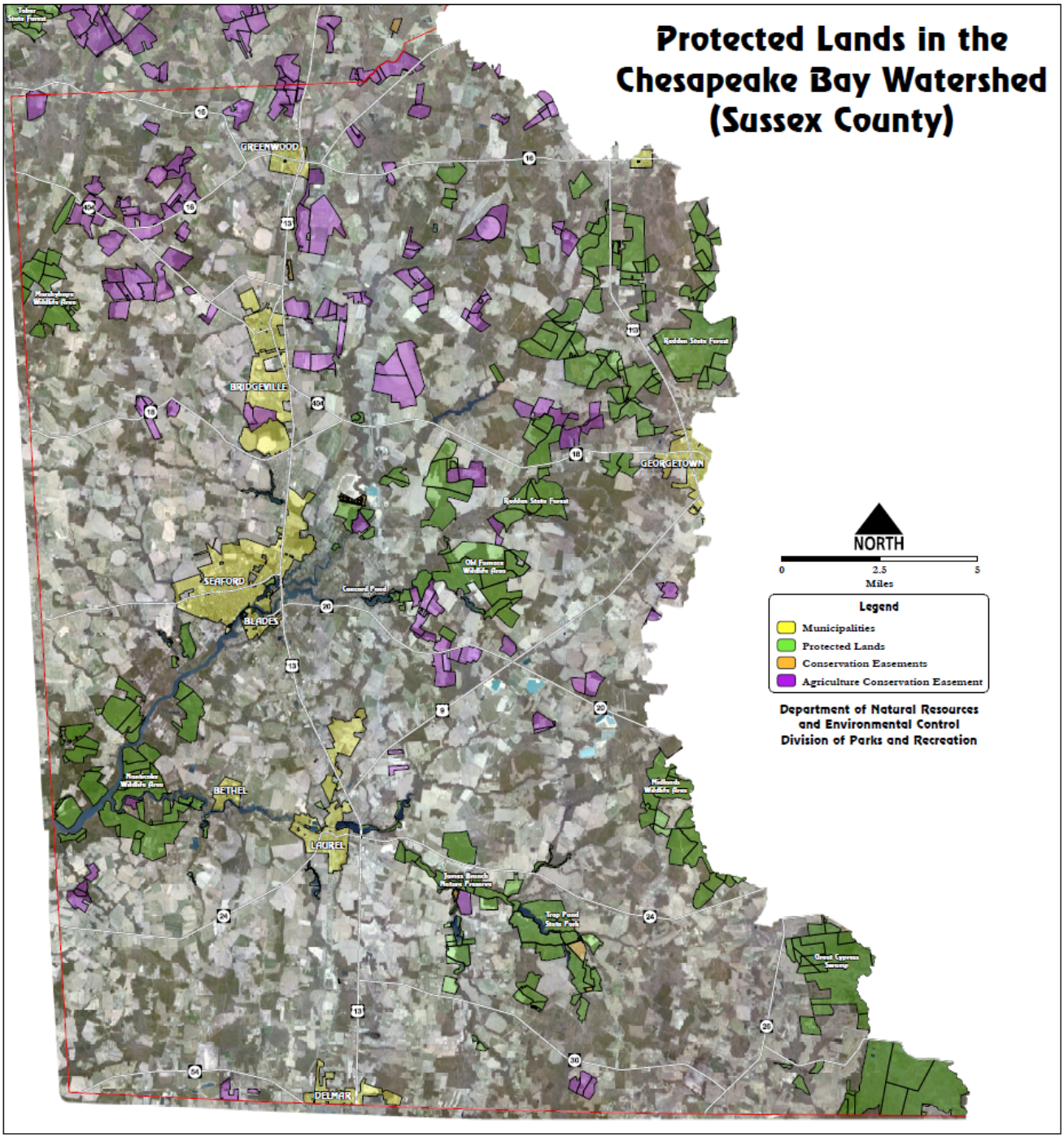

Figure 29: Chesapeake Protected Lands - Sussex

11.4. Strategy to Fill Gaps

All of the public lands managed by the agencies noted above, as well as other public lands, such as schools, DelDOT sites, county and municipal parks, and federal lands, should lead by example in the area of water quality protection and enhancement in the watershed. In order to achieve this, the Public Lands Subcommittee will work with public land managers and other subcommittee members to provide the following information:

- Review existing best management practices (BMPs) on public lands
- Determine potential for increased/new BMPs
- Verify compliance with authorized BMPs
- Analyze reforestation/aforestation opportunities
- Review tax ditch management
- Review effectiveness of stormwater facilities
- Review Tributary Action Teams recommendations for consistency

DNREC and DDA manage over 38,000 acres in the watershed. Of this amount 3,000 acres are in farmland. During calendar year 2011, these agencies, working through the Public Lands Subcommittee will analyze this acreage for the above-listed information.

11.5. Contingencies

After the initial review of DNREC and DDA owned lands is complete, any major corrective actions regarding BMP implementation issues will be brought forward to the appropriate agency with suggested implementation plans. During the review process, minor adjustments may be made as noted. As an example, agricultural leases may need to be modified and can be accomplished on an annual or as needed basis.

11.6. Tracking and Reporting Protocols

A BMP tracking database for public lands managed by DNREC and DDA will be established and populated over the next 12 months. This will be expanded to other public lands after completing these two departments. Data maintained external to the departments will be incorporated into the new system. This data will then be extracted into the National Environmental Information Exchange Network (NEIEN) schema so that data may be directly sent to the Chesapeake Bay Program through network nodes and receive credit in the model. A description of data generation and acquisition, assessment and oversight, and data validation and usability will be provided in Delaware's Nonpoint Source Best Management Practice Implementation Data Quality Assurance Project Plan (Appendix C). The QAPP will be updated to reflect recent changes by April 30, 2011. DNREC staff is also participating in the development of the Bay TMDL Accounting and Tracking System (BayTAS) Version 1.0 to track the TMDL waste load allocations and load allocations and Delaware's progress toward meeting those goals.

SECTION 12. FEDERAL LANDS

Around 8% of the entire Chesapeake Bay watershed is made up of federal lands. In Delaware, there are very few federally owned lands. According to EPA, there are two federally owned parcels in the Chesapeake Bay Watershed in Delaware. They are both Army National Guard properties (Figure 30); one parcel is roughly 11.19 acres and the other is 3.02 acres (Figure 31). In addition to the federal facilities identified by EPA, there are likely several post offices that would collectively add up to a small area.

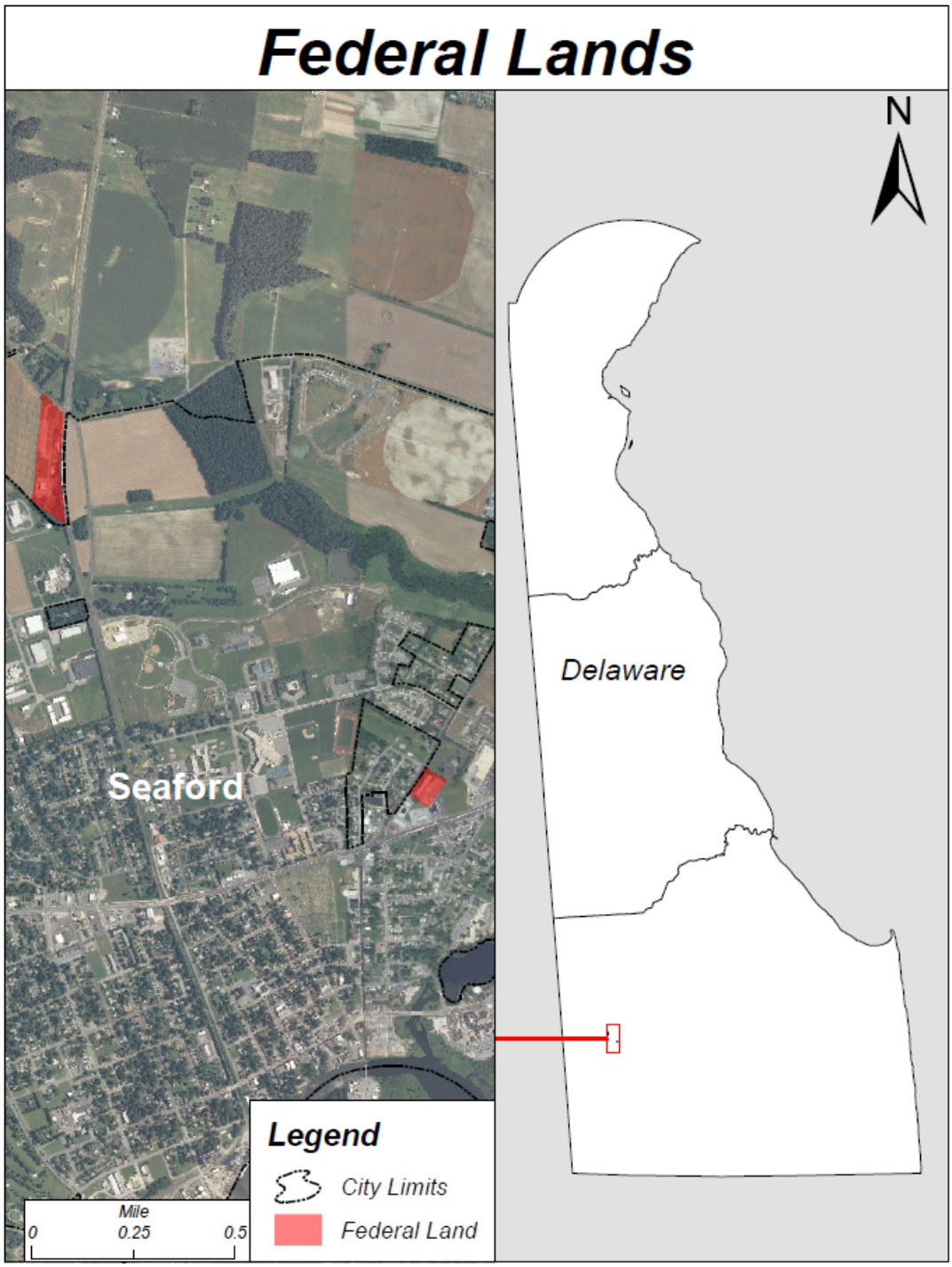

Figure 30: Federal lands in Delaware's Chesapeake Basin

Figure 31: Two Army National Guard properties in Delaware's Chesapeake Basin.

According to EPA, federal landowners are expected to achieve LA and WLA allocations through actions, programs, and policies that will reduce the release of nitrogen, phosphorus, and sediment. For Phase I of the WIPs, EPA expects the jurisdictions to propose final LAs and WLAs that include Federal Lands. The loads from Delaware's federal lands, as calculated by EPA's model, are shown in Table 39 below. For Phase II, the jurisdictions will further distribute LA and WLA allocations at the local level (counties, sub-watersheds, etc.) including federal facilities. The Phase II WIP should identify federal agency actions, programs, policies, and resources necessary to achieve facility-specific allocations. Federal agencies will be expected to create two-year milestones for planning actions that will be included in the Phase II WIP. These milestones will be used for tracking progress, and providing transparency on federal sector performance related to agency TMDL responsibilities in the watershed.

Source	Urban		Agriculture	Forest
	Impervious	Pervious		
Nitrates (lbs/year)	32.77	43.67	89.7	1.34
Phosphates (lbs/year)	9.63	2.67	6.08	0.08
Sediments (tons/year)	0.82	0.11	0.10	0.00

Table 39: Loads by land use source from federal facilities in Delaware

Also, according to EPA, federal facility allocations and load reduction plans will be developed using determined nutrient and sediment loads, and considering, at a minimum, the following in targeting and achieving load reductions:

- Installation of urban retrofit practices and implementing non-structural control measures that reduce volume and improve quality of stormwater discharge
- Cost-effective urban stormwater retrofits and erosion repairs with TMDL goals and jurisdictions' two-year milestones
- Appropriate non-structural practices to control stormwater dischargers from developed areas
- Nutrient and sediment sources from particular facilities

Section 501 of Executive Order 13508 and the subsequent federal strategy state that each federal agency with land, facilities, or installation management responsibilities affecting ten or more acres in the watershed will implement Section 502 guidance on federal land management. Compliance with the new requirements for federal facilities under the Executive Order and Section 438 of the Energy Independence and Security Act should go a long way toward meeting target load reductions; however, benefits would be marginal since there are very few federal facilities with Delaware's Chesapeake watershed.

SECTION 13. AIR

EPA has identified atmospheric deposition of nitrogen as a major contributing source to the Chesapeake Bay watershed and will be allocating an allowable loading of nitrogen from air deposition in the Chesapeake Bay TMDL. The nitrogen loadings come from many jurisdictions in general proximity to the Chesapeake Bay watershed. Figure 32 shows the approximate delineation of the Bay airshed.

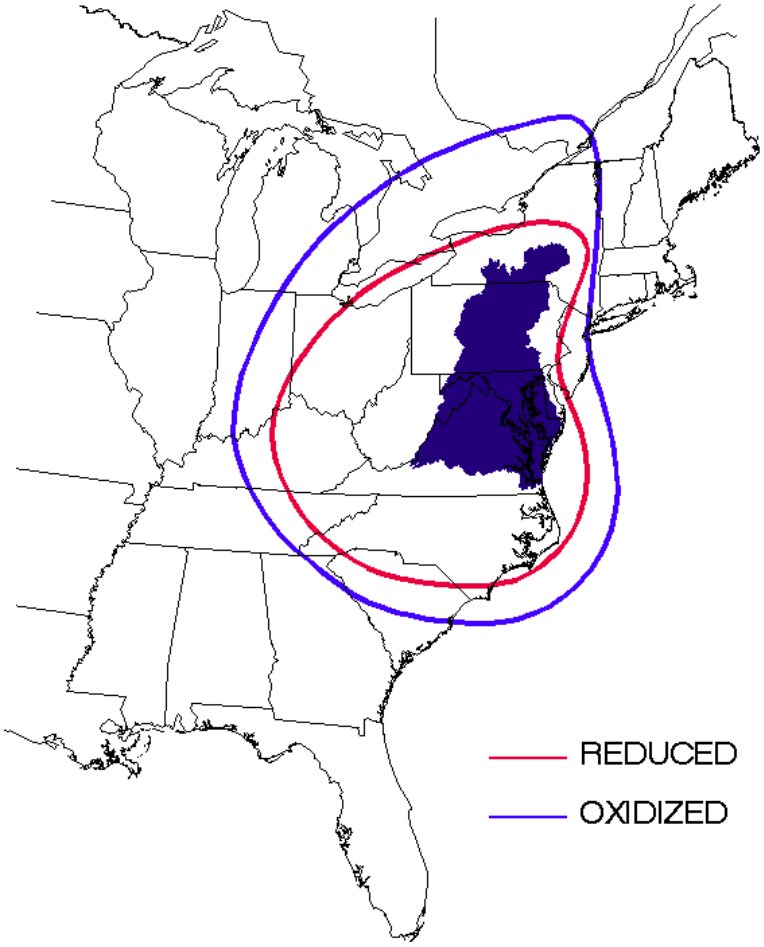

Figure 32: The Chesapeake Bay Airshed for Nitrogen

EPA differentiates between nitrogen deposition occurring on the land and non-tidal waters and deposition occurring directly onto the tidal waters. The deposition on the land becomes part of the allocated load to the jurisdictions. This is because the air deposition on the land becomes mixed with the nitrogen loadings from the land based sources and dealt with through the management measures placed on the land. The nitrogen deposition directly to tidal waters is a direct loading with no land based management controls and therefore needs to be linked directly back to the air sources and air controls.

EPA used the reductions expected from regulations implemented through the Clean Air Act authority to meet National Ambient Air Quality Standards for criteria pollutants in 2020 to base scenarios for future air controls and allocations. According to EPA, the air allocation scenario includes:

- The Clean Air Mercury Rule (CAMR).
- The Best Available Retrofit Technology (BART) used for reducing regional haze, and the off-road diesel and heavy duty diesel regulations.
- On-Road mobile sources: For On-Road Light Duty Mobile Sources this includes Tier 2 vehicle emissions standards and the Gasoline Sulfur Program, which affects SUVs pickups, and vans that are now subject to same national emission standards as cars.
- On-Road Heavy Duty Diesel Rule – Tier 4: New emission standards on diesel engines starting with the 2010 model year for NOx, plus some diesel engine retrofits.
- Clean Air Non-Road Diesel Rule: Off-road diesel engine vehicle rule, commercial marine diesels, and locomotive diesels (phased in by 2014) require controls on new engines.
- EGUs: CAIR second phase in place (in coordination with earlier NOx SIP call).
- Non-EGUs: Solid Waste Rules (Hospital/Medical Waste Incinerator Regulations).

EPA included an explicit basinwide nitrogen allocation, which was determined to be 15.7 million pounds of atmospheric deposition loads directly to the Chesapeake Bay and tidal tributary surface waters. If air deposition and expected reductions in nitrogen loading to the Bay are not included in the LAs, then other sources would have to reduce nitrogen discharges even further to meet the nutrient loading cap.Activities associated with implementation of federal Clean Air Act regulations by EPA and the jurisdictions through 2020 will ensure achievement of this allocation and are already accounted for within the jurisdiction and major basin nitrogen allocations. Any additional nitrogen reductions realized through more stringent air pollution controls at the jurisdictional level, beyond minimum federal requirements, may be credited to the individual jurisdictions through future revisions to the jurisdictions' WIPs, two-year milestones, and the Chesapeake Bay TMDL tracking and accounting framework.

Based on consultation with the DNREC's Division of Air Quality, Delaware feels that EPA's 2020 scenario relies on a weak and inadequate NOx cap of roughly 1.4 million tons annually. Analysis conducted by the Ozone Transport Commission indicates that using highly cost effective and reasonable control technologies will cause this cap to be no higher than 0.9 million tons annually. This is significant because the higher the load allocated to the atmospheric deposition, the lower the load allocated to various watersheds.

Based on available data and information, approximately 1.5% of NOx emissions will be deposited in the watershed as nitrogen, which means for every 200,000,000 pounds of NOx, there will be an additional 3,000,000 pounds of nitrogen deposited into the watershed, more than one-half of Delaware's allocation of 5,000,000 pounds. The difference between a weak Federal program and what could be a more reasonable Federal program is nearly 1,000,000,000 pounds of NOx emissions, equivalent to 15,000,000 pounds of nitrogen loading to the bay – an amount that is about three times Delaware's allocation.

Therefore, Delaware urges EPA to revise their methodology and set more stringent federal goals for air quality management, as most of the NOx that is deposited in Delaware, originates in other jurisdictions. Delaware has adopted stringent NOx emission standards for every individual electric generating unit as well as standards for other fuel burning equipment. There is little left in Delaware's regulatory arsenal to reduce point source NOx emissions within its boundaries. Even if more stringent air controls were identified and adopted in Delaware, little impact will be realized in the deposition occurring in Delaware's Chesapeake due to the location of Delaware sources and climatic patterns.

SECTION 14. WATER QUALITY MONITORING

Water quality monitoring has provided evidence of changes in water quality and necessary data to develop models and TMDLs to meet the Clean Water Act goals or restoring the physical, chemical and biological properties of the Delaware's waters. Delaware has been at the forefront of TMDL development for nutrients in the Chesapeake Bay drainage basin. Monitoring will be needed to document changes as the Delaware and Chesapeake Bay TMDLs are implemented.

14.1. Current Programs and Capacity

14.1.1. Delaware's Surface Water Quality Monitoring Program

Delaware follows a five-year rotating basin scheme to monitor all surface waters of the State. During every five-year cycle, each watershed within the State is monitored monthly for two years and bi-monthly for the remaining three years. Within the Chesapeake Bay drainage, Delaware maintains a network of 24 monitoring stations (Table 40 and Figure 33). Two of the stations, i.e., Station 304191 at Nanticoke River at Rt. 545 Bridge, and Station 302031 at Marshyhope Creek at Rt. 308 Bridge are part of the Chesapeake Bay Program Non-tidal Monitoring Network and are always monitored monthly. In addition to monthly sampling, eight storm samples (two per season) are collected at both of these sites every year. According to the State's five-year rotating basin monitoring schedule, the remaining 22 stations within the Chesapeake Bay Drainage are monitored monthly during State's Fiscal Years of 2010 and 2011, and will be monitored bi-monthly during the fiscal years of 2012, 2013, and 2014. Please note that Delaware's Fiscal Years start in July 1 of each year and ends in June 30 of the following year.

Surface waters of the State, including waters within the Chesapeake Bay Drainage, are monitored for a suite of 24 parameters including nutrients, chlorophyll a, turbidity, bacteria, organics, pH, dissolved oxygen, etc. (Table 41). It is estimated that water quality monitoring costs for the Chesapeake basin be about $110,000 for fiscal year 2011. For fiscal years 2012, 2013, and 2014 when monitoring frequency for most stations are reduced to bi-monthly, the monitoring cost is estimated to be about $60,000. These estimates exclude monitoring for metals that occurs at some stations in the basin and also exclude quality control sampling and other monitoring plans and programs.

Analytical results from the stations is promptly published in the EPA STORET system and are available as part of the STORET network. More details for the Surface Water Quality Monitoring Plan (SWQMP) are available on DNREC's website.

CHESAPEAKE BAY DRAINAGE	*STORET Station*	*Projected Sampling Schedule*			
		2010	*2011*	*2012*	*2013*
Chester River					
Sewell Branch @ Sewell Branch Rd. (Rd. 95)	112021	12	12	6	6
Choptank River					
Cow Marsh Creek @ Mahan Corner Rd. (Rd. 208)	207021	12	12	6	6
Tappahanna Ditch @ Sandy Bend Rd. (Rd. 222)	207081	12	12	6	6
Culbreth Marsh Ditch @ Shady Bridge Rd. (Rd. 210)	207091	12	12	6	6
White Marsh Branch @ Cedar Grove Church Rd. (Rd. 268)	207111	12	12	6	6
Marshyhope Creek					
Marshyhope Creek @ Fishers Bridge Rd. (Rd. 308)	302031	12	12	12	12
Nanticoke River					
Nanticoke River @ buoy 45 (near state line)	304071	12	12	6	6
Nanticoke River @ buoy 66 (confluence with DuPont Gut)	304151	12	12	6	6
Nanticoke River @ Seaford WWTF (near boat ramp)	304461	12	12	6	6
Nanticoke River Tributaries					
Racoon Prong @ Pepperbox Rd. (Rd. 66)	304671	12	12	6	6
Nanticoke River @ Rifle Range Rd. (Rd. 545)	304191	12	12	12	12
Concord Pond @ German Rd. (Rd. 516)	304311	12	12	6	6
Williams Pond @ East Poplar St. (across from Hospital)	304321	12	12	6	6
Bucks Branch @ Conrail Rd. (Rd. 546)	304381	12	12	6	6
Nanticoke River @ Rt. 13	304471	12	12	6	6
Records Pond @ Willow St.	307011	12	12	6	6
Horseys Pond @ Sharptown Rd. (Rt. 24)	307171	12	12	6	6
Gravelly Branch @ Coverdale Rd. (Rd. 525)	316011	12	12	6	6
Trap Pond on Hitch Pond Branch @ Co. Rd. 449 or Trap Pond Rd	307081	12	12	6	6
Deep Creek above Concord Pond, near Old Furnace at Rd. 46	304591	12	12	6	6
Gravelly Branch at Deer Forest Road (Rd 565) on west edge of Redden State Forest Jester Tract	316031	12	12	6	6
Broad Creek at Main Street in Bethel (Rd 493)	307031	12	12	6	6
Nanticoke River at Beach HWY (Ellendale Greenwood HWY) on east edge of Greenwood	304681	12	12	6	6
Pocomoke River					
Pocomoke River @ Bethel Rd. (Rd. 419)	313011	12	12	6	6

Table 40: EPA MEthods and Analytical Detection Limits

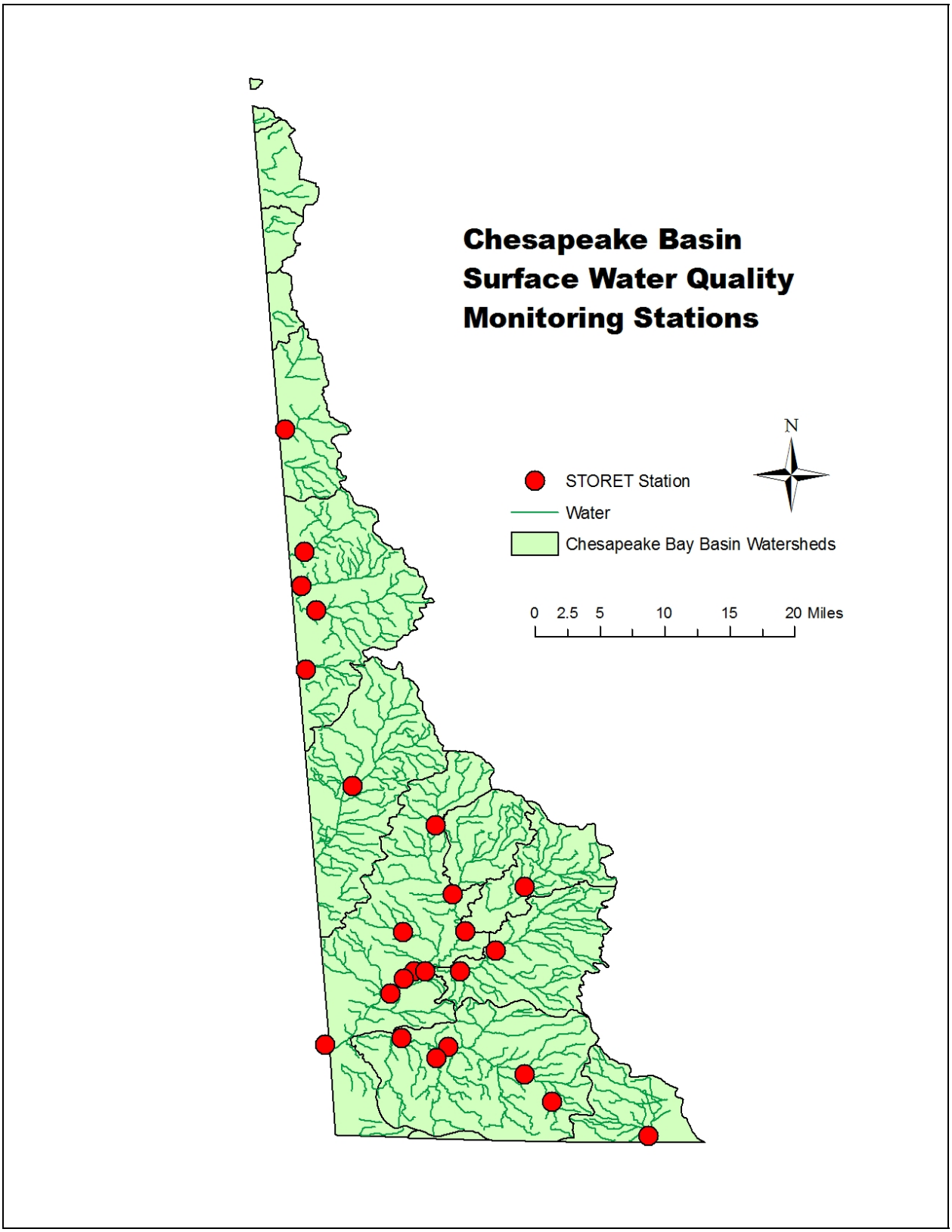

Figure 33: Water Monitoring Stations

Parameter	*Method Reference (EPA)*	*Reporting Level*[1]
Water Column Nutrients		
Total Phosphorus	EPA365.1 M	0.005 mg/l P
Soluble Ortho-phosphorus	EPA365.1	0.005 mg/l P
Ammonia Nitrogen	EPA350.1	0.005 mg/l N
Nitrite+Nitrate N	EPA353.2	0.005 mg/l N
Total N	SM 4500 NC	0.08 mg/l N
Carbon and Organics		
Total Organic Carbon	EPA415.1	1 mg/l
Dissolved Organic Carbon	EPA415.1	1 mg/l
Chlorophyll-a (Corr)	EPA 445.0	1 g/l
Biochemical Oxygen Demand		
BOD_5, N-Inhib (CBOD)	SM20thed-5210B	2.4 mg/l
BOD_{20}, N-Inhib (CBOD)	SM20thed-5210B	2.4 mg/l
General		
Dissolved oxygen – Winkler[2]	EPA360.2	0.25 mg/l
Dissolved oxygen – Field	EPA360.1	0.1 mg/l
Total Suspended Solids	EPA160.2	2 mg/l
Alkalinity	EPA310.1	1 mg/l
Hardness	EPA130.2	5 mg/l
Field pH	EPA150.1	0.2 pH units
Conductivity – Field	EPA120.1	1 S/cm
Salinity	SM20thed-2520B	1 ppt
Temperature	EPA170.1	^{o}C
Secchi Depth[3]	EPA/620/R-01/003	meters
Light Attenuation[4]	EPA/620/R-01/003	%
Turbidity	EPA180.1	1 NTU
Chloride	EPA325.2	1 mg/l
Bacteria		
Enterococcus	SM20thed-9230C	1 cfu/100 ml

Table 41: Water Quality Parameters to be analyzed at all Stations in the Monitoring Network, FY 2011

14.1.2. Nanticoke River Watershed Baseflow/Groundwater Study

DNREC's Groundwater Protection Branch (GPB) will be completing a groundwater quality study in the Nanticoke River watershed. The intention of this study is to use the data to identify subwatersheds that are yielding excessive loads and target them for intensive nutrient management efforts, including BMP implementation. The United States Geological Survey (USGS) NAWQA analytical protocol for chemical analyses will be used, which is identical to what was done for a groundwater quality study in the Inland

Bays watershed. After consultation with experts from the USGS, the GPB has planned to perform the following tasks as part of this groundwater study in the Nanticoke River Watershed.

- Random Groundwater Sampling - A 5,000 by 5,000 meter grid was established across the basin. A groundwater sample, from a well, will be randomly taken from each grid area. All wells will be verified to be completed in the unconfined aquifer. Approximately 50 wells will be sampled.
- Groundwater Base Flow Sampling - Surface water samples will be taken during high base flow (late February to early April) at selected streams across the basin. Discharge measurements will be taken at the time of sampling.
- Special Studies - If time allows, the GBP has selected four specific study areas. The study areas will examine differences in land use and soil types. The study areas include 1) Highly agricultural with moderate to well drained soils, 2) Highly agricultural with poorly drained soils, 3) Highly forested with poorly drained soils, and 4) Highly residential with well drained soils. Surface and/or groundwater samples will be taken in each study area. Surface water samples will be taken at high base flow (late February to early April) and low base flow (August to September). Additional wells will be sampled.
- Laboratory Parameters - All water samples (groundwater and surface water) will be sampled for nutrients and major ions. The complete list of parameters include alkalinity, chloride, ammonia as N, nitrate as N, phosphorus, silica, sulfate, calcium, iron, magnesium, potassium, and sodium. Field parameters including temperature, pH, dissolved oxygen, and specific conductance will be taken for all samples.
- Final Report - A final report will summarize the results of groundwater quality in the Nanticoke River watershed. Nutrient loads to Nanticoke River will also be estimated.
- Time Frame - The tentative timeframe for the project is shown below. All data collection will be completed by September 30, 2011.

Table 42: Nanticoke River Watershed Baseflow/Groundwater Study Timeline

Project Component	Months (2010 to 2012)																	
	2010			2011												2012		
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Project Management																		
Sampling Location Selection																		
Well Sampling																		
Surface Water Sampling																		
Laboratory Analysis																		
Data Analysis																		
Progress Reports																		
Final Report																		

14.1.3. Citizen Monitoring Programs

The Department works with Citizen Monitoring groups such as Delaware Nature Society and the Nanticoke Watershed Alliance's Creekwatcher Citizen Monitoring group to monitor those waters of the State that are not monitored routinely by the Department. DNREC works with the above citizen groups to develop their monitoring and quality assurance programs. In addition, the Department uses Citizen Monitoring data in developing water quality models as well as in preparing the State's biannual 305(b) reports that are submitted to the EPA every two years. A more detailed description of the Nanticoke Creekwatcher program can be found in Section 15.

14.2. Accounting for Growth

Delaware's Surface Water Quality Monitoring Program is designed to characterize the water quality condition of the State's surface waters and detect trends in water quality. Therefore, growth would not directly affect the program. However, monitoring results can be used to assess the impact of growth on surface water quality.

14.3. Gap Analysis

Delaware's Surface Water Quality Monitoring Program is funded by State General Funds as well as funds provided by the US EPA Clean Water Act Section 106 Program. The current monitoring effort is designed in part to calculate annual nutrient loads as well as to detect water quality trends in major waterbodies. However, the current funding levels are not sufficient for regular sampling in headwaters that would clearly demonstrate changes in water quality that occur as the result of implementation of BMPs. Additionally, establishment of continuous monitoring for selected parameters at key points in the network may be important data for future modeling efforts and can be implemented with additional funding.

14.4. Strategy to Fill Gaps

The Department will work with the Chesapeake Bay Program and other partners to identify Federal and State funding sources that can be used to develop and implement a comprehensive monitoring plan for headwater streams and continuous monitoring programs at key locations.

14.5. Contingencies

Changes in the Monitoring Plan may be necessitated by budget constraints in the future. However, in those situations, Delaware DNREC will attempt to prioritize its monitoring efforts in such a way that the impact on monitoring within the Chesapeake Bay drainage is minimized.

14.6. Tracking and Reporting Protocols

Data from monitoring is published online by EPA in the STORET data base. The Department publishes an Integrated 305(b) Report and 303(d) List of Waters Needing TMDLs every even numbered year by April 1st. In addition, the Department is participating in data exchange efforts with the Chesapeake Bay Program so that collected water quality data are directly reported to the Bay Program based on approved exchange protocols.

SECTION 15. EDUCATION, OUTREACH, AND VOLUNTEERISM

There are several nonprofit environmental and watershed based organization active in the Delaware portion of the Chesapeake. These organizations are in an excellent position to help implement this Watershed Implementation Plan. Two organization in particular, the Nanticoke Watershed Alliance and the Delaware Nature Society, have extensive experience with education and outreach efforts, which will help inform residents, businesses, and visitors within the Watershed of actions that they can do to improve water quality, and they have a volunteer base to assist with monitoring and implementation projects.

15.1. The Nanticoke Watershed Alliance

The Nanticoke Watershed Alliance is a consortium, or organization of organizations, with a mission to foster partnerships and progress in conserving the natural, cultural, and recreational resources of the Nanticoke River watershed through dialogue, collaborative outreach, and education. Partners of the Alliance include representatives from other local environmental, watershed, and land conservancy groups, local governments and business, and stakeholders related to farming and development within the Watershed. The Alliance has three main goals: (1) monitor river health through collaborative relationships with regional experts, local volunteers, and the scientific community to disseminate objective information; (2) develop and promote innovative approaches to management and conservation of the watershed, engaging partners, policy makers, and the public through outreach and education; and (3) support and promote the conservation initiatives of organizations within the Nanticoke River watershed. The Alliance also administers to main programs. The first is the Nanticoke Vision, or Green Infrastructure Initiative, which is an inclusive process that is focused on positive solutions for community, human health, ecology, business, industry, and working landscapes (farming and forestry heritage). In order to bring effective conservation to the entire watershed, the Alliance is working to bridge the barriers of state and county lines to produce a plan that encompasses the well-being of all the watershed's residents. The second main program is the Creekwatcher Citizen Monitoring Program which is described in more detail below.

15.1.1. Nanticoke Creekwatchers Citizen Monitoring Program

The Nanticoke Creekwatchers is a bi-state water monitoring program developed by the Nanticoke Watershed Alliance in 2006. The Alliance trains local citizens to assess water quality at 37 locations throughout the 725,000 acre Nanticoke Watershed. During April-November, volunteers collect in-situ measurements of key parameters such as dissolved oxygen and water clarity as well as information on water depth, temperature and salinity, and collect samples for laboratory analysis of nutrients and bacteria. Its Quality Assurance Project Plan has been approved by the EPA's Chesapeake Bay Program, making the volunteers' efforts and resulting data much more powerful for use in river protection and bay cleanup efforts. Since 2007, the Nanticoke Watershed Alliance has published an annual report of water quality data, and recently adopted the "report card" model in order to make water quality data more meaningful to the general public. The Nanticoke River received a B minus, making it one of the cleanest tributaries of the Chesapeake Bay. The Alliance uses the report card as part of their extensive outreach and education efforts, and the data is sent to the EPA's Chesapeake Bay Program Office and state agencies including DE Dept. of Natural Resources and Environmental Control, MD Dept. of Natural Resources and MD Dept. of the Environment. It is also made available for use by to academic institutions, other organizations and individuals. As the body of data continues to grow, trends in water quality will become more evident and will be used to guide the restoration, outreach and other efforts of the Alliance.

Funding for this effort is provided by the Delaware Dept. of Natural Resources and Environmental Control and the Chesapeake Bay Trust. The Alliance also receives generous in-kind donations from Envirocorp Labs in Harrington, DE for all water quality analysis and from Johns Hopkins University in Baltimore, MD for assistance with data management and analysis. Other program partners include private business and landowners who allow water access for monitoring and as a sample transfer location. As the Nanticoke Creekwatchers Program has continued to grow and gain more public awareness, it has proven to be an excellent way to engage a diversity of stakeholders in the protection of the Nanticoke River.

15.2. Delaware Nature Society

Founded in 1964, the Delaware Nature Society is the pre-eminent non-profit environmental organization in the state. This position has been well earned through its long-term and consistently active preservation, conservation and advocacy programs. Delaware Nature Society is unique in the way it integrates education as a vital element in its role in preservation, conservation and advocacy. Currently, thousands of members support this important work and/or participate in programs while over 1,000 volunteers assist the 32 member core staff and interns so that annual programs continue to improve and increase.

Since 1964, Delaware Nature Society's modest beginnings at Brandywine Creek State Park have evolved into environmental education programs and camps for more than 1.4 million people. The organization has facilitated preservation of more than 100,000 acres of open space and farmland. Stewardship of regional natural resources is effectively advocated. A few startup volunteers have grown into 21 full-time, 11 part-time and 120 seasonal instruction employees and more than 1,000 volunteers, located statewide at the Ashland and Abbott's Mill Nature Centers, Coverdale Farm, Cooch-Dayett Mills and DuPont Environmental Education Center.

The Delaware Nature Society (DNS) owns or manages more than 1,100 acres of wildlife habitat and educational preserves. Farm education programming is held at our 352-acre Coverdale Farm. Abbott's Mill's historic, water powered gristmill is preserved and operational. Delaware Nature Society's Burrows Run and Flint Woods Preserves in New Castle County and Marvel Saltmarsh and Cedar Bog Preserves in Sussex County provide extensive field study opportunities.

Encouraged by the Wilmington Junior League and a dozen nature and education-related organizations, DNS was incorporated on September 28, 1964. Its consistent mission has been to foster understanding, appreciation and enjoyment of the natural world, preserve ecologically significant areas and advocate stewardship and conservation of natural resources. Unlike many nature centers that offer environmental education only, DNS has Natural Resource Conservation and Advocacy components also. In addition, it is the Delaware affiliate of the National Wildlife Federation (NWF), with input on national issues of concern in our region. Further information can be found at www.delawarenaturesociety.org.

DNS applied for a NOAA B-Wet grant which is a 3 year $500,000 grant that will focus attention solely on the Nanticoke Watershed; however, the outcome of their application will not be announced until late spring to early summer of 2011. If received, this grant will help promote involvement in the wider Seaford community through school-based initiatives, celebrations, and watershed lectures on an annual basis. In this way, DNS hopes to promote the importance of sustainable landscaping and the important roles people play in maintain the Bay's health.

Additionally, DNS will focus advocacy efforts on the Nanticoke Watershed through review and comments on specific development projects. In their comments, they will recommend strong stormwater preventative measures and smart growth decisions, in an attempt to decrease the pollutants caused by stormwater runoff from entering the watershed.

SECTION 16. FUNDING

The purpose of the funding committee is to coordinate funding sources, including match sources, close funding gaps and achieve implementation milestones described in the WIP, coordinate grant applications when possible, and develop mechanisms to track external expenditures in the Chesapeake Bay Watershed for future reporting. The committee includes representatives from various programs within DNREC, DDA, DelDOT, Sussex Conservation District, Kent Conservation District, and USDA.

Source sector committees for stormwater management, agriculture, onsite wastewater, restoration, and land use have worked to identify funding needs to meet the implementation goals described in the WIP.

16.1. Current Funding Sources

Implementation Grant

Chesapeake Bay funding will be used by all of Delaware's Chesapeake Bay watersheds between June 2009 and May 2015 to manage a wide range of nutrient and sediment sources. These activities include bringing stakeholders together, evaluating progress through water quality monitoring and BMP data tracking, accelerating implementation of nutrient and sediment reducing activities, and contributing knowledge of new approaches to reduce nutrients and sediment. This work plan proposes to support both traditional and innovative BMPs that are cost effective and sustainable. Technical support and cost share funding will be provided for more traditional agricultural BMPs such as manure relocation and cover crops, while the effectiveness of targeting irrigation to reduce nutrient loadings will be investigated. The Nanticoke Restoration Strategy will be implemented, leading to stream restoration types of projects. Efforts will also be expended in the urban sector to install nutrient reducing practices like rain gardens on existing developed lands. Further education and outreach will also be done to promote the use of new green development practices.

Regulatory and Accountability Grant

Delaware would not be able to achieve its water quality goals for the Chesapeake Bay without assistance from the Regulatory and Accountability (R&A) grant. The R&A grant addresses four objectives. The first is the development of the TMDL Watershed Implementation Plan, which will detail the necessary steps to minimize pollutant inflow to the Bay and achieve the TMDL set by EPA. As a result of the 2010 grant, DNREC will be able to provide the timely development and submittal of required Phase I and II WIPs. Additionally, stakeholders from partner agencies and each nutrient and sediment source sector will be engaged to obtain additional input into the development of the WIP. As a result, Delaware will be able to propose and implement effective strategies to reduce nutrient and sediment loads to local impaired waters and the Bay in accordance with the timeline provided by EPA.

The second objective is to improve and expand regulation of sources of nitrogen, phosphorus, and sediment delivered to the Bay. As a result of the 2010 grant, Delaware's regulations for for industrial storm water sites will be revised to address the Chesapeake Bay TMDLs, as well as other TMDLs established within the State of Delaware. The regulations will also establish new guidelines that reflect new federal mandates, implement stricter standards such as the inclusion of effluent limitations, and require stricter reporting requirements. In addition, the grant is providing funds to develop Technical Standards for Sediment and Stormwater Regulations which will:

- Incorporate runoff reduction approaches in the new DURMM model to provide a tool that is both unique to Delaware and serve as a practical tool for the stormwater designer. Professional engineers and designers will be more successful in meeting regulatory requirements utilizing tools that enable them to take advantage of the available science and technology.
- Provide technical specifications for Green Technology Practices that will be utilized to optimize land development toward the goal of 0% effective imperviousness for new development. The technical specifications will be consistent with other Bay area specifications that are being utilized to maximize pre-development hydrology.
- Provide training functions each year for agency review personnel to ensure they are consistently applying the standards based approach in the new regulations, provide training functions annually for the regulated design community to transfer technology associated with the new design approaches and standards. New projects associated with the use of these practices should achieve the percent load reduction to meet the TMDL as well as meet runoff reduction goals of 0% effective imperviousness.

Thirdly, the R&A grant will provide for enforcement and compliance assurance. Compliance inspectors will make certain that agricultural, wastewater, and storm water related practices have been installed properly and are being maintained to achieve adequate nutrient or sediment goals. This grant will provide:

- A compliance inspector in Sussex County to inspect every acre to ensure that cover crops are planted at the appropriate time and that no manures or fertilizers are spread on the cover cropped fields. In the spring, the inspector will again inspect each field for compliance for approved destruction methods and to ensure that no manure or fertilizer applications occurred. In the fall of 2009, there were over 15,000 acres of cover crops planted in the Chesapeake Bay Watershed in Sussex County.
- Delaware has nearly 400 industrial storm water sites. The addition of an environmental scientist will allow for increased inspections of these sites. It is estimated that the addition of this staff will result in completion of up to 250 inspections per year. Although the Industrial Stormwater Program currently requires that sites be inspected once every three years, the Surface Water Discharges Section has a goal of inspecting each site at least annually to provide updated data to the Chesapeake Bay Program.
- A staff person to work with approximately 240 CAFO permittees in the Chesapeake Bay Watershed through the NOI and permit approval process. Schedule public workshops and hearings as necessary to review NOIs, conduct audits and inspections as necessary at each operation to ensure compliance with the new CAFO regulations and provide educational and technical support.

Lastly, a portion of funding from the grant is improving tracking and accountability. Sussex and Kent Conservation Districts have delegation over the Sediment and Stormwater Program. The Conservation Districts' responsibilities include review and approval of sediment and storm water management plans, construction inspection, maintenance inspection, and outreach and education. Funding will provide for:

- Inspection of all closed out projects constructed in the Chesapeake Bay Watershed since 1991 and provides storm water maintenance report/technical guidance on how the BMP is designed to function and its proper maintenance. Recommendations will be generated on improvements

that can be made to increase removal of nutrients through the implementation of practices such as buffers, meadows, native landscaping, and other practices.
- Inspection of all 59 tax ditch systems in Kent County.
- An up-to-date GIS data layer for industrial storm water sites within the State, and the creation of a "mapbook" for inspection sites within the State.

National Fish and Wildlife Foundation Grant

DNREC has been awarded a $100,000 Small Watershed Grant from the NFWF for FY2010. DNREC plans to partner with federal, state, local, and non-governmental groups to reduce nutrients and sediment from urban and rural nonpoint sources in the headwaters of the Chesapeake Bay using innovative storm water retrofits and riparian, channel and wetland restoration techniques. The proposal includes prioritization of urban retro-fit and restoration opportunities within the Delaware portion of the Chesapeake Bay Watershed, targeting sub-watersheds primarily in the Nanticoke, Chester and Choptank Watersheds to focus implementation using innovative techniques. This approach addresses two of the key challenges identified by the National Fish and Wildlife Foundation, focuses within the geographic priority areas and provides holistic strategies to address all major sources of nutrients while providing outreach, technical assistance, implementation and monitoring.

The implementation of this proposal will result in a prioritized inventory of opportunities for urban storm water upgrades, the restoration of up to 1.5 miles of tax ditch and stream channels by reestablishing natural floodplains and reconnecting channels to floodplains, and restoration of up to 10 acres of freshwater wetlands down gradient of agriculture areas, as well as the validation of nutrient and sediment reduction efficiencies for these practices.

Section 106 Grant

Delaware and EPA have developed work plans for the Section 106 NPDES Permit/Enforcement activities under this grant. These work plans seek to initiate a closer coordination and integration of EPA and state permitting/enforcement activities. Several of the activities are focused on the Chesapeake while others are focused statewide and will have a benefit in the Chesapeake. Below is a summary of the five work plans contained in the draft final FY2011 grant.

1. Chesapeake Bay Watershed Point Sources
    a. Goal – incorporate Chesapeake Bay TMDL Waste Load Allocations (WLAs) into point source permits and to ensure compliance for construction schedules and limits
    b. State Activities: DNREC will provide a schedule for incorporation of WLAs into remaining significant and all non-significant point sources by February 1, 2011; DNREC will compile a list/timeline of effective dates for compliance with permit limits and submit to EPA by February 1, 2011; DNREC will submit to EPA for review, all draft permits as they are developed that incorporate the TMDL WLAS; DNREC will provide quarterly updates on permit compliance with TMDL and Chesapeake Bay tributary strategies via the PCS database; and DNREC will participate in QEM calls to provide necessary information to support enforcement activities.
2. Concentrated Animal Feeding Operations (CAFOs)

a. Goal – ensure that permitting and compliance activities meet environmental objectives and public expectations
    i. Chesapeake specific objective – permits, specifically the technical standards being applied to CAFOs to develop the terms of a site-specific nutrient management plan, are protective of water quality in order to meet the objectives of the Chesapeake Bay TMDL.
b. State Activities: 1) DNREC will submit a plan to EPA for review and comment which addresses deficiencies identified in the initial review of technical standards within 90 days after receipt of EPA comments; By December 30, 2010, EPA will develop, in coordination with DNREC, a joint plan to complete CAFO determinations of targeted operations and CAFOs; On an annual basis, DNREC will provide an inspection list of CAFOs and operations where CAFO determinations are planned; and DNREC will identify, document, and track the compliance status of all CAFOs and provide semi-annual compliance reports to EPA through the Section 106 grant process.

3. Municipal Stormwater (MS4)
    a. Goal – ensure that permitting and compliance activities meet environmental objectives and public expectations
        i. Chesapeake specific EPA activity – EPA will review targeted new and reissued permits to ensure consistency with regulatory requirements as well as EPA's Chesapeake Bay Strategy (where applicable) and EPA's expectations as outlined in correspondence.
    b. State Activities: 1) The Delaware Department of Natural Resources and Environmental Control (DNREC) will submit a schedule to reduce the backlog of expired permits in response to EPA letter dated July 2, 2010; DNREC will submit permits to EPA for review and comment in a timely fashion; DNREC will submit a plan to EPA for review and comment which addresses deficiencies identified through the Stormwater Program Review; DNREC will submit a Compliance Monitoring Strategy for review and comment by January 30, 2011; and DNREC will provide permit implementation training to MS4 permittees. EPA technical assistance is available upon request.
4. State Review Framework (SRF)
    a. Goal – identify recommendations for improvement to ensure fair and consistent enforcement and compliance programs across the states.
    b. State Activities: DNREC will work in partnership with EPA to create a final SRF report; DNREC will submit for EPA review and comment on the "Compliance and Enforcement Response Guide" by November 30, 2010; and DNREC will submit a schedule addressing any necessary action required under the SRF within 60 days after receipt of the SRF recommendations.
5. Permit Quality Review (non-mining)
    a. Goal – ensure that permits and supporting documents developed by Delaware include applicable requirements of the NPDES regulations and adhere to the central tenets of the permit program.

b. State Activities: DNREC will provide comments to the 2008 Draft PQR Report by October 31, 2010; and DNREC will submit semi-annual Action Item progress reports to EPA beginning April 15, 2011, and October 15, 2011.

Source of Funds	Funding Amount	Activities to be funded
State General Funds	$2,028,386	Implementation, Education/Outreach, Program Administration, Technical Assistance, Monitoring
CWA 319	$500,000	Implementation and Program Administration
CWA 106	40,000	Monitoring
CWA 117: Implementation Grant FY10	$500,000	Implementation
CBP Regulatory and Accountability	$729,090	Regulatory Development, IT Support, Planning, permitting, technical assistance
Farm Bill	$1,000,000	EQIP, CRP, CREP, etc.
Private	UNKNOWN	Match of federal projects and cost share
Local	UNKNOWN	Match for federal and state projects including BMP, restoration, etc.

Table 43: Other Funding Sources and Levels of Funding (FY10)

FUTURE ACTIONS/NEXT STEPS - 2011

- DNREC and DDA are coordinating with the NRCS State Conservationist to develop a plan to better leverage USDA Farm Bill funding with existing state cost share programs. This plan will be developed in the near future.
- Further develop and refine the estimate of the annual and total cost to achieve the TMDL goals and milestones through 2025 and 2017 according to the approved WIP.
- Develop a prioritization tool to assist decision makers better direct funding, including the future CBRAP and Implementation grants to achieve WIP goals and milestones.
- Develop a mechanism to track annual spending in the Chesapeake Watershed on an annual basis through collaboration and cooperation from local, state, federal and nonprofit agencies.
- Coordinate and leverage restoration expenditures with the Forest Service, NRCS, DelDOT, mitigation funds, in-lieu funds, penalty funds, etc
- Submit grant application for 2011 to the National Fish and Wildlife Foundation (NFWF) to address a holistic approach to watershed management in Delaware's Chesapeake Watershed.

16.2. Subcommittee Funding Needs

Source sector committees for stormwater management, agriculture, on-site wastewater, restoration, and land use have worked to identify funding needs to meet the implementation goals described in the WIP.

These needs include, by sector:

Wastewater

There is a need for State and Federal funding resources to include grants to make upgrades to existing waste water treatment facilities affordable for the local communities.

Onsite Wastewater

In order to improve compliance and increase participation rates by 20%, funding should be increased to provide greater outreach, staffing, and technical resources. Three FTEs wee recently vacated and need to be re-filled in order to maintain workload and increase work levels to achieve new goals. Two of the three positions will be filled by the end of CY2010, with the final position expected to be filled by FY12. The Section would be better served by increasing the staffing levels by one additional FTE ($50K annually). Additional needs to fill gaps are identified below:

- Additional staff or staff movement will likely be needed to maintain a new aggressive operation and maintenance inspection program in addition to the current operation and maintenance program for the innovative and alternative system requirements, and data collection.
- Improved tracking and reporting of pump-outs and inspections, advanced treatment units, and connections to central sewer
    - Delaware's Environmental Navigator, a data management system, needs improvements. Additional funding for database upgrades and management ($50K annual)
- Staff training in advanced treatment units for permitting, inspection, operation, and maintenance requirements.
- Will need funds to update the database to track waste haulers and verify septic system pump out requirements are being met and expect to have grant funding to update the database.
- There is a need for State and Federal funding resources to include grants to make municipal systems affordable and to help low-income on-site users replace or repair failing systems and/or install nutrient reducing technologies
    - See Community Financing for Septic Management in the Inland Bays Watershed prepared by the Environmental Finance Center January 29, 2008.

Stormwater Management

The funding opportunities to improve stormwater quality in the Bay watershed are tied to several funding sources. The State Revolving Loan Fund (SRF) has recently been utilized for "green projects" of which stormwater is a major component. Recent projects approved for a low interest loan have included a major flood abatement project in Seaford which integrated a water quality component to the project. More projects may seek this funding in an effort to improve community drainage, and a strategy should be employed to assure that a water quality benefit is also a part of the project design.

The state has utilized a special fund named the 21rst Century Resource Conservation and Development (RCD) fund to finance major and minor flooding and drainage projects throughout the state for the past 16 years. While these funds are limited, there should be a concerted effort to integrate water quality management in a retro-fit manner into projects funded through this revenue stream.

State cost share funds if enhanced, could be made available for funding more urban projects with a demonstrated water quality benefit in the future. These funds are made available to landowners and could be expanded to include municipalities with a plan for identifying and implementing water quality practices. The Financial Assistance Branch (FAB) of DNREC through the leadership of the Clean Water Advisory Council (CWAC) is developing a program to deliver funding to municipalities through Stormwater Planning Grants which would require that priority water quality goals be met. In addition, the CWAC and FAB have developed funding through community water quality grants that serve to improve water quality through matching grants.

Other grant funding through Section 319 Grants as well as direct grant funds through the Chesapeake Bay Program and other sources such as National Fish and Wildlife Federation will be used within the watershed, although most of these funds in the past have not been used in the urban corridors. This strategy is changing and more funding in the future will be directed toward the developed portion of the landscape.

The Department will also aggressively seek additional funding and work with the towns, municipalities and the Conservation Districts to identify resources and utilize them to the extent possible to meet the growing demands for funding stormwater source reduction strategies and retro-fits within the Bay watershed.

- GIS data management and system upgrades. (CBRAP 2010)
- Revised regulations for industrial storm water management (CBRAP 2010)
- New and revised technical standards for management practices. (CBRAP 2010)
- Additional training program for staff, permittee, and system owners and operators. (CBRAP 2010)
- Outreach to system owners and operators regarding new requirements.
- Additional maintenance inspections on storm water facilities in Kent and Sussex Counties.(CBRAP 2010)
- Staff to conduct increased number of compliance inspections and enforcement (CBRAP)
- Urban retrofits inventory (NFWF 2010)
- Municipal urban storm water retrofit demonstration projects
- Storm water Retrofits: $140 million

Land Use

- Funding to conduct outreach and educational with stakeholders and decision makers regarding land use and planning for the future.
- Planning and implementation funds to implement strategies for effective communication with local governments and stakeholders
- Planning funds to develop a Master Plan for Bridgeville-Seaford-Laurel Corridor.

Agriculture

Realizing a significant boost in funding will be warranted for full implementation of BMPs. Delaware will need to pursue increased funding through State programs such as the State of Delaware Conservation Cost Share Program, Delaware CREP Program, Delaware Nutrient Relocation, Delaware CAFO, and Delaware Nutrient Management Programs. Likewise, it is essential Federal Programs, such as EQIP and the Chesapeake Bay Program Grant, be expanded or re-prioritized within the Chesapeake Bay Watershed to account for additional funding needs. Through the Delaware Conservation Partnership, responsible agencies meet quarterly to discuss issues or targeted or prioritized efforts, needs and funding. The

Partnership is made up of representatives from NRCS, DDA, DNREC, US Fish and Wildlife, the Conservation Districts, Nutrient Planning Companies, and others. An example of recent NRCS funding change that resulted from the Conservation Partnership is an amendment of the EQIP funding of the cover crop cost share program to an annual contract rather than through a three year contract. This simple amendment made the program more attractive to participants and garnered additional interest in 2010 cover crop planting. Through the Conservation Partnership, additional resources will be pursued to accommodate the increased goal of BMP implementation within the Chesapeake Watershed as highlighted within this document.

As additional funding needs will certainly be warranted, private grants and/or exploratory grants will be additionally pursued. Lastly, to accommodate easier land owner participation by Private Landowners, the State of Delaware, Revolving Loan Fund Program should be review and expanded to allow additional BMP funding as applicable.

Table 44: Summary of Current Agriculture Funding Sources and Future Need By Grant Program

Program	Chesapeake Bay Annual Budget (2009)	Funding Needs
9.1.1.2 Nutrient Planning Program	$172,436	
9.1.1.3 Nutrient Relocation Program	$286,529	Yes
9.1.1.4 Kent County Conservation District Cost Share	$287,856	$425,000
9.1.3 Sussex Conservation District Cost Share Program	$805,411	$3,164,701
9.1.4 New Castle Conservation District Cost Share Program	$150,000	Yes
9.1.5 Agriculture Management Assistance Program	$60,000	
9.1.6 Wetland Reserve Program	$215,000	
9.1.7 Wildlife Habitat Incentives Program	$100,000	
9.1.8 Environmental Quality Incentives Program (EQIP)	$1,787,055	
9.1.9 Chesapeake Bay Watershed Initiative (CBWI)	$1,020,093	$3,880,665
9.1.10 Delaware Conservation Reserve Enhancement Program (CREP)	$93,347	
9.1.11 Conservation Reserve Program (CRP)		
TOTAL	$4,692,013	$7,470,366

- Implementation and administration of CAFO Program, including staff to conduct compliance inspections and monitoring and permit review. Funding from the 2010 CBRAP has been provide to hire a temporary staff person to assist with this program, however additional funds will be needed for long term implementation.
- Expand Farm Land Preservation Program
- Outreach for the Amish community
- Data on animal counts and animal feeding operations
- Improved data management system

Table 45: Summary of BMP Funding Needs for Increased Implementation of Agriculture Practices to Achieve TMDL

BMPS: PRIVATE LANDS	Funding Needed for Full Implementation	Funding Mechanism
Traditional Cover Crops	$1,002,000-2,004,000 annually	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Commodity Cover Crops	$922,775 - $1,318,250	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Nutrient Management Compliance	TBD	Regulatory
Soil Conservation and Water Quality Plans	$0	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Conservation Tillage	$3,279,770	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Continuous No-Tillage Conservation	$1,446,360	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Decision/Precision Agriculture	$2,936,430	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Livestock Waste Structures	$2,310,000	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Water Control Structures	$75,000	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Stream Protection With Fencing	$3,000	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Stream Protection Without Fencing	$227,500	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Upland Prescribed Grazing		Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Manure Relocation	$478,470	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Poultry Waste Structures	$7,534,395	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP

		Funding.
Runoff Control Systems	$1,344,000	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Mortality Composters	$1,217,712	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Large Animal Mortality Program	$840,000	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Streamside Grass Buffers	$538,904	Cost Share through CREP
Streamside Forest Buffers	$2,958,318	Cost Share through CREP
Wetland Restoration	$3,209,968	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Shoreline Erosion Control		Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Retire Highly Erodible Lands		Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Land Retirement		Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Forest Harvesting Practices		Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
SUBTOTAL	$30,324,602	
BMPS: PUBLIC LANDS		
Tree Planting	$43,200	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Wetlands Restoration	$25,530	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Streamside Forested Buffers	$12,750	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Streamside Grass Buffers	$22,500	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
Ag Strategies on DNREC/DDA		Cost-Share State Conservation Cost

Lands		Share, Farm Bill Programs, EPA /CBP Funding.
Natural Filters on Other Public Lands	$225,000	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
SUBTOTAL	$328,980	
NEW FARMING PRACTICES		
CAFO Setbacks		Regulatory
Cropland Irrigation Management		Private
Vegetative Environmental Buffers	$600,000	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding. Delmarva Poultry Industry, Inc.
Streamside/Tax Ditch Restoration	$1,762,500	Cost-Share State Conservation Cost Share, Farm Bill Programs, EPA /CBP Funding.
SUBTOTAL	$2,362,500	
EVOLVING PRACTICES		
Phosphorus-sorbing materials		Private or Exploratory Grants
In-house poultry ammonia emission control		Private or Exploratory Grants
Agronomic Improvements		Private
Voluntary Practices		Private
Carbon Sequestration/Alternative Crops		Private or exploratory grants
Alternative Use of Manure		Private or exploratory grants
Revised Phosphorus Index for Nutrient Management Planning		Private or Exploratory Grants
Dairy Manure Incorporation technology		Private or Exploratory Grants
Poultry manure incorporation technology		Private or Exploratory Grants
Windrowing		Private or Exploratory Grants
Poultry House Remediation		Private or Exploratory Grants
TOTAL COST SHARE REQUIRED TO ACHIEVE 2025 GOALS	$33,016,082* (2010)	COST SHARE DOLLARS
*Costs for some practices are currently unknown.		

Restoration

- Revamped tracking database for ecological restoration projects.
- Cost Share Funding for on the ground restoration for private landowners
- Restoration of channelized streams and wetlands (2010 NFWF grant)

16.3. Economic Value

The University of Delaware's Water Resources Agency is developing a report documenting the socioeconomic value of the Chesapeake Bay Watershed in Delaware including the direct market value of goods and services provided by the Chesapeake Bay watershed, the value of ecosystem services provided by the watershed's environmental resources in Delaware, and a summary of the 2010 economic activity in Delaware. The draft report is available as Appendix I to this WIP.

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7103 Guidance and Regulations Governing the Land Treatment of Wastes:
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Surface Water Discharges Section: Board of Certification for Wastewater Operators:
http://www.wr.dnrec.delaware.gov/Services/OtherServices/Pages/SurfaceWaterDischargesLicensing.aspx

Groundwater Discharge Section:
http://www.wr.dnrec.delaware.gov/Services/Pages/GroundWaterDischarges.aspx

Delaware Code, Ch. 60, Title 7: http://delcode.delaware.gov/title7/c060/sc02/index.shtml

Simply Septics: http://www.dnrec.state.de.us/water2000/Sections/Watershed/ws/simplyseptic2006web.pdf

Regulations Governing On-Site Wastewater Treatment and Disposal Systems:
http://www.wr.dnrec.delaware.gov/INFORMATION/GWDINFO/Pages/Regulations%20Governing%20On-Site%20Wastewater%20Treatment%20And%20Disposal%20Systems.aspx

Groundwater Discharges Section:
http://www.wr.dnrec.delaware.gov/Services/Pages/GroundWaterDischarges.aspx

Groundwater Discharges Section: Regulations:
http://www.wr.dnrec.delaware.gov/Information/regulations/Pages/GroundWaterDischargesRegulations.aspx

ICIS: http://www.epa.gov/compliance/data/systems/icis/index.html

Green Technology:
http://www.dnrec.state.de.us/DNREC2000/Divisions/Soil/Stormwater/PDF/Green%20Technology.pdf

Sediment and Stormwater Reductions: http://regulations.delaware.gov/AdminCode/title7/5000/5101.shtml

Planned Revision to Reductions:
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Sussex County Conservation District: http://sussexconservation.org/index.htm

New Castle Country Conservation District: http://newcastleconservationdistrict.org/

Nutrient Management: http://dda.delaware.gov/nutrients/index.shtml

Nutrient Management Relocation:
http://dda.delaware.gov/nutrients/forms/2008/081208_NMRPGuidelinesREV.pdf

Agriculture Week: http://www.rec.udel.edu/AgWeek/home.htm

Tax Ditch Channels: http://www.swc.dnrec.delaware.gov/Drainage/Pages/TaxDitches.aspx

ACRONYMS AND ABBREVIATIONS

Acronym	Meaning
AFO	Animal Feeding Operation
AMA	Agricultural Management Assistance
BAT	Best Available Technology
BMP	Best Management Practice
BNR	Biological Nutrient Removal
CAFO	Concentrated Animal Feeding Operation
CBP	Chesapeake Bay Program
CBWI	Chesapeake Bay Watershed Initiative
CGP	Construction General Permit
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CWA	Clean Water Act
DDA	Delaware Department of Agriculture
DELIP	Delaware Landowner Incentive Program
DelDOT	Delaware Department of Transportation
DMR	Discharge Monitoring Regulations
DNMC	Delaware Nutrient Management Commission
DNREC	Department of Natural Resources and Environmental Control
DOSPC	Delaware Office of State Planning Coordination
ENR	Ecological Nutrient Removal
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ERES	Exceptional Recreational or Ecological Significance
FWS	Fish and Wildlife Services
GTBMP	Green Technology Best Management Practice
GWDS	Ground Water Discharge Section
ICIS	Integrated Compliance Information System
KCD	Kent Conservation District
LA	Load Allocations
MOS	Margin of Safety
MS4s	Municipal Separate Storm Sewer Systems
NACDNET	National Association of Conservation Districts
NCCD	New Castle Conservation District
NCCDE	New Castle County
NEIEN	National Environmental Information Exchange Network

NMA	Nutrient Management Act
NMC	Nutrient Management Commission
NML	Nutrient Management Law
NMP	Nutrient Management Plan
NPDES	Nonpoint Discharge Elimination System
NPS	Nonpoint Source Pollution
NRCS	Natural Resources Conservation Districts
NOV	Notice of Violation
OMB	Office of Management and Budget
OWTDS	Onsite Wastewater Treatment Disposal Systems
PCS	Pollution Control Strategy
PLUS	Preliminary Land Use Service
PS	Point Source Pollution
R&A Grant	Regulatory and Accountability Grant
SGCN	Species of Greatest Conservation Needs
SCD	Sussex Conservation District
STP	Sewage Treatment Plant
SWDS	Storm Water Discharge Section
SWQS	Surface Water Quality Standards
TAT	Tributary Action Team
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorous
TSS	Total Suspended Solid
USDA	United States Department of Agriculture
USFWS	U.S. Fish and Wildlife Services
WHIP	Wildlife Habitat Incentive Program
WIP	Watershed Implementation Plan
WRP	Wetland Reserve Program
WLA	Waste Load Allocation
WQS	Water Quality Standard
WWTP	Wastewater Treatment Plant

APPENDICES

Appendix A – Public Talk, Real Choices, Real Strategies

Appendix B – Interagency Workgroup and Subcommittee Members

Appendix C - Delaware's Nonpoint Source Best Management Practice Implementation Data Quality Assurance Project Plan

Appendix D – Seaford's Washington Street Stormwater Retrofit Project

Appendix E – DRAFT – The Modeling of Land Use Activities within the Delaware Segment of the Chesapeake Bay Watershed

Appendix F – Scope of Work: Modifying Delaware's Nutrient Budget Protocol for Use as an Offset Tracking Tool in the Chesapeake Bay Watershed

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Appendix H – Nutrient Management Annual Report Form for the Choptank Watershed

Appendix I – DRAFT – Progress Report – Socioeconomic Value of the Chesapeake Bay Watershed in Delaware

APPENDIX A

Public Talk – Real Choices: A Model for Public Engagement in Creating Pollution Control Strategies

Bill McGowan[1], Joe Farrell[2], Ed Lewandowski[3], Kathy Bunting-Howarth[4], Lyle Jones[5]

Introduction

Public issues are complex, 'wicked' problems. Poverty, education, land-use, environment and others are issues not easily resolved. Delaware for example is a national leader in welfare reform, education reform, land use legislation and the environment but those close to these issues know the reforms are stalled locally and nationally. Why? We believe a lack of public engagement in creating public policy is a fundamental reason. We have become a technocratic society, resulting in the public abdicating it's role as participants in creating public policy to a bureaucracy. It is generally accepted by both parties, the public and bureaucracy, that the public does "not have the capacity" to work through complex issues. It is incumbent on those who work with the public to create a better way to engage the public in creating sustainable public policy.

A Common Model for Public Engagement

One model found frequently when public agencies need public input is the "workshop" model. The model begins with a selection of a small group of people, a citizens advisory committee or "blue ribbon" panel. The group, usually with the help of the public agency, goes through an education process, writes a report, and delivers it to the agency. The agency holds "tell and sell" workshops, followed by public hearings and possible promulgation of regulation. The model more often than not fails to give the public a significant chance to participate in policy formation, resulting in disillusionment, and failed policy. Both the public and public agencies need and deserve a better way to work together that produces sustainable decisions.

A Preliminary Approach

Losing Ground: What Will We Do About Delaware's Changing Landscape? A series of issue forums or public conversations, throughout the state in 1996, introduced deliberative dialogue to 340 Delawareans. Deliberative Dialogue is a conversation in which people, the public, weigh the cost and consequences of their thinking and make choices based on their deliberations. It was the first time for many where in a public meeting citizens had the opportunity to both listen and talk to each other in an environment conducive to learning. It was not a public hearing where comments are taken for the record or workshop with information presented by experts. Comments after the forums indicated citizens would come out and discuss issues of importance, people want a way to engage issues personally, and will engage each other in questioning and learning. The results of *Losing Ground* appear to indicate the public wants a better model to engage public issues. It is from the conversations heard from citizens that participated in *Losing Ground* that the model *Public Talk – Real Choices* emerged.

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Why Develop Another Model?

Two major citizen efforts assisted by DNREC, the Inland Bays Monitoring Committee and the Citizens Advisory Committee of the National Estuary Program, produced action plans for restoration of the Inland Bays. The plans are very similar to each other, in fact a matrix of the two plans attempts to avoid duplication of effort (CCMP, 1995). Citizens spent over nine years of work between the two plans. Both plans emerged from a visioning model asking the questions "What do we want the Bays to look like?" and "How can we get there?" The action plans are broad recommendations that lack specific suggestions for implementation. There remains a tremendous amount of frustration from citizens who have engaged in one or the other or both of the Bay protection efforts (Citizen Advisory Committee Minutes, 1997) and the public agency, DNREC, whose mission is to preserve and protect the natural resources of Delaware. Both parties want the same thing, healthy bays, and still there is no solution or commitment.

A Caveat

There is a difference between then and now and that is TMDL's are regulations. Both the Inland Bays Monitoring Committee and the National Estuary Program were voluntary. The regulatory community can argue TMDL's are promulgated regulation that demand action through pollution control strategies. That is true to a point. The State met the requirement of the settlement by establishing the TMDL's for the watershed. The pollution control strategies are self-imposed requirements. Without significant public engagement in creating strategies that potentially impact all residents in the watershed, the strategies will die in the political arena. By taking time on the front end, and working through a truly public process, the State stands to gain more in the end product of a sustainable public policy.

The Model: Public Talk – Real Choices

The purpose of *Public Talk – Real Choices* is to move formulation and creation of a major public policy decision from a public agency to the public for dialogue and deliberation. *Public Talk – Real Choices* builds on what happened in *Losing Ground* forums. Using deliberative dialogue as the core, *Public Talk* goes further by engaging the public in learning about the issue, weighing the costs and consequences of what is important through dialogue with each other, and coming to public judgment. The model consists of six steps; Organization of Work Team, Education, Issue Framing, Evaluation of the Issue Framework, Public Forums/Choice Work, Recommendations.

Model Components

Organization - is a structural component that brings the public agency and public, the work team, into agreement as to what needs to be accomplished. Without preliminary understanding and agreement by both parties, the effort will fail. **Education -** further enhances this arrangement by building upon the knowledge of the process shared in the organizational discussions and then adding information necessary to frame the issue. A good portion of technical information will come from the public agency e.g. the Inland Bays Whole Basin Assessment Report.

Issue framing - is the critical piece necessary for public engagement. Issue framing lays out in an organized fashion for public consumption three or four choices. The framework must be unbiased, represent the under girding values embedded in policy choices and articulate the basic costs and consequences of the choices. It should represent the voices of all impacted by the issue.

The framework sets the stage for our conflicting motives – those things we consider valuable and that pull us in different directions when we have to decide

how to act. The issues need to be stated in ways that compel the public to make their views known.

Evaluation of the Framework - This piece gives insight into how successfully the teams framed the issue. The use internal deliberation, focus groups, etc. enhances the success of the framework. For successful public deliberation all voices need to heard within the framework. The choices must be neutral and offer a positive approach for issue resolution.

Public deliberation - is the cornerstone *of Public Talk – Real Choices*. A significant representation of the public must deliberate the issue. This occurs through successful planning and selection of venues for forums. The forums must result in some form of common ground for action.

Recommendations - The work teams sift through and analyses the public voice they heard from the forums. From this public voice the work team develops the pollution control strategies.

Why This Model?

National Issues Forums

National Issues forums are "town meetings" that bring people together to deliberate "wicked problems," problems that won't go away, with the help of moderator. The medical analogy of a broken arm versus diabetes describes wicked problems. The broken arm can be set and heals. Diabetes requires life -changing alterations. Participants use an issue book that offers three to four choices for resolution. Within the choices are basic values, cost and consequences of the choice. With the help of a moderator the public works through the choices, by looking at four things: What is valuable? What are the costs and consequences of the choice? Where is the tension? Where is there common ground for action? Participants must consider "It's not what I want to do but what we ought to do."

Why Are These Models Effective?

The Harwood Group in a report *Meaningful Chaos- How People Form Relationships with Public Concerns*, found nine factors necessary for public engagement.

Connections – People tend to enlarge rather than narrow their views of public concerns, making connections among ideas and topics that society tends to fragment.

Personal Context – People relate to concerns that "fit" with their personal context, moving beyond self-interest to what is meaningful

Coherence – People want to hear the whole story. They want to understand what it means.

Room for Ambivalence – People do not immediately see black and white. They want a gray area to question, discuss, test ideas, and become comfortable with their opinions.

Emotion – Too many processes try to remove emotion from decisionmaking. Emotions are necessary to sustain relationships with public concerns.

Authenticity – People and information must "ring true".

Sense of Possibilities – People really want something to happen and they might play a role in it.

Catalysts – Everyday people, not just experts and elite, are critical in helping people form relationships with public issues.

Mediating Institutions – Places where people come together to talk and act on public concerns. (Harwood, 1993)

National Issues Forums and *Public Talk – Real Choices* adhere to these tenets.

The Facilitator Team

Public Talk – Real Choices uses a neutral, third party facilitator. By using a neutral, third party as the facilitator, the facilitator becomes an advocate for the process (Kaner, 1996). Third party facilitation avoids the perception of bias that can occur when the facilitator is personally associated with the issue.

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Appendix B

Appendix B

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Appendix C

Appendix C

STATE OF DELAWARE

NONPOINT SOURCE BEST MANAGEMENT PRACTICE IMPLEMENTATION DATA

QUALITY ASSURANCE PROJECT PLAN

January 2008

Delaware Department of Natural Resources and Environmental Control
Division of Water Resources
Watershed Assessment Section
820 Silver Lake Boulevard, Suite 220
Dover, DE 19904-2464
302-739-9939

State of Delaware
Nonpoint Source Best Management Practice Implementation Data
Quality Assurance Project Plan

Group A – Project Management

A1 – Title and Approval Sheet

Plan Coverage: This *Nonpoint Source BMP Implementation Data Quality Assurance Project Plan* reflects the overall Quality Assurance Program framework and management systems necessary to assure that data reported by the Delaware Department of Natural Resources and Environmental Control-Division of Water Resources-Watershed Assessment Section (DNREC-DWR-WAS) are of acceptable quality to meet the needs of the United States Environmental Protection Agency's Chesapeake Bay Program Office (EPA-CBPO).

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Name: John Schneider
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Appendix C

A3 – Distribution List

This document is being provided to the following:

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Mary Ellen Ley, USGS / EPA-CBPO, Quality Assurance Coordinator
Terry Simpson, EPA Region 3, Regional Quality Assurance Manager
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Mike Sistek, City of Newark, Stormwater BMPs
Kelley Dinsmore, City of Newark, Stormwater BMPs
Morris Deputy, Town of Middletown, Stormwater BMPs
Jared Atkins, Kent Conservation District, *Stormwater BMP Data Provider*
Jessica Watson, Sussex Conservation District, Stormwater BMPs

A4 – Project / Task Organization

Best management practices (BMPs) to reduce nonpoint source (NPS) pollution are funded and installed by numerous federal, state, local, and private agencies within Delaware including the Department of Natural Resources and Environmental Control (DNREC), the Department of Agriculture, the Natural Resource Conservation Service (NRCS), three county Conservation Districts, counties and towns, and the Perdue AgriRecycle facility. The BMP data that is generated is maintained and undergoes quality assurance procedures by the implementing organization, which includes spot checks of installed BMPs.

Data is aggregated from these multiple groups and reported to funding agencies for tracking purposes. The Chesapeake Bay Program (CBP) Implementation Grant Manager compiles and organizes the data, serves as an independent quality assurance manager, and develops and maintains the official, approved Quality Assurance Project Plan (QAPP) covering all programs receiving funds from the CBP Implementation Grant. In addition, the CBP Implementation Grant Manager prepares and submits semi-annual reports to the EPA-Chesapeake Bay Program Office (CBPO) for inclusion in watershed model runs of progress towards reaching restoration goals. An organization chart showing reporting and quality assurance responsibilities is provided in Figure 1.

A5 – Problem Definition and Background

The tracking, reporting, and quality assurance of NPS BMPs are requirements of the Delaware CBP Implementation Grant from the EPA-CBPO. Data is provided to EPA-CBPO for inclusion in watershed model progress evaluations on or before July 15th and December 31st of each year or as otherwise stipulated in the grant documents.

Since this work involves the acquisition of environmental data generated from direct measurement activities, data collected from other sources, and data compiled from computerized information databases and systems, an approved QAPP must be in place. This technical document of quality assurance and control procedures and specifications serves as the QAPP in accordance with 40 CFR 30.54 and 31.45. This QAPP will support the quality of the data behind the CBP's annual *Restoration Assessment for Reducing Pollution*, will allow the EPA-CBPO to understand the sources of NPS BMP data and any analyses done by jurisdictions prior to submission to the EPA-CBPO, and will assist the EPA-CBPO in preparing for possible future scrutiny of all watershed model inputs under a Chesapeake Bay Total Maximum Daily Load (TMDL).

A6 – Project / Task Description

Data regarding the implementation of NPS BMPs are compiled in order to assess progress toward reaching water quality goals, which includes both State of Delaware prescribed TMDL reductions for nutrients and bacteria as well as CBP restoration goals for nutrients and sediment. Implementation is ongoing and data is reported to the EPA-CBPO semi-annually (on or before July 15th and December 31st each year) to reflect recent implementation activities. A full description of the quality assurance activities performed on these data sets is included in the following sections and this QAPP will be updated annually (on or before December 31st) to reflect any changes to field, sample handling and storage, laboratory, quality control, or data management activities.

A7 – Quality Objectives and Criteria

Details regarding the quality of the NPS BMP data reported by the DNREC-DWR-WAS to the EPA-CBPO for use in watershed modeling to estimate restoration

progress are contained in the following sections. All efforts have been made to produce data that is comparable to data collected previously and currently by other Chesapeake Bay Program grant recipients and partners.

A8 – Special Training / Certification

Any special training or certification required to implement or inspect NPS BMPs is determined and overseen by the implementing organization. Individuals involved with NPS BMP data management and data quality assurance and control procedures are not required to have any special training or certification, however in order to perform these functions effectively, training in spreadsheets, databases, and geographic information systems (GIS) may be necessary. Due to privacy concerns, BMP implementing organizations determine who may have clearance to complete data sets and in some situations restrict the transfer of personal and locational information.

A9 – Documents and Records

Implementing organizations will maintain NPS BMP data sets. Data included in EPA-CBPO semi-annual reports will be retained electronically and in paper format by the DNREC-DWR-WAS in perpetuity. The DNREC-DWR-WAS will send the QAPP electronically to all individuals on the distribution list (A3) on or before November 15th each year for annual review and comment. Any edits to reflect changes in status or procedure will be incorporated into the final document submitted to the EPA-CBPO on or before December 30th each year. The final, EPA-CBPO approved QAPP will be electronically distributed to the same individuals and will be retained in both electronic and paper format in perpetuity by the DNREC-DWR-WAS.

Group B – Data Generation and Acquisition

Sections B1 through B8 of this QAPP are not directly applicable to NPS BMP data tracking and reporting. Situations where implementing organizations generate data through sampling to answer research questions do occur. For example, soil samples are taken during the development of a nutrient management plan to determine appropriate fertilizer and manure application rates. Likewise, manure is sampled to determine nutrient content. In addition, samples may be taken to determine the performance level of a BMP, such as taking effluent samples from alternative and innovative onsite wastewater treatment and disposal systems. Details regarding any sampling protocols related to NPS BMPs will be incorporated in future versions of this QAPP.

B1 – Sampling Process Design (Experimental Design)

B2 – Sampling Methods

B3 – Sample Handling and Custody

B4 – Analytical Methods

B5 – Quality Control

B6 – Instrument / Equipment Testing, Inspection, and Maintenance

B7 – Instrument / Equipment Calibration and Frequency

B8 – Inspection / Acceptance of Supplies and Consumables

B9 – Non-direct Measurements

DNREC's Watershed Assessment Section obtains NPS BMP tracking data from both internal and external sources (See Figure 1), which are then reported to the EPA-CBPO for inclusion in model scenario runs. BMP data associated with stormwater fall

under the prevue of the nine delegated agencies under DNREC's Division of Soil and Water Conservation - Sediment and Stormwater Program. BMPs associated with wastewater treatment are implemented, tracked, and reported by DNREC's Division of Water Resources - Groundwater Discharges Section. BMP data associated with agriculture are implemented, tracked, and/or maintained by multiple agencies including the NRCS, DNREC's 319 Program, Delaware Department of Agriculture, the three county Conservation Districts, and the Perdue Agrirecycle company.

In the spring of 2007, DNREC's Divisions of Water Resources and Soil and Water Conservation contracted with URS Corporation to conduct an assessment of BMP data collection activities across the state. The resulting report, which summarizes the points of contact, type of BMP data maintained by each agency, data storage structures, data sharing limitations, and supporting software, can be found in Appendix A. The implementing agencies described in Appendix A are responsible for ensuring delivery of quality data and the independent Quality Assurance Manager reviews all data to ensure BMP reported levels reasonably reflect on-the-ground conditions.

B10 – Data Management

Currently, BMP data is requested on a semi-annual or more frequent basis from numerous agencies that implement, track, and/or maintain this type of data in the stormwater, wastewater, and agriculture-related sectors. Figure 1 depicts BMP data reporting and quality assurance responsibilities. The majority of data submitted to DNREC-DWR-WAS is done electronically in Excel spreadsheets, however, paper copies are occasionally submitted from reporting agencies. The Quality Assurance Manager reviews all data for reasonableness and errors and compiles BMP

implementation levels from all reporting agencies into a single Excel document, which is submitted to the EPA-CBPO on a semi-annual basis.

This current reporting procedure is inconvenient and time consuming for all involved and in order to improve accuracy and efficiency, the DNREC-DWR-WAS plans to develop an integrated BMP database and reporting system so that data can be directly reported to the EPA-CBPO through a network node. The inquiry to gather background information on BMP data conducted by URS Corporation (Appendix A) is the first step of this process. The DNREC-DWR-WAS has consulted with staff from the Pennsylvania Department of Environmental Protection and will review the schema that is currently in use by Maryland, Pennsylvania, and Virginia. Following this review, any modifications to the schema to fit Delaware's needs will be made and the DNREC-DWR-WAS will begin working with BMP implementing organizations to refine their data collection and reporting procedures to easily fit into the established schema.

Group C – Assessment and Oversight

C1 – Assessments and Response Actions

A variety of assessments are performed on the NPS BMP data that is reported to the EPA-CBPO for inclusion in model scenario runs. Depending on the type of BMP, field assessments may be performed and implementing organizations are responsible for ensuring that reported BMPs have indeed been installed. Procedures are in place for verifying implementation when cost share or permits are involved. In some situations though, adequate staff and resources are not available to inspect the upkeep and maintenance of long-term BMPs, such as stormwater ponds, on a regular basis and inspections may only occur if a problem is reported. Inspection frequencies can be found in Appendix A. If a BMP is found to be unsatisfactorily installed or maintained, cost share funds may be recouped if the BMP is not brought into compliance. In addition to field inspections, BMP data is regularly assessed by the Quality Assurance Manager to determine status and trends. This analysis will review any anomalies, errors, or questionable levels of implementation.

C2 – Reports to Management

Status and trends assessments of BMP implementation levels by the Quality Assurance Manager are done semi-annually as data is submitted, prepared, and reported to the EPA-CBPO. If anomalies, errors, or questionable levels of implementation are suspected, the Quality Assurance Manager will work directly with implementing organizations to verify and validate reported data.

Group D – Data Validation and Usability

D1 – Data Review, Verification, and Validation

It is the responsibility of the implementing organization to verify that all data reported to the DNREC-DWR-WAS is complete, correct, and complies with all rules and policies of that organization. The independent Quality Assurance Manager conducts an additional review of compiled NPS BMP data for completeness, anomalies, errors, or questionable levels of implementation through a status and trends evaluation as a validation procedure.

D2 – Verification and Validation Methods

During the Quality Assurance Manager's validation procedure, implementation levels over time and implementation rates in relation to the availability of funds will be evaluated. If implementation levels do not show an increase over time or match the level of funds invested, this may suggest that an error or change in reporting procedure has occurred and requires rectifying. The Quality Assurance Manager will work directly with the implementing organization to review raw data and their verification procedures to ensure complete and accurate data.

D3 – Reconciliation with User Requirements

The collection, tracking, and reporting of NPS BMP data is done to assess progress toward reaching water quality goals, including both State of Delaware prescribed TMDL reductions for nutrients and bacteria as well as CBP restoration goals for nutrients and sediment. The data is ultimately used in watershed and water quality models to project progress toward meeting goals to inform decision makers, so it is imperative that data is collected and reported in a usable format.

Appendix C

Uncertainties in the data likely do exist and may result from input errors, inconsistent data input and management procedures, and uncoordinated reporting requirements. One example of data uncertainty is that there is currently no procedure in place to remove agriculture BMPs from records when a farm parcel is developed, which may result in the same parcel receiving additional reduction credits for stormwater or wastewater practices. The creation of an integrated database and reporting system, based on the schema developed by Maryland, Pennsylvania, and Virginia, should minimize and/or eliminate many of these uncertainties. This type of system with agreed upon data entry fields will minimize data entry errors, standardize data input and management procedures, and unify reporting from multiple agencies.

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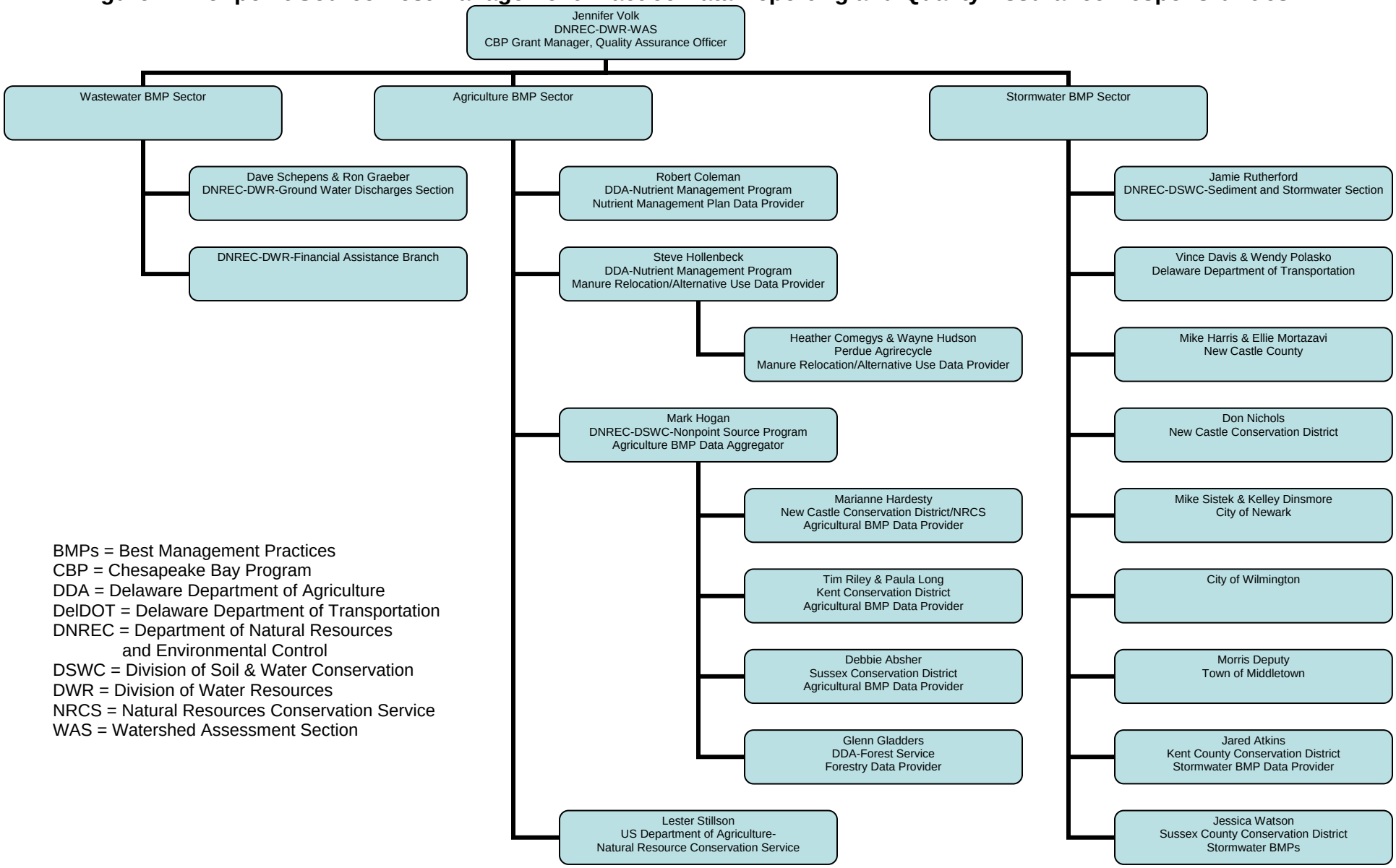
Appendix C

Figure 1. Nonpoint Source Best Management Practice Data Reporting and Quality Assurance Responsibilities

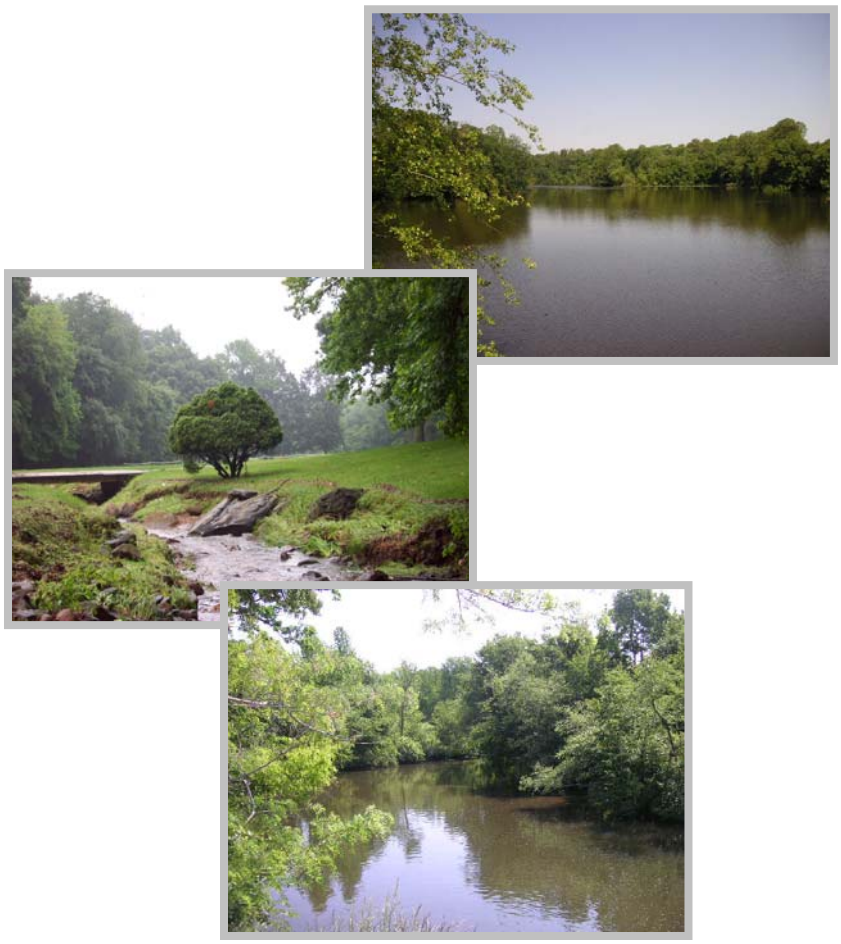


BMPs = Best Management Practices
CBP = Chesapeake Bay Program
DDA = Delaware Department of Agriculture
DelDOT = Delaware Department of Transportation
DNREC = Department of Natural Resources and Environmental Control
DSWC = Division of Soil & Water Conservation
DWR = Division of Water Resources
NRCS = Natural Resources Conservation Service
WAS = Watershed Assessment Section

Appendix C1

REPORT

DELAWARE STATEWIDE BEST MANAGEMENT PRACTICES DATABASE ASSESSMENT



- Division of Soil & Water Conservation
- Division of Water Resources

URS

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January 25, 2008

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APPENDICES

1. Interview Questionnaire
2. Interview Summaries

In the spring of 2007, URS was contracted by the Delaware Department of Natural Resources and Environmental Control (DNREC) to perform an assessment of Best Management Practice (BMP) data collection throughout the state. The objective of the assessment was to determine how best to combine statewide BMP data into a single system that could be used within DNREC, and possibly externally to assist in the tracking and maintenance of BMPs. The project initially began with the Division of Soil and Water Conservation, and was soon expanded to include the Division of Water Resources. While this effort involved two separate contracts, the results are presented in this joint report due to the similarities between the two efforts.

During the summer and early fall of 2007, URS met with Delegated Agencies of the Division of Soil and Water Conservation and organizations that report BMP information to the Division of Water Resources. A standard questionnaire was used during each interview (Appendix 1) and results were tabulated in a Microsoft Access database for review and reporting purposes. Focused on the overall objective of the assessment, the questionnaire contained four sections and was designed to achieve the following:

1) Determine the types of BMP information currently collected throughout the state.
2) Determine how BMP information is stored and maintained.
3) Identify restrictions, limitations, and concerns regarding the sharing of data.
4) Identify what hardware and software is currently in use by managers of BMP information.

Interview results from each meeting are contained Appendix 2 of this report. The Points of Contact of the Soil and Water Conservation Delegated Agencies are identified in Table 1. Table 2 identifies the Points of Contact of Reporting Agencies for the Water Resources portion of the project.

In a general sense, BMPs that fall under the oversight of one of the Delegated Agencies of the Division of Soil and Water Conservation tend to be project related and are physical features that can be visited in the field and inspected. These BMPs include, but are not limited to, wet ponds, dry ponds, infiltration trenches / basins, filter strips, bio-retention areas, bio-swales, sand filters, sediment forebays, and check dams. In most cases these BMPs are inspected on a regular basis. The method of data storage does vary significantly from Delegated Agency to Delegated Agency however.

Each Delegated Agency, with the exception of the City of Wilmington, was interviewed. Numerous attempts were made to meet with representatives from the City, however a meeting was unable to be scheduled.

BMPs that fall under the oversight of the Division of Water Resources tend to be programmatic and geographic in nature. These BMPs are less likely to be discrete features that can be located in the field and do not lend themselves to a regular inspection program. Instead, these BMPs consist of the collection and tracking of information regarding the use and condition of lands throughout the state, and lend themselves to the

creation of Geographic Information Systems (GIS) shapefiles. Example BMPs include the tracking of manure management plans, the monitoring of forest preservation plans, and the monitoring of groundwater discharges and agricultural land use.

For purposes of this report, the results of the interview process are presented in two sections, one for the Division of Soil and Water Conservation and one for the Division of Water Resources. While the findings are similar, this format will allow each Division to better assess its BMP data collection process, requirements and needs.

TABLE 1: Points of Contact (Soil and Water Conservation)

Reporting Agency	*POC: Primay* *POC: Secondary*	*Phone: Primary POC* *Phone: Secondary POC*	*Email: Primary POC* *Email: Secondary POC*
City of Newark	Mike Sistek Kelley Dinsmore	(302) 366-7040 (302) 366-7040	pwoperations@newark.de.us kdinsmore@newark.de.us
DelDOT	Vince Davis Wendy Polasko	(302) 760-2180 (302) 760-2542	Vince.Davis@state.de.us Wendy.Polasko@state.de.us
DNREC	Jamie Rutherford	(302) 739-9921	Jamie.Rutherford@state.de.us
Kent Conservation District	Jared Adkins	(302) 741-2600	Jared.adkins@state.de.us
New Castle Conservation District	Don Nichols	(302) 832-3100	N/A
New Castle County	Mike Harris Ellie Mortazavi	(302) 395-5806 (302) 395-5802	MHarris@nccde.org EMortazavi@nccde.org
Sussex Conservation District	Jessica Watson	(302) 856-7219	Jessica.Watson@state.de.us
Town of Middletown	Morris Deputy	(302) 378-9120	mdeputy@middletownde.org

TABLE 2: Points of Contact (Water Resources)

Reporting Agency	POC: Primay POC: Secondary	Phone: Primary POC Phone: Secondary POC	Email: Primary POC Email: Secondary POC
Delaware Department of Agriculture: Forest Service	Glenn Gladders	(302) 698-4553	Glenn.gladders@state.de.us
Delaware Department of Agriculture: Nutrient Mgmnt Comm	Steve Hollenbeck	(302) 698-4500	Steven.hollenbeck@state.de.us
Delaware Department of Agriculture: Nutrient Mgmnt Plans	Bob Coleman	(302) 698-4556	Robert.coleman@state.de.us
DNREC: 319 Program	Mark Hogan	(302) 739-9922	Mark.hogan@state.de.us
DNREC: Coastal Program	Marcia Fox	(302) 739-9282	Marcia.fox@state.de.us
DNREC: Groundwater Discharges	Dave Schepens Ron Graeber	(302) 739-9948 (302) 739-9948	Dave.schepens@state.de.us Ronald.Graeber@state.de.us
Kent Conservation District	Tim Riley Paula Long	(302) 741-2600 (302) 741-2600	Timothy.riley@state.de.us Paula.long@state.de.us
NCCD (NRCS)	Marianne Hardesty	(302) 832-3100	Marianne.hardesty@de.usda.gov
Perdue Agricycle	Heather Comegys Wayne Hudson	(302) 943-2732 (410) 543-3919	Heather.comegys@perdue.com Wayne.hudson@perdue.com
Sussex Conservation District	Debbie Absher	(302) 856-3990	Debbie.Absher@de.nacdnet.net

Division of Soil & Water Conservation

Existing BMP Data

To gain an understanding of the types of BMP data currently collected, Delegated Agencies were asked to describe the types of BMPs that they maintain, whether the BMPs are regularly inspected, and the inspection periodicity. All but two of the Delegated Agencies, the Town of Middletown and the Sussex Conservation District, maintain an inventory of their BMPs. The Town of Middletown has a planner on staff and has set as a goal the development of a BMP inventory. The Sussex Conservation District is currently working with DNREC to develop a project tracking database that will have as a component a BMP inventory.

The type of data collected varies widely and only three of the Delegated Agencies inspect BMPs on a regular basis (typically yearly). DelDOT currently maintains two sets of inspection data. The first (structure) is data that is static, and not expected to change. This includes classification, dimensions, material, etc. The second (inspection) is expected to change over time, and a historical record is maintained.

Historical data provides a valuable history of not only the performance of a BMP but also changes in BMP condition over time. All but three of the Delegated Agencies maintain some from of historical data, however in many cases it is not maintained in an electronic format. The City of Newark for instance stores BMP data in a Microsoft Excel spreadsheet, and only maintains current data in an electronic format. Historical inspection reports are maintained by the City in a paper format. As a comparison, DelDOT stores historical data electronically, and does not overwrite any data.

An inventory, along with historical records, provides valuable data for the assessment of BMP condition and performance; however, this does not provide a complete picture of the individual BMP. Spatial data, combined with photographs, provide a convenient means to locate BMPs and review them without having to go into the field. Spatial data allows an individual to locate a BMP in relation to it's surroundings and better assess the area that it treats. Digital photographs provide a visual record of conditions at the time of inspection and aid in identifying trends in BMP condition and performance over time. Only four of the Delegated Agencies maintain spatial data and photographs. As with other data, there is variation between the Delegated Agencies in how they collect spatial data and tie photos to the overall inventory. DelDOT surveys the perimeter of each BMP while New Castle County, the Kent Conservation District, and the City of Newark survey the outlet of the BMP. Finally, not all inventories have photos directly linked to inspection data.

Table 3 summarizes the data collected by the Delegated Agencies.

Storage, Display and Maintenance of Data

In order to develop a composite BMP database, DNREC must know not only what data is collected, but also how it is stored. In addition, each Delegated Agency is a stakeholder in the BMP data process and will play a role in how the composite database is maintained

and updated. For this reason, attention was paid to the concerns of each Delegated Agency regarding the maintenance of BMP data.

Depending on the Delegated Agency, BMP data is stored in paper format, spreadsheets, one of several database systems, and in one case, Hansen. Only three Delegated Agencies link BMP data to a Graphical User Interface (GUI). In each case, an ESRI software product is used. It is important to note that although different software and database systems are in use, it will be possible to combine all the electronic data into a single database. The key is to have an electronic format, either as a database, spreadsheet or shapefile to allow for the conversion of data.

The final format of a composite BMP system will impact how data is maintained by the individual Delgated Agencies. When asked their preference for data maintenance (in-house or by an outside entity) there was near unanimous agreement that data should be maintained and updated locally and then forwarded to DNREC for inclusion in the composite BMP system. The two main concerns are network security and data integrity. Each Delegated Agency maintains their own computer network and from a security perspective would not be willing allow outside entities access. In addition, each Delegated Agency feels that they have the greatest understanding of their BMPs and inspection processes and thus prefer to maintain control of their data. There was little hesitation in terms of providing DNREC with periodic data updates for a composite BMP database.

Table 4 summarizes the storage, display and maintenance of BMP data.

Data Sharing

There is little concern among the Delegated Agencies about sharing Soil and Water Conservation BMP data. While some feel that a Freedom of Information Act (FOIA) request might be needed, the only real limitation is the resources needed to pull data together. There was some concern that the size of files, especially if digital photographs are included, could pose a problem with data transfer. There are a variety of alternatives available for the transfer of large data files, thus it is not likely that this will be a problem.

When asked how they envision shared BMP data in a composite system being used, a variety of items were mentioned including:

- A planning tool to help determine maintenance needs
- Support of watershed assessments
- PCS / TMDL development
- A tool to help monitor and assess BMP performance, and what other areas are doing

Table 5 summarizes the perceived issues involved with the sharing of BMP data.

Hardware and Software

Although the Division of Soil and Water Conservation initially intends to use the composite BMP database for internal purposes only, the possibility of it being made available to the Delegated Agencies does exist. In addition, the Delegated Agencies will be tasked with provided data updates to the composite system on a regular basis. For this reason, it is important to have an understanding of the comfort level each stakeholder has with key software and the IT resources that they have in place. The final portion of the interview focused on these areas and the results are summarized in Table 6.

Recommendations

BMP data collected by Delegated Agencies of the Division of Soil and Water relates to a common set of structures that are located in the field. For this reason, it will be beneficial to standardize data collection, processing and reporting. During the interview process it became apparent that specific guidance from DNREC would be desirable. This guidance would help to ensure that common data is collected allowing BMPs data collected and maintained by different Delegated Agencies to be compared and displayed in a common format.

To achieve this, the following steps should be taken:

1. *Develop a standard set of inspection forms to be used by each Delegated Agency.*
2. *Standardize the method by which photographs and spatial data is collected.*
3. *Develop a standard format for the storage of BMP data.*
4. *Develop a standard export format for BMP data to allow easy assimilation into the composite database.*

Each step is discussed in greater detail below.

1. *Develop a standard set of inspection forms to be used by each Delegated Agency.*

The nine Delegated Agencies all have the same requirements in terms of BMP maintenance and data collection. There is, however, a significant variation in the way each has chosen to implement their individual BMP monitoring program. In order to bring data from each Delegated Agency together it will have to be standardized. Not only does each need to look at a given BMP and ask the same questions, the answer needs to be standardized as well. The development of a standard set of BMP inspection forms will accomplish this.

Many of the Delegated Agencies have developed inspection forms that they are comfortable working with. While they do vary from one another, there is commonality which should be used as a starting point in the development of a common inspection form. By starting with existing forms, not only will changes be minimized, but the best aspects of each can be maintained and the individual Delegated Agencies will be more involved in the process and thus be able to add the value of their own experiences.

In addition to the different forms currently in use, there are differences in the depth of inspection. The development of a common inspection form implies the establishment of a minimum standard for inspection. While it is important to establish inspection requirements, it may not be reasonably feasible to achieve them right away. It would be reasonable to set an inspection standard, with a regular periodicity, and expect that the required level of data be collected within one inspection cycle. As an example the inclusion of the specific watershed that a BMP resides in could be accomplished over the next inspection cycle. Additional data, such as the drainage area served by a BMP should also be added as time and resources allow.

Finally, to minimize subjectivity and increase standardization, pre-defined selection lists should be established for each inspection point. This will ensure that data collected throughout the state can be compared regardless of who performed the inspection or where and when it occurred. In addition, set selection lists will add validity to condition assessments making sure that good is good and fair is fair.

2. *Standardize the method by which photographs and spatial data is collected.*

Currently available GPS survey equipment makes the collection of spatial data easy and reasonably cost-effective. Within a few seconds, a point can be located in the field, surveyed and added to a shapefile. The issue is what to actually survey in the field. While it is quite feasible to walk the perimeter of a pond and the line of a swale and actually survey the shape of the feature, this does not represent what many of the Delegated Agencies have done. To balance usefulness of data with cost of collection, the outfall of each BMP should be used as the survey point.

The outfall will locate the BMP in relation to its surroundings and provide a point to tie inspection data with photographs for a complete Graphical User Interface. In addition, many of the Delegated Agencies have already surveyed the outfall of their BMPs making this a reasonable common point. The survey of additional points such as drainage into the BMP, defects and the shape should not, however, be discouraged.

A series of photographs of each BMP should be collected to include landscape photos to show the overall BMP and its surroundings. Key features including the outfall and any defects should also be photographed. By numbering each photo with the unique identifier of the BMP, the photos and inspection data will be able to be linked in the final database.

3. *Develop a standard format for the storage of BMP data.*

BMP data is stored in different formats by the various Delegated Agencies. It is not necessary to require each to change to a common program (for example Microsoft Access). Instead, the data structure and naming of fields and columns must be standardized to allow data from different Delegated Agencies to be converted and stored in a common database. With each Delegated Agency maintaining BMP data, using the

same data structure processes to upload data into a common database can be put in place and common report formats developed.

4. *Develop a standard export format for BMP data to allow easy assimilation into the composite database.*

With standard data collection practices in place and a standardized data storage structure developed, processes can then be created to streamline the export and subsequent combination of BMP data. Data, once in an electronic format, can be converted from one format to another. In order to work with the greatest common factor, data should initially be delivered to DNREC in a Microsoft Excel format. Whether a Delegated Agency chooses to store data as a shapefile, or one of many database formats, an Excel file can be created and used to load data into the composite BMP database.

In addition to a standard export file, standard reports can be developed for submission to DNREC. Standard reporting has the potential to simplify the reporting process for the Delegated Agencies and will provide data to DNREC in a regular format allowing for comparison of different BMPs.

TABLE 3: Existing BMP Data (Soil and Water Conservation)

Organization	BMPs Maintained	Inventory	BackGround Data	Regular Inspection	Inspection Frequency	Historical Data	Spatial Data	Photos
City of Newark	Mostly extended detention basins, also have some ponds, bio-swales, bio-retention, sand filters, grass filter strips and structural BMPs. Some meet pre '91 regulations and some meet post '91 regulations.	Yes	No	Yes	Yearly	Yes	Yes	Yes
DelDOT	Wet ponds, dry ponds, infiltration trenches / basins, filter strips, bio-retention areas, bio-swales, sand filters, sediment forebays, check dams.	Yes	Yes	Yes	Under Development	Yes	Yes	Yes
DNREC	DNREC has statewide responsibility for all state and federal projects (Schools, Post Offices, etc) as well as remediation sites and contaminated sites.	Yes	No	No	N/A	Yes	No	No
Kent Conservation District	Stormwater BMPs (ponds, infiltration, bio-infil, sand filters, etc). County, Municipal and private BMPs fall under the KCD (all of Kent County except for federal and state facilities)	Yes	No	Yes	Yearly	Yes	Yes	Yes
New Castle Conservation District	Provide E&S review for 9 municipalities (all except Wilmington, Newark & Middletown). Existing BMPs are a grey area because a lot of the responsibility lies with HOAs or the Town / City	Yes	No	No	N/A	No	No	No
New Castle County	Sand Filters, Infiltration, Bio-retention, Bio-swales, Recharge Basins, Underground Detention, Wetlands, and Ponds.	Yes	No	Yes	Yearly	Yes	Yes	Yes
Sussex Conservation District	The SCD does not maintain SW practices, they provide inspection services and technical support. SCD maintains a listing of projects by name, when approved. Plans would then need to be pulled to see what BMPs might be on a given site.	No	No	No	N/A	No	No	No

TABLE 3: Existing BMP Data (Soil and Water Conservation)

Organization	BMPs Maintained	Inventory	BackGround Data	Regular Inspection	Inspection Frequency	Historical Data	Spatial Data	Photos
Town of Middletown	Dry ponds, wet ponds, infiltration ponds, some structural (underground systems) swales, bio-retention	No	No	No	N/A	No	No	No

TABLE 4: BMP Data Storage (Soil and Water Conservation)

Organization	How Data Is Stored	Where Data is Stored	Data Maintained By	Linked To GUI	GUI Software	Future Data Maintenance
City of Newark	Excel spreadsheets (inspection data) ARC 8.3 (mapping)	Shared City network drive	Data: Mike Sistek & Kelley Dinsmore. Network: IT	Yes	ArcView 8.3	Would like to be able to make changes locally. Local update and storage w/ periodic updates made to DNREC
DelDOT	Oracle	DelDOT server in Dover	DelDOT OIT	Yes	ESRI based	DelDOT would prefer to maintain their data
DNREC	MS Access. It is being migrated to SQL server	DNREC Server	DNREC IT	No	N/A	DNREC would prefer to maintain data themselves.
Kent Conservation District	MS Access	KCD server in Dover	KCD Program Staff	No	N/A	No preference, as long as the data is accessible.
New Castle Conservation District	Paper project files	NCCD building	Don Nichols	No	N/A	No Comments
New Castle County	Hansen: General descriptive information. Oracle based GUI for specific BMP information.	NCC Government center	NCC IT staff	Yes	ArcView 9.x	In house data management has several advantages, but for technical problems an outside player would be helpful.
Sussex Conservation District	MS Access	SCD building in Georgetown	In house staff member with DNREC IT support	No	N/A	SCD would prefer to input and maintain the data, if there are problems then they can go to IT. They would want to be able to control their data
Town of Middletown	Paper files	Town building		No	N/A	Prefer to maintain BMP information locally (both inspections and the data) then upload to a separate system (outside of the Town's) for sharing and distribution. Security is the main concern (along with data integrity).

TABLE 5: BMP Data Sharing Limitations (Soil and Water Conservation)

Organization	Sharing Limitations	How to Obtain BMP Data	Possible Stakeholder Use
City of Newark	Connecting into City computers is not likely to occur. The City connects to the web through U of D, although a new system is in discussion.	Just ask. The spreadsheets and inspection forms were readily shared for this project. The photos and mapping files are too big to easily share.	Making all BMP data available to residents could cause problems. Perhaps make basic data available to all (locations and types) but specifics on condition and maintenance should not be shared. Newark is focused on what they own and maintain thus little interest in data out of Newark, except maybe for City fringe areas.
DelDOT	A data request can be made, and DelDOT will determine the need. A FOIA request may be needed.	Ask. DelDOT would be able to release the data, although a spreasheet with basic data would liklely be provided first.	A planning tool to help determine maintenance needs. Display aerial photos and the user could look to see general data (approx size, year built, flow, drainage areas).
DNREC	There are limits on who can gain access (security). There are possible FOIA requirements as well due to the presence of correspondence.	Make a formal request, identify the data desired and DNREC would try to supply it.	Mainly internal requests, used for watershed assessments.
Kent Conservation District	None really exist	Request the data from the program manager	Not quite sure at this point
New Castle Conservation District	Has never been an issue. Nobody has ever really requested data from the NCCD. Sharing with state agencies is not an issue.	NCCD has not received any requests, however NCCD does reply to complaints.	NCCD does not feel that what the NCCD does lends itself to a computer application. NCCD focus is construction regulation. Once the BMP is built, maint & resp. falls to the HOA or town / city.
New Castle County	FOIA is a driver. The County likes to be consistent with distribution. Sharing with another government agency is not a problem. Many BMPs are owned by an HOA or Maint. Corp so there could be some privacy issues.	Make a FOIA request, there is a County employee who processes them	It would be helpful to have DelDOTs drainage collection system relative to the BMPs available. That would help with TMDLs as stakeholders. NCC could see private groups using the system to look for work opportunities, and that could pose a headache for maintenance corps.
Sussex Conservation District	Don't really have any issues sharing BMP data with other agencies. SCD would not mind working with Mosquito Control to get a better idea of which BMPs are breeding mosquitos, and which are not	FOIA request	In support of PCS / TMDLs with info provided on nutrient loading and removal rates. Simplification of the reporting process. If data is made available to all who need it, less time may need to be spent generating reports.
Town of Middletown	Do not want to let people into their network. Just ask (FOIA) and the data can be provided. Middletown is autonomous and does not share data in a digital format.	Just ask	Provide the ability to see what others are doing, and how BMPs are performing. Look at maintenance practices and a comparison of facilities, this will help determine if Middletown is keeping up.

TABLE 6: Software (Soil and Water Conservation)

Organization	Comfortable with MS Access	Comfortable with GIS Software	Current Software in Use	IT Staff	IT Staff Size
City of Newark	Yes	Yes	Excell & ArcView 8.3	Yes	2 people
DelDOT	Yes	Yes	ESRI	Yes	70 - 80 people
DNREC	Yes	Yes	Access, some GIS for individual cases	Yes	
Kent Conservation District	Yes	Yes	MS Access, some GIS	No	Rely on DNREC IT
New Castle Conservation District	No	No	Currently not tracking data electronically	No	N/A
New Castle County	Yes	Yes	Hansen, vb.net, Oracle	Yes	15-30 people
Sussex Conservation District	Yes	Yes	MS Access	No	N/A
Town of Middletown	Yes	No	Currently not tracking data electronically.	Yes	1 full-time professional

Division of Water Resources

Existing BMP Data

To gain an understanding of the types of BMP data currently collected and forwarded to the Division of Water Resources, Reporting Agencies were asked to describe the types of BMPs that they maintain, whether the BMPs are regularly inspected, and the inspection periodicity. All but two of the Agencies, the Delaware Department of Agriculture (DDA): Forest Service and the Kent Conservation District reported having some type of BMP inventory. The DDA Forest Service did state, however, that BMP data is maintained on forest specific BMPs.

BMP data reported to the Division of Water Resources tends to be both programmatic and geographic in nature. The BMPs are programmatic in that they involve rules and regulations related to the use of land. Permits are granted, land use designations are made and it is data that is collected and stored. The data is geographic in that a permit is good for a specific parcel of land, a preservation plan sets aside specific land. Examples include forest preservation plans, agricultural cover crop data, and nutrient management planning. As a result, background information in terms of areas served, waste removal, and physical location is typically available.

The inspection frequency of BMPs varies widely and is dependent on the type of BMP. Many of the practices are programmatic and do not lend themselves to physical inspection. As an example it would be somewhat impractical from a resource perspective to visit each farm in Sussex County to assess the use of cover crops. Therefore, in some cases, inspections occur at the time a permit or application is submitted, while in other cases inspections are random and might even be administrative in nature.

Historical data provides a valuable history of not only the performance of a BMP but also changes in BMP condition over time. Each Reporting Agency interviewed maintains some form of historical data, however, there is some variation in the amount of historical data maintained, with the majority having historical data back to 2001.

An inventory, along with historical records, provides valuable data for the assessment of BMP condition and performance. However, this does not provide a complete picture of the individual BMP. Spatial data, combined with photographs provide a convenient means to locate BMPs and review them without having to go into the field.

Spatial data is particularly important when looking at the relationship of various programs and how they can combine to affect overall water quality in an area. The ability to view forest preservation plans, crop rotation and cover plans along with the location of more physical BMPs (i.e. ponds) greatly enhances the ability to assess, plan and manage various BMP practices. All but three of the interviewees reported having spatial BMP data. The three that do not maintain spatial data relate to agricultural land use that brings into question privacy issues. This is discussed in a later section on data sharing.

Only DNREC's Groundwater Discharge section and the New Castle and Kent Conservation Districts report having photos of BMPs. These agencies maintain more "physical" BMPs that can specifically be visited in the field. It would not be practical to maintain photos of every farm or track of forest in a preservation plan.

The Kent and Sussex Conservation Districts use the NRCS Toolkit to track BMP data and the Performance Review System (PRS) to generate reports. These are systems developed by the NRCS to track and maintain data on a national level. While it is not known at this time if DNREC would be allowed direct access to the system, it may be possible for reports to be generated and forwarded to the Division of Water Resources in an electronic format. This will need to be explored further with the local NRCS office in Delaware

Table 7 summarizes BMP data collected that is reported to the Division of Water Resources.

Storage, Display and Maintenance of Data

In order to develop a composite BMP database, DNREC must know not only what data is collected, but also how it is stored. In addition, each Reporting Agency is a stakeholder in BMP data process and will play a role in how the composite database is maintained and updated. For this reason, attention was paid to the concerns of each Reporting Agency regarding the maintenance of BMP data.

Depending on the Agency, BMP data is stored in paper format, spreadsheets, one of several database systems and in the case of the Kent and Sussex Conservation Districts, the NRCS Toolkit and PRS. Four of the 10 Agencies interviewed link BMP data to a Graphical User Interface (GUI), with two using ESRI software and two using PRS and Toolkit. It is important to note that although different software and database systems are in use, it will be possible to combine all the electronic data into a single database. The key is to have an electronic format, either as a database or spreadsheet, to allow for the conversion of data.

The final format of a composite BMP system will impact how data is maintained by the individual Reporting Agencies. When asked their preference for data maintenance (in-house or by an outside entity) there was near unanimous agreement that data should be maintained and updated locally and then forwarded to DNREC for inclusion in the composite BMP system. The two main concerns are network security and data integrity. Each agency maintains their own computer network and from a security perspective would not be willing to allow outside entities access. In addition, each Reporting Agency feels that they have the greatest understanding of their BMPs and inspection processes and prefer to maintain control of their data. There was little hesitation about providing DNREC with periodic data updates for a composite BMP database.

Table 8 summarizes the storage, display and maintenance of BMP data.

Data Sharing

Much of the BMP data is currently being reported to DNREC, thus there is little concern over sharing data with government agencies. If the data is to be made public, certain privacy issues will arise. A large amount of the BMP data is collected on agricultural practices and can thus be linked to individual farms and farmers. While data specific to a farm should be protected, there is general agreement that if data is provided on a watershed basis, and individual farmers are masked, then the data can be shared. In any case, a Freedom of Information Act (FOIA) request will likely be required.

Perdue Agricycle has an additional concern in that their list of farms served and the amount of product processed is also a client list. From a business perspective, they would not like to see their client list made public. They did agree, however, that if data about farms served is provided on a watershed basis, the issue would be avoided.

When asked how they envision BMP data in a composite system being used, a variety of items were mentioned including:

- An aid in the development of reports to DNREC. The system could consolidate information to simplify the reporting process.
- Support watershed assessments.
- Provide a data clearing house so data could be downloaded direct, instead of having to make a request to DNREC.
- Support the TMDL / PCS process by providing relevant data.

Table 9 summarizes the perceived issues involved with the sharing of BMP data.

Hardware and Software

Although it is initially intended that the Division of Water Resources will use the composite BMP database for internal purposes only, the possibility for it being made available to the general public does exist. In addition, the Reporting Agencies will be tasked with providing data updates to the composite system on a regular basis. For this reason, it is important to have an understanding of the comfort level each stakeholder has with key software and the IT resources that they have in place. The final portion of the interview focused on these areas and the results are summarized in Table 10.

Recommendations

Combining the BMP data collected and reported to the Division of Water Resources will be more complicated than for the Division of Soil and Water Conservation. There are three reasons for this:

- There is much more variation in the types of data collected. Some of the data is geographic in nature and is collected and maintained in a shapefile format. This

is the case for many of the forestry and crop management programs. Other data is collected in a tabular format and is stored in spreadsheets and data tables. This is the case for the nutrient management programs.

- Much of the BMP data relates to agricultural practices and there are concerns in the agricultural community with associating data with individual farms and farmers.
- Data that is collected and maintained by the Conservation Districts is managed within the NRCS Toolkit and Performance Review Systems (PRS). These systems are not integrated with state systems and further work will be required to determine what types of reports and data can be provided to DNREC.

With these limitations in mind, there are some steps that can be taken by DNREC to begin the process of developing a composite BMP database.

1. *Ensure that all available shapefile data is sent to DNRECs 319 Program*
2. *Encourage the attribution of watershed information to agricultural data*
3. *Work with the NRCS to determine what data can be released and what format it can be provided in.*

Each step is discussed in greater detail below.

1. *Ensure that all available shapefile data is sent to DNRECs 319 Program.*

Currently much of the BMP data that exists in shapefile format either resides with or is forwarded to DNRECs 319 Program. In addition to shapefile data for agricultural BMPs and forest preservation areas, the 319 Program also collects nutrient management data from the Department of Agriculture. The 319 Program could thus serve as the starting point in an effort to bring various BMP datasets together. By integrating data from DNRECs Groundwater Discharges Section and the NRCS it would be possible to create a multi-layed GIS that could be used to relate the various practices together and develop a more holistic view of water resource practices throughout the state.

2. *Encourage the attribution of watershed information to agricultural data.*

Privacy issues will likely remain a concern for as long as site specific data is collected on individual farms. While there is concern about releasing specific data on farms there is much less concern with making general data available. For example, the fact that there are 1,500 acres of farm land covered by nutrient management plans in a watershed would be acceptable, identifying the farms by name and address would not be. By tracking crop rotation, manure generation and other agricultural items at the watershed level, DNREC will be able to monitor and manage issues affecting water quality while the privacy of the agricultural community is maintained.

To accomplish this, a standard watershed breakdown must first be established. Next, watershed data must be made a part of the various data sets for the various agricultural BMPs. In this way DNREC will be able to track the number of manure capture devices

in watershed X, the acres of cover crop and watershed Y and the number of farms using manure recycling in watershed Z.

3. *Work with the NRCS to determine what data can released and what format it can be provided in.*

The Conservation Districts, in coordination with the NRCS, collect a significant amount of data within the state. This information is then stored and managed using the NRCS Toolkit and Performance Review System. As of this report, there was not a lot of interaction between the NRCS and DNREC. To make use of this data, DNREC must engage the NRCS, determine what data is available, how it is stored and how it might be made available to DNREC.

With these initial steps in place, it will be possible to begin the integration of the various data sets and create a composite system to review all Water Resources BMP data in a single location. The challenge will continue to be that, unlike the Soil and Water Conservation BMPs that are all of a similar type, the Water Resources BMPs each represent a different program, with its own unique objectives and data sets.

TABLE 7: Existing BMP Data (Water Resources)

Organization	BMPs Maintained	Inventory	BackGround Data	Regular Inspection	Inspection Frequency	Historical Data	Spatial Data	Photos
Delaware Department of Agriculture: Forest Service	Forest Stewardship Plans (shapefiles); Timber Harvest Permitting (shapefiles); Urban Forestry Program (small component) reported as points vs areas because the areas are small (even though several trees might have been planted). All data is reported to DNREC's 319 Program.	No	Yes	No	N/A	Yes	Yes	No
Delaware Department of Agriculture: Nutrient Mgmnt Comm	Poultry manure tracking. Poultry is the main contributor in DE. Manure shipping is tracked in an Access database. Shipping permits are submitted, the data is put into the d/b and later exported to Excel. In-state shipments are tracked by watershed. Out of state the source is tracked by watershed but not the destination.	Yes	Yes	Yes	As apps are submitted	Yes	No	No
Delaware Department of Agriculture: Nutrient Mgmnt Plans	Nutrient Management Plan Program. All farms greater than 10 acres, or 8 animal units (~30,000 chicken) must submit a NMP. DDA reimburses farmers for the cost of the plans. Plans run in 3 year cycles, either 1 3-year plan, or 3 1-year plans.	Yes	Yes	Yes	Random admin. Reviews	Yes	No	No
DNREC: 319 Program	Cover Crop data (Kent & Sussex counties), CREP (Conservation Reserve Enhancement Program), Livestock BMPs (manure storage, incinerators, composters, animal waste handling, etc), Conservation reserve program.	Yes	Yes	Yes	Varies by program	Yes	Yes	No
DNREC: Coastal Program	The coastal program is a federal program that operates a little outside of the state agencies. They do not maintain any BMP data, and have turned tracking over to other groups.							
DNREC: Groundwater Discharges	On site waste water systems of all sizes (incl. spray irrigation): Over 80,000 on site septic systems, Several hundred > 2,500 gpd; Underground injection control program.	Yes	Yes	Yes	>2500 gpd: yearly	Yes	Yes	Yes

TABLE 7: Existing BMP Data (Water Resources)

Organization	BMPs Maintained	Inventory	BackGround Data	Regular Inspection	Inspection Frequency	Historical Data	Spatial Data	Photos
Kent Conservation District	The KCD does not really maintain BMP data on programs of their own. Instead, they support farmers that are tasked with meeting requirements. The data then goes to the appropriate agency to track.	No	Yes	Yes	varies by BMP	Yes	Yes	Yes
NCCD (NRCS)	Cover Crop Data, Horse Pastures and loading, No till Data, Some cost share from SWM, Some riparian buffers in urban areas, Filter Strips, Some E&S measures at the edge of Ag lands, Fragmites Control.		No	No	On construction & randomly	Yes	Yes	Yes
Perdue Agricycle	Tracks of the amount of waste taken from sites and the ultimate destination whether in or out of state. They serve most of the Kent and Sussex farming community (~1,400 farms.) PA does not have data on nutrient management plans, or if they are current. PA is told yes or no on if a plan exists, but not the expiration date.	Yes	Yes	No	N/A	Yes	No	No
Sussex Conservation District	SCD provides technical and financial assistance, they are not regulatory.	Yes	Yes	Yes	---		Yes	No

TABLE 8: BMP Data Storage (Water Resources)

Organization	How Data Is Stored	Where Data is Stored	Data Maintained By	Linked To GUI	GUI Software	Future Data Maintenance
Delaware Department of Agriculture: Forest Service	ARCView 9.2 & Access. Data is joined to the shapefiles.	Dover network & desktop.	Glenn Gladders	Yes	ARCView 9.2 and Access	Glenn would prefer to maintain and store the data locally.
Delaware Department of Agriculture: Nutrient Mgmnt Comm	MS Access	DDA Network	Steve Hollenbeck	No	N/A	Centralized data storage would work better, with local updating and maintenance.
Delaware Department of Agriculture: Nutrient Mgmnt Plans	MS Access & Excel	DDA network	Bob Coleman and Judy Burnes	No	N/A	DDA would prefer to maintain the data and provide updates as needed.
DNREC: 319 Program	ESRI with MS Access back-up	DNREC Network. Data on local drive.	DNREC IT	Yes	ArcGIS 9.x	Maintain in house, share the data.
DNREC: Coastal Program						
DNREC: Groundwater Discharges	MS Access, Adabase, file folders. Data being migrated to SQL server.	Dover & Georgetown	Groundwater Discharges section staff.	No	N/A	Dave would prefer for his group to manage and maintain the data, then upload it to a master system.
Kent Conservation District	File folders.	District facility	KCD staff	No	N/A	---
NCCD (NRCS)	Performance Review System (NRCS computer system).	National Server	NRCS IT	Yes	PRS/Toolkit	NRCS will maintain their data, then have it pulled. NRCS will not upload.
Perdue Agricycle	Exel spreadsheet	Perdue Agricycle factility	Perdue Agricycle staff	No	N/A	Perdue Agricycle would prefer internal management of data, especially since it is sensitive to the business practice and protection of customer base.
Sussex Conservation District	PRS & Toolkit	National server	NRCS IT	Yes	PRS/Toolkit	SCD would input data and maintain it. Problems go to IT, SCD wants to maintain control on their data.

TABLE 9: BMP Data Sharing Limitations (Water Resources)

Organization	Sharing Limitations	How to Obtain BMP Data	Possible Stakeholder Use
Delaware Department of Agriculture: Forest Service	The only requests for data come from the 319 program. It is reported at the watershed level. Individual land owners are masked in the report.	Likely no real issue with sharing data, but would like to know more. Individual names associated with data do not need to be made public.	To provide a method of mapping and reporting to DNREC.
Delaware Department of Agriculture: Nutrient Mgmnt Comm	None identified, the data is already sent to the 319 Program on a regular basis.	Ask Steve Hollenbeck. Data is already sent to the 319 Program on a regular basis.	Looking at data on a watershed basis.
Delaware Department of Agriculture: Nutrient Mgmnt Plans	Likely would need to remove names due to privacy concerns.	For DNREC and other state agencies they can call the NMC and ask for a report. For members of the general public, it would likely involve a FOIA request.	General watershed information. Bob does not see a need for individual farm info and acreage to be available, but tracking of the number of acreage in a watershed could be helpful.
DNREC: 319 Program	Mark does not like to give up point data for structural BMPs (privacy issue) however descriptive information is not a problem. Gov't groups: data sharing is not an issue.	Just ask Mark Hogan.	DNREC perform daily updates. An outside source would connect in to retrieve data and put it into a database that others can use. Thus, instead of going to Mark, parties would just go to the database.
DNREC: Coastal Program			
DNREC: Groundwater Discharges	No real restrictions. Tend to follow the lead of DNREC Water Resources. Sharing data with state agencies is not too big an issue.	Make a FOIA request. If the request for data is too large, the applicant may be asked to narrow it down.	Access based system with information to support the project at hand.
Kent Conservation District	Privacy Issues: farmers ID. FOIA request likely needed. If personal information is stripped out, it is ok to let the data go.	Likely see Mark Hogan (DNREC 319 Program), as the paper folders do not contain summary data.	Possibly adding photographs to the overall system.
NCCD (NRCS)	Specifics to a farm, by name or location is an issue, Can't give financial data, On a watershed basis, there are no issues with sharing data.	---	Tracking the acceptance of conservation practices, Calculations on nutrient management practice impacts, Input for state reports that need to be submitted.
Perdue Agricycle	Perdue Agricycle is concerned about what type of data is potentially made public as it is essentially a customer list. Data on manure removal on a watershed basis would not be as much of a problem as the customer base is masked.	It would depend on who it is, government agency would be ok. From a business perspective it really depends.	The end users (customers) are growing in number, and PA wants to protect that data. Identify how many growers are signed up as generators and end uses. Identify how many are growers / generators and not end users.

TABLE 9: BMP Data Sharing Limitations (Water Resources)

Organization	Sharing Limitations	How to Obtain BMP Data	Possible Stakeholder Use
Sussex Conservation District	Privacy issues with farmers. Don't mind sharing data but don't want to be too specific. Maps that are not to specific (ie don't tag BMPs to a parcel, but rather say there of XX of BMP YY in a watershed) would be ok.	FOIA request	Providing information for PCS & TMDLs, Simplify the reporting process by making data available to all who would need it.

TABLE 10: Software (Water Resources)

Organization	Comfortable with MS Access	Comfortable with GIS Software	Current Software in Use	IT Staff	IT Staff Size
Delaware Department of Agriculture: Forest Service	Yes	Yes	ARCView 9.2 & Access.	Yes	2 people
Delaware Department of Agriculture: Nutrient Mgmnt Comm	Yes	No	MS Access & Excel	Yes	2 people
Delaware Department of Agriculture: Nutrient Mgmnt Plans	Yes	No	MS Access & Excel	Yes	2 People
DNREC: 319 Program	Yes	Yes	ArcView 9.x & MS Access	Yes	Separate Department
DNREC: Coastal Program					
DNREC: Groundwater Discharges	Yes	Yes	Some Access, some Adabase	Yes	Separate Department
Kent Conservation District			---		---
NCCD (NRCS)	Yes	Yes	PRS & Toolkit	Yes	USDA IT
Perdue Agricycle	Yes	No	Excel	Yes	Corporate IT staff
Sussex Conservation District	Yes	Yes	PRS & Toolkit. Excel (state revolving funds)	Yes	USDA IT

Appendix 1

DNREC Best Management Practice (BMP) Assessment Questionnaire

Organization: **Phone Number:**

Point of Contact: **E-mail address:**

I. Existing BMP Information

1. What types of BMPs do you maintain?

2. Do you have an inventory listing each BMP? Is there inspection / description data associated with the listing?

3. Is background information on the BMPs (areas served, nutrient reduction observed, etc) available?

4. Are the BMPs inspected on a regular schedule?

5. How is the BMP data updated?

6. Is historical data maintained?

7. Do you have spatial (location) data for each BMP?

    a. What format is the spatial data in?

    b. What type of locational information is available (lat / long, state plane, address, etc)?

8. Have the BMPs been photographed?

    a. If so, how are the photos catalogued and associated with BMP data?

II. Data / Information storage

1. What format is BMP data stored in?

2. Where (physically) is the data stored?

3. Who is responsible for storing and maintaining the data?

4. If BMP data is stored in an electronic format, is the data linked into a Graphical User Interface (GUI)?

   a. Is so, what software is used? version?

   b. What programming language (if any) was used in building the GUI?

   c. Who built the GUI?

5. In terms of future data maintenance, would you prefer to house and maintain BMP data yourself, or have an outside entity store and maintain it?

III. Data Sharing

1. What requirements or limitations do you have in place to control the distribution and sharing of data?

2. How would an interested party go about getting a copy of your BMP data?

3. How do you envision stakeholders / end users accessing and retrieving BMP information?

IV. Hardware / Software

1. Are you comfortable using MS Access? ESRI (or other) GIS software?

2. What software are you currently using to track BMP data?

3. Do you have an IT staff? If so, how large is it?

Appendix 2

Interview Summary

Organization City of Newark

Primary POC: Mike Sistek ***Phone:*** (302) 366-7040 ***Email:*** pwoperations@newark.de.us

Secondary POC: Kelley Dinsmore ***Phone:*** (302) 366-7040 ***Email:*** kdinsmore@newark.de.us

Exisiting BMP Information

BMPs Maintained:

Mostly extended detention basins, also have some ponds, bio-swales, bio-retention, sand filters, grass filter strips and structural BMPs. Some meet pre '91 regulations and some meet post '91 regulations.

Inventory: Yes ***Inventory Comments:*** sorted by private vs Newark & pre and post 1991

Background Data: No ***Regular Inspections:*** Yes ***Inspection Frequency:*** Yearly

How data is updated: Inspectors update the master spreadsheet each year following the inspection.

Historical Data: Yes ***Historical Data Comments:*** Spreadsheet has current data. Paper records maintained.

Spatial Data: Yes ***Spatial data format:*** Typically the outfall is GPSd. DE State Plane.

Photos: Yes ***How photos are catalogued:*** Linked using a common structure ID

Data and Information Storage

Storage Format: Excel spreadsheets (inspection data) ARC 8.3 (mapping)

Storage Location: Shared City network drive ***Maintained By:*** Data: Mike Sistek & Kelley Dinsmore. Network: IT

Data Linked To a GUI: Yes ***GUI Software:*** ArcView 8.3

GUI Language: --- ***GUI Built By:*** Kelley Dinsmore

Thoughts on Future Data Maintenance:

Would like to be able to make changes locally. Local update and storage w/ periodic updates made to DNREC

Data Sharing

Data Sharing Limitations: Connecting into City computers is not likely to occur. The City connects to the web through U of D, although a new system is in discussion.

How to Obtain Data: Just ask. The spreadsheets and inspection forms were readily shared for this project. The photos and mapping files are too big to easily share.

Thoughts on Stakeholder Use:

Making all BMP data available to residents could cause problems. Perhaps make basic data available to all (locations and types) but specifics on condition and maintenance should not be shared. Newark is focused on what they own and maintain thus little interest in data out of Newark, except maybe for City fringe areas.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: Yes ***IT Staff Size:*** 2 people

Current Software: Excell & ArcView 8.3

Interview Summary

Organization DelDOT

Primary POC: Vince Davis ***Phone:*** (302) 760-2180 ***Email:*** Vince.Davis@state.de.us

Secondary POC: Wendy Polasko ***Phone:*** (302) 760-2542 ***Email:*** Wendy.Polasko@state.de.us

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Exisiting BMP Information

BMPs Maintained:

Wet ponds, dry ponds, infiltration trenches / basins, filter strips, bio-retention areas, bio-swales, sand filters, sediment forebays, check dams.

Inventory: Yes ***Inventory Comments:*** ---

Background Data: Yes ***Regular Inspections:*** Yes ***Inspection Frequency:*** Under Development

How data is updated: Consultants submit design data in the same format as the inventory. DelDOT has two sets of data. The first (structure) is data that is static, and not expected to change. This includes classification, dimensions, material, etc. The second (inspection) is expected to change over time, and a historical record is maintained.

Historical Data: Yes ***Historical Data Comments:*** No data will be overwritten.

Spatial Data: Yes ***Spatial data format:*** DE State Plane

Photos: Yes ***How photos are catalogued:*** By BMP # and sorted by year.

Data and Information Storage

Storage Format: Oracle

Storage Location: DelDOT server in Dover ***Maintained By:*** DelDOT OIT

Data Linked To a GUI: Yes ***GUI Software:*** ESRI based

GUI Language: JAVA, SDE ***GUI Built By:*** GeoDecisions

Thoughts on Future Data Maintenance:

DelDOT would prefer to maintain their data

Data Sharing

Data Sharing Limitations: A data request can be made, and DelDOT will determine the need. A FOIA request may be needed.

How to Obtain Data: Ask. DelDOT would be able to release the data, although a spreasheet with basic data would liklely be provided first.

Thoughts on Stakeholder Use:

A planning tool to help determine maintenance needs. Display aerial photos and the user could look to see general data (approx size, year built, flow, drainage areas).

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: Yes ***IT Staff Size:*** 70 - 80 people

Current Software: ESRI

Interview Summary

Organization DNREC

Primary POC: Jamie Rutherford ***Phone:*** (302) 739-9921 ***Email:*** Jamie.Rutherford@state.de.us

Secondary POC: ***Phone:*** ***Email:***

Exisiting BMP Information

BMPs Maintained:

DNREC has statewide responsibility for all state and federal projects (Schools, Post Offices, etc) as well as remediation sites and contaminated sites.

Inventory: Yes ***Inventory Comments:*** Tied to project database. It lists what BMPs are on what site.

Background Data: No ***Regular Inspections:*** No ***Inspection Frequency:*** N/A

How data is updated: Regular updates do not occur.

Historical Data: Yes ***Historical Data Comments:*** Paper Records

Spatial Data: No ***Spatial data format:*** N/A

Photos: No ***How photos are catalogued:*** N/A

Data and Information Storage

Storage Format: MS Access. It is being migrated to SQL server

Storage Location: DNREC Server ***Maintained By:*** DNREC IT

Data Linked To a GUI: No ***GUI Software:*** N/A

GUI Language: N/A ***GUI Built By:*** N/A

Thoughts on Future Data Maintenance:

DNREC would prefer to maintain data themselves.

Data Sharing

Data Sharing Limitations: There are limits on who can gain access (security). There are possible FOIA requirements as well due to the presence of correspondence.

How to Obtain Data: Make a formal request, identify the data desired and DNREC would try to supply it.

Thoughts on Stakeholder Use:

Mainly internal requests, used for watershed assessments.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: Yes ***IT Staff Size:***

Current Software: Access, some GIS for individual cases

Interview Summary

Organization Kent Conservation District

Primary POC: Jared Adkins ***Phone:*** (302) 741-2600 ***Email:*** Jared.adkins@state.de.us

Secondary POC: ***Phone:*** ***Email:***

Exisiting BMP Information

BMPs Maintained:

Stormwater BMPs (ponds, infiltration, bio-infil, sand filters, etc). County, Municipal and private BMPs fall under the KCD (all of Kent County except for federal and state facilities)

Inventory: Yes ***Inventory Comments:*** ---

Background Data: No ***Regular Inspections:*** Yes ***Inspection Frequency:*** Yearly

How data is updated: The Access database is updated / verified with each inspection.

Historical Data: Yes ***Historical Data Comments:*** Some data is only available on the field form

Spatial Data: Yes ***Spatial data format:*** UTM (BMP location) Lat/Long (projects)

Photos: Yes ***How photos are catalogued:*** They are stored in an electronic project file, however they are not linked to the database.

Data and Information Storage

Storage Format: MS Access

Storage Location: KCD server in Dover ***Maintained By:*** KCD Program Staff

Data Linked To a GUI: No ***GUI Software:*** N/A

GUI Language: N/A ***GUI Built By:*** N/A

Thoughts on Future Data Maintenance:

No preference, as long as the data is accessible.

Data Sharing

Data Sharing Limitations: None really exist

How to Obtain Data: Request the data from the program manager

Thoughts on Stakeholder Use:

Not quite sure at this point

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** No

Comfortable wth GIS Software: Yes ***IT Staff Size:*** Rely on DNREC IT

Current Software: MS Access, some GIS

Interview Summary

Organization New Castle Conservation District

Primary POC: Don Nichols ***Phone:*** (302) 832-3100 ***Email:*** N/A

Secondary POC: ***Phone:*** ***Email:***

Exisiting BMP Information

BMPs Maintained:

Provide E&S review for 9 municipalities (all except Wilmington, Newark & Middletown). Existing BMPs are a grey area because a lot of the responsibility lies with HOAs or the Town / City

Inventory: Yes ***Inventory Comments:*** No inventory, however an annual report is sent to DNREC.

Background Data: No ***Regular Inspections:*** No ***Inspection Frequency:*** N/A

How data is updated: No inventory to update

Historical Data: No ***Historical Data Comments:*** N/A

Spatial Data: No ***Spatial data format:*** N/A

Photos: No ***How photos are catalogued:*** N/A

Data and Information Storage

Storage Format: Paper project files

Storage Location: NCCD building ***Maintained By:*** Don Nichols

Data Linked To a GUI: No ***GUI Software:*** N/A

GUI Language: N/A ***GUI Built By:*** N/A

Thoughts on Future Data Maintenance:

No Comments

Data Sharing

Data Sharing Limitations: Has never been an issue. Nobody has ever really requested data from the NCCD. Sharing with state agencies is not an issue.

How to Obtain Data: NCCD has not received any requests, however NCCD does reply to complaints.

Thoughts on Stakeholder Use:

NCCD does not feel that what the NCCD does lends itself to a computer application. NCCD focus is construction regulation. Once the BMP is built, maint & resp. falls to the HOA or town / city.

Hardware and Software

Comfortable with MS Access: No ***IT Staff:*** No

Comfortable wth GIS Software: No ***IT Staff Size:*** N/A

Current Software: Currently not tracking data electronically

Interview Summary

Organization New Castle County

Primary POC: Mike Harris ***Phone:*** (302) 395-5806 ***Email:*** MHarris@nccde.org

Secondary POC: Ellie Mortazavi ***Phone:*** (302) 395-5802 ***Email:*** EMortazavi@nccde.org

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Exisiting BMP Information

BMPs Maintained:

Sand Filters, Infiltration, Bio-retention, Bio-swales, Recharge Basins, Underground Detention, Wetlands, and Ponds.

Inventory: Yes ***Inventory Comments:*** Inspection and Description data does is maintained

Background Data: No ***Regular Inspections:*** Yes ***Inspection Frequency:*** Yearly

How data is updated: There is a physical folder for each BMP that has plans, photos, historical inspections. Data is collected on laptops and uploaded wirelessly.

Historical Data: Yes ***Historical Data Comments:*** Back to 2004

Spatial Data: Yes ***Spatial data format:*** Typically the outfall of the structure

Photos: Yes ***How photos are catalogued:*** Not directly linked to BMP data

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Data and Information Storage

Storage Format: Hansen: General descriptive information. Oracle based GUI for specific BMP information.

Storage Location: NCC Government center ***Maintained By:*** NCC IT staff

Data Linked To a GUI: Yes ***GUI Software:*** ArcView 9.x

GUI Language: vb.net & Oracle ***GUI Built By:*** NCC Staff

Thoughts on Future Data Maintenance:

In house data management has several advantages, but for technical problems an outside player would be helpful.

Data Sharing

Data Sharing Limitations: FOIA is a driver. The County likes to be consistent with distribution. Sharing with another government agency is not a problem. Many BMPs are owned by an HOA or Maint. Corp so there could be some privacy issues.

How to Obtain Data: Make a FOIA request, there is a County employee who processes them

Thoughts on Stakeholder Use:

It would be helpful to have DelDOTs drainage collection system relative to the BMPs available. That would help with TMDLs as stakeholders. NCC could see private groups using the system to look for work opportunities, and that could pose a headache for maintenance corps.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: Yes ***IT Staff Size:*** 15-30 people

Current Software: Hansen, vb.net, Oracle

Interview Summary

Organization Sussex Conservation District

Primary POC: Jessica Watson ***Phone:*** (302) 856-7219 ***Email:*** Jessica.Watson@state.de.us

Secondary POC: ***Phone:*** ***Email:***

Exisiting BMP Information

BMPs Maintained:

The SCD does not maintain SW practices, they provide inspection services and technical support. SCD maintains a listing of projects by name, when approved. Plans would then need to be pulled to see what BMPs might be on a given site.

Inventory: No ***Inventory Comments:*** Project tracker, not a BMP tracker, not NPDES driven.

Background Data: No ***Regular Inspections:*** No ***Inspection Frequency:*** N/A

How data is updated: The database itself is not updated. Individual reports are saved as word documents.

Historical Data: No ***Historical Data Comments:*** Maintenance reports and approved plans are saved.

Spatial Data: No ***Spatial data format:*** N/A

Photos: No ***How photos are catalogued:*** N/A

Data and Information Storage

Storage Format: MS Access

Storage Location: SCD building in Georgetown ***Maintained By:*** In house staff member with DNREC IT support

Data Linked To a GUI: No ***GUI Software:*** N/A

GUI Language: N/A ***GUI Built By:*** N/A

Thoughts on Future Data Maintenance:

SCD would prefer to input and maintain the data, if there are problems then they can go to IT. They would want to be able to control their data

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Data Sharing

Data Sharing Limitations: Don't really have any issues sharing BMP data with other agencies. SCD would not mind working with Mosquito Control to get a better idea of which BMPs are breeding mosquitos, and which are not

How to Obtain Data: FOIA request

Thoughts on Stakeholder Use:

In support of PCS / TMDLs with info provided on nutrient loading and removal rates. Simplification of the reporting process. If data is made available to all who need it, less time may need to be spent generating reports.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** No

Comfortable wth GIS Software: Yes ***IT Staff Size:*** N/A

Current Software: MS Access

Interview Summary

Organization Town of Middletown

Primary POC: Morris Deputy ***Phone:*** (302) 378-9120 ***Email:*** mdeputy@middletownde.org

Secondary POC: ***Phone:*** ***Email:***

Exisiting BMP Information

BMPs Maintained:

Dry ponds, wet ponds, infiltration ponds, some structural (underground systems) swales, bio-retention

Inventory: No ***Inventory Comments:*** A BMP inventory is a priority. Getting flooded by new development.

Background Data: No ***Regular Inspections:*** No ***Inspection Frequency:*** N/A

How data is updated: Currenlty not updated.

Historical Data: No ***Historical Data Comments:*** N/A

Spatial Data: No ***Spatial data format:*** N/A

Photos: No ***How photos are catalogued:*** N/A

Data and Information Storage

Storage Format: Paper files

Storage Location: Town building ***Maintained By:***

Data Linked To a GUI: No ***GUI Software:*** N/A

GUI Language: N/A ***GUI Built By:*** N/A

Thoughts on Future Data Maintenance:

Prefer to maintain BMP information locally (both inspections and the data) then upload to a separate system (outside of the Town's) for sharing and distribution. Security is the main concern (along with data integrity).

Data Sharing

Data Sharing Limitations: Do not want to let people into their network. Just ask (FOIA) and the data can be provided. Middletown is autonomous and does not share data in a digital format.

How to Obtain Data: Just ask

Thoughts on Stakeholder Use:

Provide the ability to see what others are doing, and how BMPs are performing. Look at maintenance practices and a comparison of facilities, this will help determine if Middletown is keeping up.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: No ***IT Staff Size:*** 1 full-time professional

Current Software: Currently not tracking data electronically.

Interview Summary

Organization Delaware Department of Agriculture: Forest Service

Primary POC: Glenn Gladders ***Phone:*** (302) 698-4553 ***Email:*** Glenn.gladders@state.de.us

Secondary POC: ***Phone:*** ***Email:***

Exisiting BMP Information

BMPs Maintained:

Forest Stewardship Plans (shapefiles); Timber Harvest Permitting (shapefiles); Urban Forestry Program (small component) reported as points vs areas because the areas are small (even though several trees might have been planted). All data is reported to DNREC's 319 Program.

Inventory: No ***Inventory Comments:*** Forest specific BMPs related to Timber Permits are tracked.

Background Data: Yes ***Regular Inspections:*** No ***Inspection Frequency:*** N/A

How data is updated: As permits are issued data is entered into the database. Once a year the data is rolled up to look for items that were not entered and then the data is archived.

Historical Data: Yes ***Historical Data Comments:*** Back to 2005

Spatial Data: Yes ***Spatial data format:*** ARCView 9.2, DE State Plane

Photos: No ***How photos are catelogued:*** N/A

Data and Information Storage

Storage Format: ARCView 9.2 & Access. Data is joined to the shapefiles.

Storage Location: Dover network & desktop. ***Maintained By:*** Glenn Gladders

Data Linked To a GUI: Yes ***GUI Software:*** ARCView 9.2 and Access

GUI Language: N/A ***GUI Built By:*** Glenn Gladders

Thoughts on Future Data Maintenance:

Glenn would prefer to maintain and store the data locally.

Data Sharing

Data Sharing Limitations: The only requests for data come from the 319 program. It is reported at the watershed level. Individual land owners are masked in the report.

How to Obtain Data: Likely no real issue with sharing data, but would like to know more. Individual names associated with data do not need to be made public.

Thoughts on Stakeholder Use:

To provide a method of mapping and reporting to DNREC.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: Yes ***IT Staff Size:*** 2 people

Current Software: ARCView 9.2 & Access.

Interview Summary

Organization Delaware Department of Agriculture: Nutrient Mgmnt Comm

Primary POC: Steve Hollenbeck ***Phone:*** (302) 698-4500 ***Email:*** Steven.hollenbeck@state.de.us

Secondary POC: ***Phone:*** ***Email:***

Exisiting BMP Information

BMPs Maintained:

Poultry manure tracking. Poultry is the main contributor in DE. Manure shipping is tracked in an Access database. Shipping permits are submitted, the data is put into the d/b and later exported to Excel. In-state shipments are tracked by watershed. Out of state the source is tracked by watershed but not the destination.

Inventory: Yes ***Inventory Comments:*** Tracking of manure shipping

Background Data: Yes ***Regular Inspections:*** Yes ***Inspection Frequency:*** As apps are submitted

How data is updated: Data is updated as applications or claims (as the state approves funding) are submitted.

Historical Data: Yes ***Historical Data Comments:*** Back to 2001.

Spatial Data: No ***Spatial data format:*** Sources change over time.

Photos: No ***How photos are catelogued:*** N/A

Data and Information Storage

Storage Format: MS Access

Storage Location: DDA Network ***Maintained By:*** Steve Hollenbeck

Data Linked To a GUI: No ***GUI Software:*** N/A

GUI Language: N/A ***GUI Built By:*** N/A

Thoughts on Future Data Maintenance:

Centralized data storage would work better, with local updating and maintenance.

Data Sharing

Data Sharing Limitations: None identified, the data is already sent to the 319 Program on a regular basis.

How to Obtain Data: Ask Steve Hollenbeck. Data is already sent to the 319 Program on a regular basis.

Thoughts on Stakeholder Use:

Looking at data on a watershed basis.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: No ***IT Staff Size:*** 2 people

Current Software: MS Access & Excel

Interview Summary

Organization Delaware Department of Agriculture: Nutrient Mgmnt Plans

Primary POC: Bob Coleman ***Phone:*** (302) 698-4556 ***Email:*** Robert.coleman@state.de.us

Secondary POC: ***Phone:*** ***Email:***

Exisiting BMP Information

BMPs Maintained:

Nutrient Management Plan Program. All farms greater than 10 acres, or 8 animal units (~30,000 chicken) must submit a NMP. DDA reimburses farmers for the cost of the plans. Plans run in 3 year cycles, either 1 3-year plan, or 3 1-year plans.

Inventory: Yes ***Inventory Comments:*** Database with farm and farmer info.

Background Data: Yes ***Regular Inspections:*** Yes ***Inspection Frequency:*** Random admin. Reviews

How data is updated: At the time of the application, data is updated.

Historical Data: Yes ***Historical Data Comments:*** Back to 2001

Spatial Data: No ***Spatial data format:*** N/A

Photos: No ***How photos are catelogued:*** N/A

Data and Information Storage

Storage Format: MS Access & Excel

Storage Location: DDA network ***Maintained By:*** Bob Coleman and Judy Burnes

Data Linked To a GUI: No ***GUI Software:*** N/A

GUI Language: N/A ***GUI Built By:*** N/A

Thoughts on Future Data Maintenance:

DDA would prefer to maintain the data and provide updates as needed.

Data Sharing

Data Sharing Limitations: Likely would need to remove names due to privacy concerns.

How to Obtain Data: For DNREC and other state agencies they can call the NMC and ask for a report. For members of the general public, it would likely involve a FOIA request.

Thoughts on Stakeholder Use:

General watershed information. Bob does not see a need for individual farm info and acreage to be available, but tracking of the number of acreage in a watershed could be helpful.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: No ***IT Staff Size:*** 2 People

Current Software: MS Access & Excel

Interview Summary

Organization DNREC: 319 Program

Primary POC: Mark Hogan ***Phone:*** (302) 739-9922 ***Email:*** Mark.hogan@state.de.us

Secondary POC: ***Phone:*** ***Email:***

Exisiting BMP Information

BMPs Maintained:

Cover Crop data (Kent & Sussex counties), CREP (Conservation Reserve Enhancement Program), Livestock BMPs (manure storage, incinerators, composters, animal waste handling, etc), Conservation reserve program.

Inventory: Yes ***Inventory Comments:*** GIS with an Access database with shapefiles for each program.

Background Data: Yes ***Regular Inspections:*** Yes ***Inspection Frequency:*** Varies by program

How data is updated: CREP: Ongoing process; Cover Crop: Data updated once a year; Livestock: updated once every six months. Data is provided to Mark, and he updates the GIS / database.

Historical Data: Yes ***Historical Data Comments:*** Back to about 1999

Spatial Data: Yes ***Spatial data format:*** Shapefiles, ArcGIS. DE State Plane

Photos: No ***How photos are catelogued:*** N/A

Data and Information Storage

Storage Format: ESRI with MS Access back-up

Storage Location: DNREC Network. Data on local drive. ***Maintained By:*** DNREC IT

Data Linked To a GUI: Yes ***GUI Software:*** ArcGIS 9.x

GUI Language: N/A ***GUI Built By:*** Glenn Gladders

Thoughts on Future Data Maintenance:

Maintain in house, share the data.

Data Sharing

Data Sharing Limitations: Mark does not like to give up point data for structural BMPs (privacy issue) however descriptive information is not a problem. Gov't groups: data sharing is not an issue.

How to Obtain Data: Just ask Mark Hogan.

Thoughts on Stakeholder Use:

DNREC perform daily updates. An outside source would connect in to retrieve data and put it into a database that others can use. Thus, instead of going to Mark, parties would just go to the database.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: Yes ***IT Staff Size:*** Separate Department

Current Software: ArcView 9.x & MS Access

Interview Summary

Organization DNREC: Coastal Program

Primary POC: Marcia Fox ***Phone:*** (302) 739-9282 ***Email:*** Marcia.fox@state.de.us

Secondary POC: ***Phone:*** ***Email:***

Exisiting BMP Information

BMPs Maintained:

The coastal program is a federal program that operates a little outside of the state agencies. They do not maintain any BMP data, and have turned tracking over to other groups.

Inventory: ***Inventory Comments:***

Background Data: ***Regular Inspections:*** ***Inspection Frequency:***

How data is updated:

Historical Data: ***Historical Data Comments:***

Spatial Data: ***Spatial data format:***

Photos: ***How photos are catelogued:***

Data and Information Storage

Storage Format:

Storage Location: ***Maintained By:***

Data Linked To a GUI: ***GUI Software:***

GUI Language: ***GUI Built By:***

Thoughts on Future Data Maintenance:

Data Sharing

Data Sharing Limitations:

How to Obtain Data:

Thoughts on Stakeholder Use:

Hardware and Software

Comfortable with MS Access: ***IT Staff:***

Comfortable wth GIS Software: ***IT Staff Size:***

Current Software:

Interview Summary

Organization DNREC: Groundwater Discharges

Primary POC: Dave Schepens ***Phone:*** (302) 739-9948 ***Email:*** Dave.schepens@state.de.us

Secondary POC: Ron Graeber ***Phone:*** (302) 739-9948 ***Email:*** Ronald.Graeber@state.de.us

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Exisiting BMP Information

BMPs Maintained:

On site waste water systems of all sizes (incl. spray irrigation): Over 80,000 on site septic systems, Several hundred > 2,500 gpd; Underground injection control program.

Inventory: Yes ***Inventory Comments:*** Some file folders, some MS Access, some Adabase

Background Data: Yes ***Regular Inspections:*** Yes ***Inspection Frequency:*** >2500 gpd: yearly

How data is updated: Field techs perform inspections and update the database. Some is done remotely in the field, some in the office. Report forms are entered into the "non-haz" database.

Historical Data: Yes ***Historical Data Comments:*** ---

Spatial Data: Yes ***Spatial data format:*** Only on larger systems, DE State Plane.

Photos: Yes ***How photos are catelogued:*** In general, photos are not linked to the data.

Data and Information Storage

Storage Format: MS Access, Adabase, file folders. Data being migrated to SQL server.

Storage Location: Dover & Georgetown ***Maintained By:*** Groundwater Discharges section staff.

Data Linked To a GUI: No ***GUI Software:*** N/A

GUI Language: N/A ***GUI Built By:*** N/A

Thoughts on Future Data Maintenance:

Dave would prefer for his group to manage and maintain the data, then upload it to a master system.

Data Sharing

Data Sharing Limitations: No real restrictions. Tend to follow the lead of DNREC Water Resources. Sharing data with state agencies is not too big an issue.

How to Obtain Data: Make a FOIA request. If the request for data is too large, the applicant may be asked to narrow it down.

Thoughts on Stakeholder Use:

Access based system with information to support the project at hand.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: Yes ***IT Staff Size:*** Separate Department

Current Software: Some Access, some Adabase

Interview Summary

Organization Kent Conservation District

Primary POC: Tim Riley ***Phone:*** (302) 741-2600 ***Email:*** Timothy.riley@state.de.us

Secondary POC: Paula Long ***Phone:*** (302) 741-2600 ***Email:*** Paula.long@state.de.us

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Exisiting BMP Information

BMPs Maintained:

The KCD does not really maintain BMP data on programs of their own. Instead, they support farmers that are tasked with meeting requirements. The data then goes to the appropriate agency to track.

Inventory: No ***Inventory Comments:*** ---

Background Data: Yes ***Regular Inspections:*** Yes ***Inspection Frequency:*** varies by BMP

How data is updated: No real updates, as things don't really change that much.

Historical Data: Yes ***Historical Data Comments:*** ---

Spatial Data: Yes ***Spatial data format:*** ---

Photos: Yes ***How photos are catelogued:*** Stormwater BMPs only.

Data and Information Storage

Storage Format: File folders.

Storage Location: District facility ***Maintained By:*** KCD staff

Data Linked To a GUI: No ***GUI Software:*** N/A

GUI Language: N/A ***GUI Built By:*** N/A

Thoughts on Future Data Maintenance:

Data Sharing

Data Sharing Limitations: Privacy Issues: farmers ID. FOIA request likely needed. If personal information is stripped out, it is ok to let the data go.

How to Obtain Data: Likely see Mark Hogan (DNREC 319 Program), as the paper folders do not contain summary data.

Thoughts on Stakeholder Use:

Possibly adding photographs to the overall system.

Hardware and Software

Comfortable with MS Access: ***IT Staff:***

Comfortable wth GIS Software: ***IT Staff Size:*** ---

Current Software: ---

Interview Summary

Organization NCCD (NRCS)

Primary POC: Marianne Hardesty ***Phone:*** (302) 832-3100 ***Email:*** Marianne.hardesty@de.usda.gov

Secondary POC: ***Phone:*** ***Email:***

Exisiting BMP Information

BMPs Maintained:

Cover Crop Data, Horse Pastures and loading, No till Data, Some cost share from SWM, Some riparian buffers in urban areas, Filter Strips, Some E&S measures at the edge of Ag lands, Fragmites Control.

Inventory: ***Inventory Comments:*** Can only pull data at the HUC 8 level. Reporting mechanism:PRS.

Background Data: No ***Regular Inspections:*** No ***Inspection Frequency:*** On construction & randomly

How data is updated: Data is entered into Toolkit / PRS by field office.

Historical Data: Yes ***Historical Data Comments:*** In Toolkit, does not migrate to PRS.

Spatial Data: Yes ***Spatial data format:*** Lat/Long

Photos: Yes ***How photos are catelogued:*** Some have been photographed.

Data and Information Storage

Storage Format: Performance Review System (NRCS computer system).

Storage Location: National Server ***Maintained By:*** NRCS IT

Data Linked To a GUI: Yes ***GUI Software:*** PRS/Toolkit

GUI Language: N/A ***GUI Built By:*** NRCS

Thoughts on Future Data Maintenance:

NRCS will maintain their data, then have it pulled. NRCS will not upload.

Data Sharing

Data Sharing Limitations: Specifics to a farm, by name or location is an issue, Can't give financial data, On a watershed basis, there are no issues with sharing data.

How to Obtain Data: ---

Thoughts on Stakeholder Use:

Tracking the acceptance of conservation practices, Calculations on nutrient management practice impacts, Input for state reports that need to be submitted.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: Yes ***IT Staff Size:*** USDA IT

Current Software: PRS & Toolkit

Interview Summary

Organization Perdue Agricycle

Primary POC: Heather Comegys ***Phone:*** (302) 943-2732 ***Email:*** Heather.comegys@perdue.com

Secondary POC: Wayne Hudson ***Phone:*** (410) 543-3919 ***Email:*** Wayne.hudson@perdue.com

Exisiting BMP Information

BMPs Maintained:

Tracks of the amount of waste taken from sites and the ultimate destination whether in or out of state. They serve most of the Kent and Sussex farming community (~1,400 farms.) PA does not have data on nutrient management plans, or if they are current. PA is told yes or no on if a plan exists, but not the expiration date.

Inventory: Yes ***Inventory Comments:*** Information to build a service map exists, it is sensitive business infor

Background Data: Yes ***Regular Inspections:*** No ***Inspection Frequency:*** N/A

How data is updated: PA weighs trucks when they deliver to the plant, that data is used to track loading. Grower info (data about the farm) is updated at time of service.

Historical Data: Yes ***Historical Data Comments:*** Back to 2001

Spatial Data: No ***Spatial data format:*** Database has farm addresses.

Photos: No ***How photos are catelogued:*** N/A

Data and Information Storage

Storage Format: Exel spreadsheet

Storage Location: Perdue Agricycle factility ***Maintained By:*** Perdue Agricycle staff

Data Linked To a GUI: No ***GUI Software:*** N/A

GUI Language: N/A ***GUI Built By:*** N/A

Thoughts on Future Data Maintenance:

Perdue Agricycle would prefer internal management of data, especially since it is sensitive to the business practice and protection of customer base.

Data Sharing

Data Sharing Limitations: Perdue Agricycle is concerned about what type of data is potentially made public as it is essentially a customer list. Data on manure removal on a watershed basis would not be as much of a problem as the customer base is masked.

How to Obtain Data: It would depend on who it is, government agency would be ok. From a business perspective it really depends.

Thoughts on Stakeholder Use:

The end users (customers) are growing in number, and PA wants to protect that data. Identify how many growers are signed up as generators and end uses. Identify how many are growers / generators and not end users.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: No ***IT Staff Size:*** Corporate IT staff

Current Software: Excel

Interview Summary

Organization Sussex Conservation District

Primary POC: Debbie Absher ***Phone:*** (302) 856-3990 ***Email:*** Debbie.Absher@de.nacdnet.net

Secondary POC: ***Phone:*** ***Email:***

Exisiting BMP Information

BMPs Maintained:

SCD provides technical and financial assistance, they are not regulatory.

Inventory: Yes ***Inventory Comments:*** Reports are made to the EPA on a watershed basis, there is a list of in

Background Data: Yes ***Regular Inspections:*** Yes ***Inspection Frequency:*** ---

How data is updated: Data is entered into PRS and the NRCS Customer Toolkit.

Historical Data: ***Historical Data Comments:***

Spatial Data: Yes ***Spatial data format:*** site not BMP specific. DE State Plane.

Photos: No ***How photos are catelogued:*** N/A

Data and Information Storage

Storage Format: PRS & Toolkit

Storage Location: National server ***Maintained By:*** NRCS IT

Data Linked To a GUI: Yes ***GUI Software:*** PRS/Toolkit

GUI Language: N/A ***GUI Built By:*** NRCS

Thoughts on Future Data Maintenance:

SCD would input data and maintain it. Problems go to IT, SCD wants to maintain control on their data.

Data Sharing

Data Sharing Limitations: Privacy issues with farmers. Don't mind sharing data but don't want to be too specific. Maps that are not to specific (ie don't tag BMPs to a parcel, but rather say there of XX of BMP YY in a watershed) would be ok.

How to Obtain Data: FOIA request

Thoughts on Stakeholder Use:

Providing information for PCS & TMDLs, Simplify the reporting process by making data available to all who would need it.

Hardware and Software

Comfortable with MS Access: Yes ***IT Staff:*** Yes

Comfortable wth GIS Software: Yes ***IT Staff Size:*** USDA IT

Current Software: PRS & Toolkit. Excel (state revolving funds)

Appendix C2

2007 BMP Data for Delaware

HUC-12	County Segment	Watershed	County	Nutreint Management Plans	Manure Relocation	Cover Crops	Conservation Tillage	Water Control Structures	AWMS: Livestock									
									Dairy Operations			Bovine Operations		Equine Operations		Swine		Goats
									Number of dairy operations	Number with animal waste handling systems	Number with manure sheds	Number of bovine (cow) operations	Number with manure sheds	Number of equine operations	Number with manure sheds	Number of hog operations	Number with manure sheds	Number of goat operations
				acres	tons	acres	acres	structures	operations	operations	operations	operations	operations	operations	operations	operations	operations	operations
20600020103	800010003	Perch Creek	New Castle County	0.00	0.00	0.00	50,158.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20600020201		C&D Canal West		4,061.09	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20600020202	370010003	Bohemia Creek		3,234.50	6,264.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20600020401	810010003	Sassafras River		3,390.03	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20600020602	380010003	Chester River		10,668.10	1,139.00	0.00		0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00
20600020601	380010001	Chester River	Kent County			1,647.68	117,232.00	0.00	6.00	1.00	0.00	2.00	0.00	4.00	0.00	2.00	0.00	0.00
20600050101	770010001	Choptank River		23,878.30	854.00	1,205.00		0.00	7.00	1.00	0.00	10.00	0.00	10.00	1.00	0.00	0.00	3.00
20600050102						2,386.36		0.00	1.00	0.00	0.00	5.00	0.00	19.00	4.00	3.00	1.00	0.00
20600050103						0.00		0.00	2.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00
20600050104	400010001					556.30		0.00	1.00	0.00	0.00	2.00	0.00	3.00	0.00	0.00	0.00	0.00
20600050106						1,092.00		0.00	1.00	0.00	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
20600050107						483.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20801090501	410010001	Marshyhope Creek				3,455.91		0.00	1.00	1.00	0.00	2.00	0.00	3.00	0.00	2.00	0.00	1.00
20801090502						5,722.79		0.00	4.00	4.00	1.00	2.00	0.00	11.00	2.00	2.00	2.00	0.00
20801090101	780010001 / 780010005	Nanticoke River				2,145.58		0.00	3.00	2.00	0.00	6.00	1.00	5.00	0.00	0.00	0.00	1.00
20801090102	780010005	Gum Branch	Sussex County	9,282.77	338.00	1,076.00	184,864.00	0.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
20801090503	410010005	Marshyhope Creek		32,086.80	3,493.00	1,244.27		0.00	4.00	2.00	1.00	1.00	0.00	2.00	0.00	0.00	0.00	0.00
20801090504						263.20		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20801090505						69.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20801090103		Gravelly Branch		7,569.31	977.00	933.90		0.00	0.00	0.00	0.00	3.00	0.00	2.00	0.00	0.00	0.00	0.00
20801090301		Deep Creek		16,250.65	71.00	678.10		0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	1.00	1.00	1.00
20801090302						737.60		0.00	0.00	0.00	0.00	1.00	0.00	2.00	0.00	1.00	0.00	0.00
20801090401		Broad Creek		39,294.03	12,114.00	234.80		0.00	0.00	0.00	0.00	5.00	1.00	4.00	0.00	0.00	0.00	0.00
20801090402						170.80		0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00
20801090403						261.30		0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	3.00	0.00	0.00
20801090404						203.20		0.00	0.00	0.00	0.00	3.00	0.00	2.00	0.00	1.00	0.00	0.00
20801090405						899.90		0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
20801090104		Nanticoke River		52,588.88	13,958.00	1,227.20		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20801090303						1,436.00		0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	2.00	0.00	0.00
20801090304						93.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20801090601						464.00		0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
20801090604						134.60		0.00	0.00	0.00	0.00	1.00	0.00	2.00	0.00	0.00	0.00	0.00
20600070101	420010005	Wicomico River		404.80	2,478.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
20600090101	430010005	Pocomoke River		10,154.08	9,718.00	233.50		0.00	0.00	0.00	0.00	1.00	0.00	2.00	0.00	3.00	2.00	0.00
TOTAL				212,863.33	51,404.00	29,055.49	352,254.00	0.00	32.00	12.00	5.00	51.00	4.00	79.00	8.00	23.00	7.00	7.00
Notes				Data not available by HUC-12 or County Segment. See "NMP" for more information.	Data not available by HUC-12 or County Segment. See "ManureRelocation" and "ManureReceivers" for more information.	Total in-place on 12/31/06.	Total for year 2004. Most recent data available. Figures include all tillage where residue is 15% or greater. Numbers are County-wide totals, but could be prorated by polygon areas to estimate acres in each County Segment.	According to NRCS there has not been much change in numbers for the year 2004 from 2003. Each structure is assumed to "treat" 75 acres of cropland in the Delaware PCS process.	Total in-place as o 12/31/07.	Total in-place as o 12/31/07.	Total in-place as o 12/31/07.	Total in-place as o 12/31/07.	Total in-place as o 12/31/07.	Total in-place as o 12/31/07.	Total in-place as o 12/31/07.	Total in-place as o 12/31/07.	Total in-place as o 12/31/07.	Total in-place as o 12/31/07.
Source				DE Nutrient Management Commission	DE Nutrient Management Commission	Delaware NPS Program / County Conservation Districts	USDA NRCS	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts

AWMS: Poultry										Other		CRP	CREP			
Poultry (# operations)					Poultry (Capacity- # Birds)											
Number of poultry operations	Number with manure sheds	Number with dead bird composters	Number with dead bird incinerators	Number with heavy use area protection	Capacity of all operations	Capacity served by manure sheds	Capacity served by composters	Capacity served by dead bird incinerators	Capacity served by heavy use area protection	Poultry House Windbreaks	Stream fencing	Retirement of Highly Erodible Land / CRP	Hardwood trees - riparian buffers (CREP)(CP22&CP3A)	Hardwood trees - wetland restoration (CREP)(CP23)	Grassed buffers (CREP)(CP21)	Wildlife habitat (CREP)(CP4D)
operations	operations	operations	operations	operations	birds	birds	birds	birds	birds	sites	feet	acres	acres	acres	acres	acres
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.10	6.30
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.90	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	10.10	0.00	8.90	22.60
3.00	4.00	4.00	0.00	1.00	389,336.00	389,336.00	197,336.00	0.00	389,336.00	0.00	0.00	86.90	18.50	3.20	19.60	30.10
19.00	12.00	10.00	0.00	0.00	1,165,383.00	866,674.00	805,339.00	0.00	0.00	0.00	0.00	137.90	45.00	0.00	42.90	1.10
9.00	6.00	7.00	0.00	4.00	658,672.00	378,670.00	510,404.00	0.00	202,669.00	0.00	0.00	38.00	98.50	35.10	16.70	12.30
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.60	0.00	11.00	4.00
7.00	7.00	7.00	0.00	4.00	586,668.00	554,668.00	554,668.00	0.00	373,334.00	0.00	0.00	63.40	17.60	29.10	18.00	9.90
3.00	3.00	3.00	0.00	1.00	256,003.00	256,003.00	256,003.00	0.00	58,668.00	0.00	0.00	0.00	47.00	0.00	0.00	4.70
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.80	5.00
14.00	10.00	6.00	0.00	17.00	762,676.00	570,674.00	477,340.00	0.00	437,339.00	0.00	0.00	62.80	122.10	6.50	113.40	44.40
34.00	25.00	22.00	0.00	18.00	2,360,016.00	1,778,679.00	1,498,677.00	0.00	840,005.00	2.00	0.00	84.40	162.30	44.60	250.60	51.30
41.00	31.00	28.00	0.00	29.00	2,304,018.00	1,541,346.00	1,605,346.00	0.00	594,670.00	1.00	0.00	5.10	388.60	82.10	45.90	39.00
36.00	26.00	20.00	2.00	48.00	2,144,011.00	1,250,675.00	1,050,671.00	0.00	824,002.00	0.00	0.00	5.00	217.20	30.00	0.00	20.00
22.00	17.00	17.00	1.00	15.00	1,312,011.00	1,048,008.00	1,112,008.00	0.00	290,669.00	0.00	0.00	4.50	124.50	9.60	2.70	19.00
7.00	6.00	6.00	0.00	1.00	661,343.00	597,343.00	613,343.00	0.00	176,004.00	1.00	0.00	0.00	32.70	8.80	7.20	20.10
4.00	3.00	3.00	0.00	0.00	277,334.00	248,000.00	248,000.00	0.00	0.00	0.00	0.00	0.00	13.20	0.00	0.00	2.30
16.00	15.00	12.00	1.00	22.00	1,320,013.00	1,218,677.00	968,005.00	0.00	546,669.00	0.00	0.00	1.70	164.40	5.40	0.00	16.60
14.00	10.00	7.00	0.00	2.00	1,445,368.00	480,004.00	458,670.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	4.00
44.00	29.00	26.00	0.00	46.00	2,634,689.00	1,504,014.00	1,586,678.00	0.00	730,672.00	2.00	0.00	25.60	42.80	0.00	0.00	5.00
29.00	22.00	21.00	0.00	30.00	1,685,342.00	1,354,672.00	1,301,340.00	0.00	701,336.00	0.00	0.00	0.00	17.50	0.00	0.00	2.40
53.00	25.00	32.00	2.00	41.00	3,176,029.00	1,520,017.00	1,986,684.00	130,667.00	696,005.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
65.00	44.00	42.00	1.00	38.00	3,584,032.00	2,568,020.00	2,552,021.00	42,667.00	749,337.00	2.00	0.00	5.00	0.00	0.00	0.00	0.00
63.00	26.00	37.00	0.00	37.00	3,847,038.00	1,957,351.00	2,615,024.00	0.00	1,045,340.00	2.00	0.00	3.60	141.10	0.00	0.00	22.10
43.00	25.00	29.00	0.00	15.00	3,040,023.00	1,738,679.00	2,200,017.00	0.00	800,007.00	1.00	0.00	5.00	89.10	0.00	0.00	8.80
34.00	21.00	27.00	0.00	21.00	2,778,688.00	1,616,014.00	2,370,682.00	0.00	597,337.00	1.00	0.00	23.20	63.30	0.00	43.40	36.00
48.00	31.00	34.00	0.00	51.00	3,829,626.00	2,701,616.00	2,789,617.00	0.00	1,533,343.00	2.00	0.00	0.00	151.00	36.00	27.20	43.90
2.00	2.00	2.00	0.00	0.00	154,667.00	154,667.00	154,667.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26.00	16.00	20.00	0.00	35.00	1,773,349.00	1,197,347.00	1,289,078.00	0.00	573,336.00	1.00	0.00	5.60	0.00	0.00	0.00	4.80
8.00	4.00	5.00	0.00	4.00	512,004.00	237,335.00	336,003.00	0.00	53,334.00	1.00	0.00	1.10	43.10	0.00	0.00	0.00
6.00	2.00	3.00	0.00	1.00	328,002.00	96,000.00	248,001.00	0.00	64,000.00	0.00	0.00	0.00	24.40	0.00	0.00	0.00
69.00	47.00	46.00	0.00	56.00	4,666,717.00	3,088,034.00	2,858,699.00	0.00	989,880.00	1.00	0.00	0.00	78.80	13.00	69.60	33.40
719.00	469.00	476.00	7.00	537.00	47,653,058.00	30,912,523.00	32,644,321.00	173,334.00	13,267,292.00	17.00	0.00	628.90	2,121.40	303.40	689.00	469.10
Total in-place as o 12/31/07.	Total in-place as o 12/31/07.	Total in-place as o 12/31/07.	Total in-place as o 12/31/07.	Total in-place as o 12/31/07.	Total in-place as of 12/31/07.	Total in-place as of 12/31/07.	Total in-place as of 12/31/07.	Total in-place as o 12/31/07.	Total in-place as of 12/31/07.	Total in-place as o 12/31/06.	Installed during calendar year 2003.	Total in-place as of December 31, 2006.	Total in-place as of December 31, 2007. Includes practices CP22 and CP3A.	Total in-place as of December 31, 2007. Practice CP23.	Total in-place as of December 31, 2007. Practice CP21.	Total in-place as of December 31, 2007. Practice CP4D.
Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County Conservation Districts	Delaware NPS Program / County USDA Service Centers	Delaware NPS Program	Delaware NPS Program	Delaware NPS Program	Delaware NPS Program

Delaware Watershed Net Report For Manure Relocation			
	Tons	Tons	Net Tons
Name	Exported	Imported	Exported/Imported
Amy Creek	0.00	0.00	0.00
Appoquinimink River	0.00	1,046.00	1,046.00
Assawoman	719.00	0.00	-719.00
Blackbird Creek	0.00	0.00	0.00
Bohemia Creek	6,264.00	0.00	-6,264.00
Brandywine Creek	0.00	0.00	0.00
Broad Creek	12,114.00	1,333.00	-10,781.00
Broadkill River	1,656.00	9,613.00	7,957.00
Buntings Branch	328.00	0.00	-328.00
C & D Canal East	0.00	0.00	0.00
C & D Canal West	0.00	0.00	0.00
Cedar Creek	0.00	228.00	228.00
Chester River	1,139.00	0.00	-1,139.00
Choptank River	854.00	796.00	-58.00
Christina River	0.00	0.00	0.00
Deep Creek	71.00	0.00	-71.00
Delaware Bay	0.00	0.00	0.00
Delaware River	0.00	0.00	0.00
Dragon Run Creek	0.00	0.00	0.00
Elk Creek	0.00	0.00	0.00
Gravelly Branch	977.00	0.00	-977.00
Gum Branch	338.00	0.00	-338.00
Indian River	1,390.00	314.00	-1,076.00
Indian River Bay	10,282.00	169.00	-10,113.00
Iron Branch	768.00	0.00	-768.00
Leipsic River	915.00	0.00	-915.00
Lewes Rehoboth Canal	0.00	0.00	0.00
Little Assawoman	0.00	0.00	0.00
Little Creek	0.00	0.00	0.00
Marshyhope Creek	3,493.00	1,227.00	-2,266.00
Mispillion River	3,109.00	165.00	-2,944.00
Murderkill River	2,615.00	0.00	-2,615.00
Naamans Creek	0.00	0.00	0.00
Nanticoke River	13,958.00	2,862.00	-11,096.00
Perch Creek	0.00	0.00	0.00
Pocomoke River	9,718.00	47.00	-9,671.00
Red Clay Creek	0.00	0.00	0.00
Red Lion Creek	0.00	1,634.00	1,634.00
Rehoboth Bay	0.00	0.00	0.00
Sassafras River	0.00	311.00	311.00
Shellpot Creek	0.00	0.00	0.00
Smyrna River	0.00	5,097.00	5,097.00
St. Jones River	1,618.00	2,282.00	664.00
White Clay Creek	0.00	0.00	0.00
Wicomico	2,478.00	0.00	-2,478.00
Totals	74,804.00	27,124.00	-47,680.00
Piedmont Basin	0.00	0.00	0.00
Delaware Bay Basin	9,913.00	20,065.00	10,152.00
Chesapeake Bay Basin	51,404.00	6,576.00	-44,828.00
Inland Bays/Atlantic Ocean	13,487.00	483.00	-13,004.00

* Net Exported if number is negative, otherwise Net Imported

Sender Watershed	Sender Basin	Receiver Town	Receiver State	Claim Tons
Nanticoke River	Chesapeake Bay Basin	Frankford	DE	72
Indian River	Inland Bays/Atlantic Ocean	Frankford	DE	50
Indian River	Inland Bays/Atlantic Ocean	Frankford	DE	47
Murderkill River	Delaware Bay Basin	Harrington	DE	237
Murderkill River	Delaware Bay Basin	Harrington	DE	597
Marshyhope Creek	Chesapeake Bay Basin	Harrington	DE	370
Nanticoke River	Chesapeake Bay Basin	Harrington	DE	71
Nanticoke River	Chesapeake Bay Basin	Harrington	DE	23
Mispillion River	Delaware Bay Basin	Laurel	DE	193
Nanticoke River	Chesapeake Bay Basin	Laurel	DE	424
Broadkill River	Delaware Bay Basin	Laurel	DE	47
Broadkill River	Delaware Bay Basin	Laurel	DE	300
Indian River	Inland Bays/Atlantic Ocean	Laurel	DE	47
Broad Creek	Chesapeake Bay Basin	Laurel	DE	119
Indian River Bay	Inland Bays/Atlantic Ocean	Laurel	DE	250
Broad Creek	Chesapeake Bay Basin	Lewes	DE	207
Broad Creek	Chesapeake Bay Basin	Magnolia	DE	545
Broad Creek	Chesapeake Bay Basin	Marydel	DE	725
Broad Creek	Chesapeake Bay Basin	Marydel	DE	987
Broad Creek	Chesapeake Bay Basin	Marydel	DE	781
Wicomico	Chesapeake Bay Basin	Marydel	DE	355
Pocomoke River	Chesapeake Bay Basin	Marydel	DE	326
Pocomoke River	Chesapeake Bay Basin	Marydel	DE	420
Bohemia Creek	Chesapeake Bay Basin	Middletown	DE	1775
Bohemia Creek	Chesapeake Bay Basin	Middletown	DE	99
St. Jones River	Delaware Bay Basin	Middletown	DE	219
Nanticoke River	Chesapeake Bay Basin	Milford	DE	228
Nanticoke River	Chesapeake Bay Basin	Milford	DE	171
Broad Creek	Chesapeake Bay Basin	Milford	DE	318
Broad Creek	Chesapeake Bay Basin	Milford	DE	696
Pocomoke River	Chesapeake Bay Basin	Milford	DE	233
Pocomoke River	Chesapeake Bay Basin	Milford	DE	380
Assawoman	Inland Bays/Atlantic Ocean	Milford	DE	323
Nanticoke River	Chesapeake Bay Basin	Millsboro	DE	24
Indian River Bay	Inland Bays/Atlantic Ocean	Millsboro	DE	290
Mispillion River	Delaware Bay Basin	Milton	DE	165
Mispillion River	Delaware Bay Basin	Milton	DE	174
Nanticoke River	Chesapeake Bay Basin	Milton	DE	516
Nanticoke River	Chesapeake Bay Basin	Milton	DE	265
Nanticoke River	Chesapeake Bay Basin	Milton	DE	89
Nanticoke River	Chesapeake Bay Basin	Milton	DE	861
Nanticoke River	Chesapeake Bay Basin	Milton	DE	400
Nanticoke River	Chesapeake Bay Basin	Milton	DE	228
Nanticoke River	Chesapeake Bay Basin	Milton	DE	262
Nanticoke River	Chesapeake Bay Basin	Milton	DE	378
Gravelly Branch	Chesapeake Bay Basin	Milton	DE	48
Broadkill River	Delaware Bay Basin	Milton	DE	252
Broad Creek	Chesapeake Bay Basin	Milton	DE	439
Broad Creek	Chesapeake Bay Basin	Milton	DE	420
Broad Creek	Chesapeake Bay Basin	Milton	DE	449
Wicomico	Chesapeake Bay Basin	Milton	DE	433
Wicomico	Chesapeake Bay Basin	Milton	DE	167
Pocomoke River	Chesapeake Bay Basin	Milton	DE	125
Pocomoke River	Chesapeake Bay Basin	Milton	DE	432
Pocomoke River	Chesapeake Bay Basin	Milton	DE	163
Pocomoke River	Chesapeake Bay Basin	Milton	DE	825
Iron Branch	Inland Bays/Atlantic Ocean	Milton	DE	225
Iron Branch	Inland Bays/Atlantic Ocean	Milton	DE	46
Indian River Bay	Inland Bays/Atlantic Ocean	Milton	DE	517
Indian River Bay	Inland Bays/Atlantic Ocean	Milton	DE	311
Indian River Bay	Inland Bays/Atlantic Ocean	Milton	DE	122
Indian River Bay	Inland Bays/Atlantic Ocean	Milton	DE	290
Bohemia Creek	Chesapeake Bay Basin	New Castle	DE	1118
Marshyhope Creek	Chesapeake Bay Basin	New Castle	DE	516
St. Jones River	Delaware Bay Basin	Seaford	DE	618
St. Jones River	Delaware Bay Basin	Seaford	DE	492
Murderkill River	Delaware Bay Basin	Seaford	DE	439

Sender Watershed	Sender Basin	Receiver Town	Receiver State	Claim Tons
Murderkill River	Delaware Bay Basin	Seaford	DE	74
Murderkill River	Delaware Bay Basin	Seaford	DE	79
Murderkill River	Delaware Bay Basin	Seaford	DE	106
Murderkill River	Delaware Bay Basin	Seaford	DE	209
Mispillion River	Delaware Bay Basin	Seaford	DE	488
Mispillion River	Delaware Bay Basin	Seaford	DE	974
Mispillion River	Delaware Bay Basin	Seaford	DE	272
Mispillion River	Delaware Bay Basin	Seaford	DE	470
Marshyhope Creek	Chesapeake Bay Basin	Seaford	DE	22
Marshyhope Creek	Chesapeake Bay Basin	Seaford	DE	180
Nanticoke River	Chesapeake Bay Basin	Seaford	DE	56
Nanticoke River	Chesapeake Bay Basin	Seaford	DE	231
Nanticoke River	Chesapeake Bay Basin	Seaford	DE	752
Nanticoke River	Chesapeake Bay Basin	Seaford	DE	632
Nanticoke River	Chesapeake Bay Basin	Seaford	DE	40
Nanticoke River	Chesapeake Bay Basin	Seaford	DE	561
Gravelly Branch	Chesapeake Bay Basin	Seaford	DE	516
Gravelly Branch	Chesapeake Bay Basin	Seaford	DE	298
Gum Branch	Chesapeake Bay Basin	Seaford	DE	292
Broadkill River	Delaware Bay Basin	Seaford	DE	443
Broadkill River	Delaware Bay Basin	Seaford	DE	64
Broadkill River	Delaware Bay Basin	Seaford	DE	486
Deep Creek	Chesapeake Bay Basin	Seaford	DE	24
Indian River	Inland Bays/Atlantic Ocean	Seaford	DE	252
Indian River	Inland Bays/Atlantic Ocean	Seaford	DE	102
Indian River	Inland Bays/Atlantic Ocean	Seaford	DE	321
Indian River	Inland Bays/Atlantic Ocean	Seaford	DE	77
Broad Creek	Chesapeake Bay Basin	Seaford	DE	239
Broad Creek	Chesapeake Bay Basin	Seaford	DE	249
Pocomoke River	Chesapeake Bay Basin	Seaford	DE	25
Pocomoke River	Chesapeake Bay Basin	Seaford	DE	34
Iron Branch	Inland Bays/Atlantic Ocean	Seaford	DE	15
Indian River Bay	Inland Bays/Atlantic Ocean	Seaford	DE	321
Indian River Bay	Inland Bays/Atlantic Ocean	Seaford	DE	72
Indian River Bay	Inland Bays/Atlantic Ocean	Seaford	DE	295
Indian River Bay	Inland Bays/Atlantic Ocean	Seaford	DE	832
Indian River Bay	Inland Bays/Atlantic Ocean	Seaford	DE	606
Indian River Bay	Inland Bays/Atlantic Ocean	Seaford	DE	247
Indian River Bay	Inland Bays/Atlantic Ocean	Seaford	DE	378
Indian River Bay	Inland Bays/Atlantic Ocean	Seaford	DE	75
Indian River Bay	Inland Bays/Atlantic Ocean	Seaford	DE	316
Indian River Bay	Inland Bays/Atlantic Ocean	Seaford	DE	109
Indian River Bay	Inland Bays/Atlantic Ocean	Seaford	DE	671
Buntings Branch	Inland Bays/Atlantic Ocean	Seaford	DE	263
Chester River	Chesapeake Bay Basin	Townsend	DE	365
Chester River	Chesapeake Bay Basin	Townsend	DE	508
Chester River	Chesapeake Bay Basin	Townsend	DE	266
Murderkill River	Delaware Bay Basin	Townsend	DE	311
Murderkill River	Delaware Bay Basin	Townsend	DE	260
Indian River Bay	Inland Bays/Atlantic Ocean	Townsend	DE	202
Wicomico	Chesapeake Bay Basin	Worton	DE	48
Choptank River	Chesapeake Bay Basin	Wyoming	DE	576
Pocomoke River	Chesapeake Bay Basin	Wyoming	DE	96
Iron Branch	Inland Bays/Atlantic Ocean	Wyoming	DE	192
Indian River Bay	Inland Bays/Atlantic Ocean	Wyoming	DE	873
Marshyhope Creek	Chesapeake Bay Basin	Chaptico	MD	551
Marshyhope Creek	Chesapeake Bay Basin	Chaptico	MD	236
Broad Creek	Chesapeake Bay Basin	Chaptico	MD	655
Broad Creek	Chesapeake Bay Basin	Charlotte Hall	MD	163
Bohemia Creek	Chesapeake Bay Basin	Chestertown	MD	522
Bohemia Creek	Chesapeake Bay Basin	Chestertown	MD	373
Bohemia Creek	Chesapeake Bay Basin	Chestertown	MD	450
Bohemia Creek	Chesapeake Bay Basin	Chestertown	MD	183
Bohemia Creek	Chesapeake Bay Basin	Chestertown	MD	362
Broad Creek	Chesapeake Bay Basin	Chestertown	MD	603
Pocomoke River	Chesapeake Bay Basin	Chestertown	MD	413
Pocomoke River	Chesapeake Bay Basin	Chestertown	MD	545
Pocomoke River	Chesapeake Bay Basin	Chestertown	MD	454

Sender Watershed	Sender Basin	Receiver Town	Receiver State	Claim Tons
Pocomoke River	Chesapeake Bay Basin	Chestertown	MD	494
Pocomoke River	Chesapeake Bay Basin	Chestertown	MD	187
Pocomoke River	Chesapeake Bay Basin	Chestertown	MD	369
Indian River Bay	Inland Bays/Atlantic Ocean	Chestertown	MD	423
Indian River Bay	Inland Bays/Atlantic Ocean	Chestertown	MD	324
Assawoman	Inland Bays/Atlantic Ocean	Chestertown	MD	396
Nanticoke River	Chesapeake Bay Basin	Clements	MD	92
Nanticoke River	Chesapeake Bay Basin	Clements	MD	237
Nanticoke River	Chesapeake Bay Basin	Denton	MD	492
Iron Branch	Inland Bays/Atlantic Ocean	Denton	MD	72
Broad Creek	Chesapeake Bay Basin	Drayden	MD	303
Murderkill River	Delaware Bay Basin	Easton	MD	24
Bohemia Creek	Chesapeake Bay Basin	Elkton	MD	526
Bohemia Creek	Chesapeake Bay Basin	Elkton	MD	277
Bohemia Creek	Chesapeake Bay Basin	Galena	MD	234
Leipsic River	Delaware Bay Basin	Galena	MD	915
Broad Creek	Chesapeake Bay Basin	Gambrills	MD	172
Pocomoke River	Chesapeake Bay Basin	Hampstead	MD	221
Nanticoke River	Chesapeake Bay Basin	Hurlock	MD	22
Indian River Bay	Inland Bays/Atlantic Ocean	Hurlock	MD	115
Marshyhope Creek	Chesapeake Bay Basin	Lexington Park	MD	286
Nanticoke River	Chesapeake Bay Basin	Lexington Park	MD	186
Nanticoke River	Chesapeake Bay Basin	Loveville	MD	955
Nanticoke River	Chesapeake Bay Basin	MarDela Springs	MD	145
Marshyhope Creek	Chesapeake Bay Basin	Mechanicsville	MD	139
Nanticoke River	Chesapeake Bay Basin	Mechanicsville	MD	73
Nanticoke River	Chesapeake Bay Basin	Mechanicsville	MD	575
Nanticoke River	Chesapeake Bay Basin	Mechanicsville	MD	48
Broad Creek	Chesapeake Bay Basin	Mechanicsville	MD	510
Nanticoke River	Chesapeake Bay Basin	Morganza	MD	209
Nanticoke River	Chesapeake Bay Basin	Nanjemoy	MD	1021
Bohemia Creek	Chesapeake Bay Basin	North East	MD	115
Broad Creek	Chesapeake Bay Basin	Park Hall	MD	566
Indian River	Inland Bays/Atlantic Ocean	Powellville	MD	147
Indian River	Inland Bays/Atlantic Ocean	Powellville	MD	67
Marshyhope Creek	Chesapeake Bay Basin	Prince Frederick	MD	567
Broad Creek	Chesapeake Bay Basin	Rhodedale	MD	718
Nanticoke River	Chesapeake Bay Basin	Rhodesdale	MD	407
Nanticoke River	Chesapeake Bay Basin	Rhodesdale	MD	72
Nanticoke River	Chesapeake Bay Basin	Ridge	MD	48
Pocomoke River	Chesapeake Bay Basin	Rock Hall	MD	848
Nanticoke River	Chesapeake Bay Basin	St. Inigoes	MD	280
Bohemia Creek	Chesapeake Bay Basin	Warwick	MD	230
St. Jones River	Delaware Bay Basin	Worton	MD	240
Iron Branch	Inland Bays/Atlantic Ocean	Worton	MD	71
Indian River Bay	Inland Bays/Atlantic Ocean	Worton	MD	122
Nanticoke River	Chesapeake Bay Basin	Worton	MD	96
Broad Creek	Chesapeake Bay Basin	Bridgeton	NJ	49
Broad Creek	Chesapeake Bay Basin	Cecil	NJ	40
Indian River Bay	Inland Bays/Atlantic Ocean	Cecil	NJ	108
Marshyhope Creek	Chesapeake Bay Basin	Elmer	NJ	49
Broad Creek	Chesapeake Bay Basin	Elmer	NJ	26
Pocomoke River	Chesapeake Bay Basin	Elmer	NJ	70
Murderkill River	Delaware Bay Basin	Elmer	NJ	24
Mispillion River	Delaware Bay Basin	Elmer	NJ	52
Indian River	Inland Bays/Atlantic Ocean	Elmer	NJ	26
Pocomoke River	Chesapeake Bay Basin	Monroeville	NJ	277
Broad Creek	Chesapeake Bay Basin	Pilesgrove	NJ	123
Pocomoke River	Chesapeake Bay Basin	Pilesgrove	NJ	522
Indian River Bay	Inland Bays/Atlantic Ocean	Pilesgrove	NJ	519
Choptank River	Chesapeake Bay Basin	Avondale	PA	111
Choptank River	Chesapeake Bay Basin	Avondale	PA	143
Murderkill River	Delaware Bay Basin	Avondale	PA	46
Murderkill River	Delaware Bay Basin	Avondale	PA	48
Mispillion River	Delaware Bay Basin	Avondale	PA	24
Mispillion River	Delaware Bay Basin	Avondale	PA	21
Mispillion River	Delaware Bay Basin	Avondale	PA	68
Mispillion River	Delaware Bay Basin	Avondale	PA	43

Sender Watershed	Sender Basin	Receiver Town	Receiver State	Claim Tons
Marshyhope Creek	Chesapeake Bay Basin	Avondale	PA	94
Nanticoke River	Chesapeake Bay Basin	Avondale	PA	22
Nanticoke River	Chesapeake Bay Basin	Avondale	PA	75
Nanticoke River	Chesapeake Bay Basin	Avondale	PA	20
Nanticoke River	Chesapeake Bay Basin	Avondale	PA	74
Nanticoke River	Chesapeake Bay Basin	Avondale	PA	470
Gravelly Branch	Chesapeake Bay Basin	Avondale	PA	22
Broadkill River	Delaware Bay Basin	Avondale	PA	21
Deep Creek	Chesapeake Bay Basin	Avondale	PA	23
Indian River	Inland Bays/Atlantic Ocean	Avondale	PA	24
Indian River	Inland Bays/Atlantic Ocean	Avondale	PA	45
Indian River	Inland Bays/Atlantic Ocean	Avondale	PA	22
Indian River	Inland Bays/Atlantic Ocean	Avondale	PA	50
Indian River	Inland Bays/Atlantic Ocean	Avondale	PA	45
Broad Creek	Chesapeake Bay Basin	Avondale	PA	117
Broad Creek	Chesapeake Bay Basin	Avondale	PA	47
Broad Creek	Chesapeake Bay Basin	Avondale	PA	96
Wicomico	Chesapeake Bay Basin	Avondale	PA	24
Wicomico	Chesapeake Bay Basin	Avondale	PA	24
Pocomoke River	Chesapeake Bay Basin	Avondale	PA	22
Pocomoke River	Chesapeake Bay Basin	Avondale	PA	26
Pocomoke River	Chesapeake Bay Basin	Avondale	PA	50
Pocomoke River	Chesapeake Bay Basin	Avondale	PA	21
Pocomoke River	Chesapeake Bay Basin	Avondale	PA	543
Iron Branch	Inland Bays/Atlantic Ocean	Avondale	PA	73
Iron Branch	Inland Bays/Atlantic Ocean	Avondale	PA	49
Indian River Bay	Inland Bays/Atlantic Ocean	Avondale	PA	25
Indian River Bay	Inland Bays/Atlantic Ocean	Avondale	PA	74
Indian River Bay	Inland Bays/Atlantic Ocean	Avondale	PA	70
Indian River Bay	Inland Bays/Atlantic Ocean	Avondale	PA	48
Indian River Bay	Inland Bays/Atlantic Ocean	Avondale	PA	44
Indian River Bay	Inland Bays/Atlantic Ocean	Avondale	PA	52
Indian River Bay	Inland Bays/Atlantic Ocean	Avondale	PA	117
Indian River Bay	Inland Bays/Atlantic Ocean	Avondale	PA	71
Buntings Branch	Inland Bays/Atlantic Ocean	Avondale	PA	45
Nanticoke River	Chesapeake Bay Basin	Booth Wynn	PA	255
Indian River Bay	Inland Bays/Atlantic Ocean	Booth Wynn	PA	161
Pocomoke River	Chesapeake Bay Basin	Kennett Square	PA	256
Broad Creek	Chesapeake Bay Basin	Toughkanamon	PA	263
Murderkill River	Delaware Bay Basin	Toughkenamon	PA	22
Murderkill River	Delaware Bay Basin	Toughkenamon	PA	22
Mispillion River	Delaware Bay Basin	Toughkenamon	PA	70
Nanticoke River	Chesapeake Bay Basin	Toughkenamon	PA	24
Nanticoke River	Chesapeake Bay Basin	Toughkenamon	PA	50
Gravelly Branch	Chesapeake Bay Basin	Toughkenamon	PA	46
Broadkill River	Delaware Bay Basin	Toughkenamon	PA	24
Broad Creek	Chesapeake Bay Basin	Toughkenamon	PA	23
Wicomico	Chesapeake Bay Basin	Toughkenamon	PA	284
Pocomoke River	Chesapeake Bay Basin	Toughkenamon	PA	25
Pocomoke River	Chesapeake Bay Basin	Toughkenamon	PA	542
Iron Branch	Inland Bays/Atlantic Ocean	Toughkenamon	PA	25
Indian River Bay	Inland Bays/Atlantic Ocean	Toughkenamon	PA	51
Indian River Bay	Inland Bays/Atlantic Ocean	Toughkenamon	PA	47
Indian River Bay	Inland Bays/Atlantic Ocean	Toughkenamon	PA	186
Choptank River	Chesapeake Bay Basin	West Grove	PA	24
St. Jones River	Delaware Bay Basin	West Grove	PA	49
Murderkill River	Delaware Bay Basin	West Grove	PA	23
Murderkill River	Delaware Bay Basin	West Grove	PA	23
Mispillion River	Delaware Bay Basin	West Grove	PA	95
Marshyhope Creek	Chesapeake Bay Basin	West Grove	PA	64
Nanticoke River	Chesapeake Bay Basin	West Grove	PA	24
Nanticoke River	Chesapeake Bay Basin	West Grove	PA	42
Gravelly Branch	Chesapeake Bay Basin	West Grove	PA	47
Indian River	Inland Bays/Atlantic Ocean	West Grove	PA	24
Broad Creek	Chesapeake Bay Basin	West Grove	PA	24
Broad Creek	Chesapeake Bay Basin	West Grove	PA	24
Broad Creek	Chesapeake Bay Basin	West Grove	PA	260
Broad Creek	Chesapeake Bay Basin	West Grove	PA	334

Sender Watershed	Sender Basin	Receiver Town	Receiver State	Claim Tons
Broad Creek	Chesapeake Bay Basin	West Grove	PA	824
Wicomico	Chesapeake Bay Basin	West Grove	PA	74
Wicomico	Chesapeake Bay Basin	West Grove	PA	302
Pocomoke River	Chesapeake Bay Basin	West Grove	PA	25
Pocomoke River	Chesapeake Bay Basin	West Grove	PA	51
Pocomoke River	Chesapeake Bay Basin	West Grove	PA	24
Pocomoke River	Chesapeake Bay Basin	West Grove	PA	553
Indian River Bay	Inland Bays/Atlantic Ocean	West Grove	PA	411
Indian River Bay	Inland Bays/Atlantic Ocean	West Grove	PA	25
Indian River Bay	Inland Bays/Atlantic Ocean	West Grove	PA	44
Indian River Bay	Inland Bays/Atlantic Ocean	West Grove	PA	74
Indian River Bay	Inland Bays/Atlantic Ocean	West Grove	PA	24
Indian River Bay	Inland Bays/Atlantic Ocean	West Grove	PA	161
Indian River Bay	Inland Bays/Atlantic Ocean	West Grove	PA	92
Indian River Bay	Inland Bays/Atlantic Ocean	West Grove	PA	25
Indian River Bay	Inland Bays/Atlantic Ocean	West Grove	PA	24
Pocomoke River	Chesapeake Bay Basin	Westgrove	PA	121
Indian River	Inland Bays/Atlantic Ocean	Bealeton	VA	22
Nanticoke River	Chesapeake Bay Basin	Center Cross	VA	443
Nanticoke River	Chesapeake Bay Basin	Center Cross	VA	564
Wicomico	Chesapeake Bay Basin	Colonial Beach	VA	191
Nanticoke River	Chesapeake Bay Basin	Dunnsville	VA	462
Murderkill River	Delaware Bay Basin	Heathsville	VA	71
Nanticoke River	Chesapeake Bay Basin	Heathsville	VA	121
Deep Creek	Chesapeake Bay Basin	Heathsville	VA	24
Indian River Bay	Inland Bays/Atlantic Ocean	Heathsville	VA	46
Nanticoke River	Chesapeake Bay Basin	Lovettsville	VA	70
Gum Branch	Chesapeake Bay Basin	Lovettsville	VA	46
Buntings Branch	Inland Bays/Atlantic Ocean	Lovettsville	VA	20
Marshyhope Creek	Chesapeake Bay Basin	Milford	VA	419
Wicomico	Chesapeake Bay Basin	Walkerton	VA	576
Broadkill River	Delaware Bay Basin	Harpers Ferry	WV	19
Indian River	Inland Bays/Atlantic Ocean	Harpers Ferry	WV	22
Indian River Bay	Inland Bays/Atlantic Ocean	Harpers Ferry	WV	22

Sum of Claim Tons from the Chesapeake Bay Basin			
Receiver State	**Receiver Town**	**Sender Basin**	**Total**
DE	Frankford	Chesapeake Bay Basin	72
	Harrington	Chesapeake Bay Basin	464
	Laurel	Chesapeake Bay Basin	543
	Lewes	Chesapeake Bay Basin	207
	Magnolia	Chesapeake Bay Basin	545
	Marydel	Chesapeake Bay Basin	3594
	Middletown	Chesapeake Bay Basin	1874
	Milford	Chesapeake Bay Basin	2026
	Millsboro	Chesapeake Bay Basin	24
	Milton	Chesapeake Bay Basin	6500
	New Castle	Chesapeake Bay Basin	1634
	Seaford	Chesapeake Bay Basin	4151
	Townsend	Chesapeake Bay Basin	1139
	Worton	Chesapeake Bay Basin	48
	Wyoming	Chesapeake Bay Basin	672
DE Total			23493
MD	Chaptico	Chesapeake Bay Basin	1442
	Charlotte Hall	Chesapeake Bay Basin	163
	Chestertown	Chesapeake Bay Basin	4955
	Clements	Chesapeake Bay Basin	329
	Denton	Chesapeake Bay Basin	492
	Drayden	Chesapeake Bay Basin	303
	Elkton	Chesapeake Bay Basin	803
	Galena	Chesapeake Bay Basin	234
	Gambrills	Chesapeake Bay Basin	172
	Hampstead	Chesapeake Bay Basin	221
	Hurlock	Chesapeake Bay Basin	22
	Lexington Park	Chesapeake Bay Basin	472
	Loveville	Chesapeake Bay Basin	955
	MarDela Springs	Chesapeake Bay Basin	145
	Mechanicsville	Chesapeake Bay Basin	1345
	Morganza	Chesapeake Bay Basin	209
	Nanjemoy	Chesapeake Bay Basin	1021
	North East	Chesapeake Bay Basin	115
	Park Hall	Chesapeake Bay Basin	566
	Prince Frederick	Chesapeake Bay Basin	567
	Rhodedale	Chesapeake Bay Basin	718
	Rhodesdale	Chesapeake Bay Basin	479
	Ridge	Chesapeake Bay Basin	48
	Rock Hall	Chesapeake Bay Basin	848
	St. Inigoes	Chesapeake Bay Basin	280
	Warwick	Chesapeake Bay Basin	230
	Worton	Chesapeake Bay Basin	96
MD Total			17230
NJ	Bridgeton	Chesapeake Bay Basin	49
	Cecil	Chesapeake Bay Basin	40
	Elmer	Chesapeake Bay Basin	145
	Monroeville	Chesapeake Bay Basin	277
	Pilesgrove	Chesapeake Bay Basin	645
NJ Total			1156
PA	Avondale	Chesapeake Bay Basin	2024
	Booth Wynn	Chesapeake Bay Basin	255
	Kennett Square	Chesapeake Bay Basin	256
	Toughkanamon	Chesapeake Bay Basin	263
	Toughkenamon	Chesapeake Bay Basin	994
	West Grove	Chesapeake Bay Basin	2696
	Westgrove	Chesapeake Bay Basin	121
PA Total			6609
VA	Center Cross	Chesapeake Bay Basin	1007
	Colonial Beach	Chesapeake Bay Basin	191
	Dunnsville	Chesapeake Bay Basin	462
	Heathsville	Chesapeake Bay Basin	145
	Lovettsville	Chesapeake Bay Basin	116
	Milford	Chesapeake Bay Basin	419
	Walkerton	Chesapeake Bay Basin	576
VA Total			2916

Chesapeake Watersheds

Name	NMP ENROLLED ACRES 2001-2007*	2002 Ag m2	2002 Ag Acres	%	Estimated NMP Acres
Bohemia Creek	3,234.50	16,466,332.99	4,068.92	79.49	3,234.50
Broad Creek	53,930.10	159,017,281.32	39,294.03	137.25	39,294.03
C & D Canal West	4,266.80	16,434,650.92	4,061.09	105.07	4,061.09
Chester River	10,668.10	44,511,978.30	10,999.15	96.99	10,668.10
Choptank River	23,878.30	125,509,796.26	31,014.15	76.99	23,878.30
Deep Creek	24,860.00	65,764,031.92	16,250.65	152.98	16,250.65
Elk Creek	0.00	113,305.35	28.00	0.00	0.00
Gravelly Branch	16,706.30	30,631,919.95	7,569.31	220.71	7,569.31
Gum Branch	15,834.80	37,566,040.73	9,282.77	170.58	9,282.77
Marshyhope Creek	32,086.80	137,928,770.60	34,082.94	94.14	32,086.80
Nanticoke River	56,398.60	212,819,630.04	52,588.88	107.24	52,588.88
Perch Creek	0.00	1,166,691.32	288.30	0.00	0.00
Pocomoke River	18,267.80	41,092,101.41	10,154.08	179.91	10,154.08
Sassafras River	4,668.10	13,718,960.70	3,390.03	137.70	3,390.03
Wicomico	404.80	2,160,331.79	533.83	75.83	404.80
Total	265,205.00	904,901,823.60	223,606.11	118.60	212,863.33

*DE's Nutrient Management Law requires NMPs for farms with 8 or more animal units and farms applying nutrients to 10 acres or more. Enrollement was phased beginning in 2002 and reached 100% in 2007. The DE Department of Agriculture maintains a dataset of acres enrolled in NMPs, however, this dataset may include duplicate acres from early cooperators and therefore misrepresent actual acres on the ground with plans. In order to determine acres on the ground with plans, the cummulative NMP enrollement acres from 2001-2007 were compared to the acres classified as agriculture in the State's 2002 Land Use and Land Cover data set (http://stateplanning.delaware.gov/information/gis_data.shtml). [NOTE: development has affected land use acreages; the 2007 LULC data set is anticipated in early 2008, at which time this analysis can be repeated] When enrolled acres are less than the total acres of agriculture in a watershed, "enrolled" acres are used; when "enrolled" acres exceed the acreage of agriculture in a particular watershed, it is assumed that re-enrollement has occured in the 2001-2007 time frame (plans are developed for 1, 2, and 3 year periods) and the acreage from the LULC data set is used to infer actual acres of NMPs.

HUC-12	County Segment	Watershed	County	Erosion and Sediment Control	Stormwater Management							
					Extended Detention (Dry Pond)	Retention Ponds (Wet Pond)	Sand Filters	Infiltration Trenches/Basins	Biofiltration	Bioretention	Filtration	Level Spreader
				sites	systems	systems	systems	systems	systems	systems	systems	systems
20600020103	800010003	Perch Creek	New Castle County		9.00	28.00			7.00	1.00	1.00	2.00
20600020201		C&D Canal West		1.00								
20600020202	370010003	Bohemia Creek		1.00								
20600020401	810010003	Sassafras River										
20600020602	380010003	Chester River										
20600020601	380010001	Chester River	Kent County									
20600050101	770010001	Choptank River			1.00	1.00		2.00				
20600050102								1.00				
20600050103				1.00				1.00				
20600050104	400010001											
20600050106												
20600050107												
20801090501	410010001	Marshyhope Creek		1.00								
20801090502												
20801090101	780010001/ 780010005	Nanticoke River		11.00	5.00	8.00		2.00				
20801090102	780010005	Gum Branch	Sussex County	1.00								
20801090503	410010005	Marshyhope Creek										
20801090504												
20801090505												
20801090103		Gravelly Branch		1.00				1.00				
20801090301		Deep Creek		1.00	5.00	7.00	2.00					
20801090302					2.00	2.00	2.00					
20801090401		Broad Creek		1.00				1.00				
20801090402								3.00				
20801090403						1.00						
20801090404				8.00	13.00	5.00		3.00				
20801090405						1.00		1.00				
20801090104		Nanticoke River		10.00	11.00	16.00		13.00				
20801090303				4.00	9.00	3.00	3.00	10.00				
20801090304												
20801090601												
20801090604												
20600070101	420010005	Wicomico River		1.00	1.00		1.00					
20600090101	430010005	Pocomoke River										
TOTAL				42.00	56.00	72.00	8.00	38.00	7.00	1.00	1.00	2.00
Notes				Total new active sites in 2004.	Represents systems constructed through 2001 in Kent and Sussex Counties. New Castle County data (not yet broken out by co-seg) through 2006. The Conservation Districts are in the process of developing improved databases to track stormwater BMPs.							
Source				DNREC Sediment and Stormwater	DNREC Sediment and Stormwater	DNREC Sediment and Stormwater	DNREC Sediment and Stormwater	DNREC Sediment and Stormwater	DNREC Sediment and Stormwater			

Open Space				Wastewater	
Forest Management Plan Implementation	Forest Harvesting Practices	Urban Tree Planting	Stream Restoration	Septic Connections / Hookups	Septic Eliminated
acres	acres	acres	linear feet	systems	
25.00	0.00				
100.00	0.00				
0.00	91.00				
60.00	164.00				
171.00	0.00				
70.00	0.00				
176.00	156.00				
142.00	74.00				
0.00	0.00				
18.00	0.00				
0.00	0.00				
73.00	0.00				
915.00	109.00				
904.00	217.00				
1,600.00	104.00				
1,538.00	163.00				
934.00	21.00				
240.00	21.00				
118.00	0.00				
2,296.00	328.00				
1,427.00	73.00				
1,141.00	89.00				
1,254.00	257.00				
557.00	57.00				
456.00	255.00				
679.00	20.00				
345.00	26.00				
276.00	44.00				
568.00	45.00				
373.00	14.00				
388.00	21.00				
265.00	17.00				
35.00	15.00				
1,245.00	112.00				
18,389.00	2,493.00	0.00	0.00	0.00	0.00
Active plans as of 12/31/06.	During calendar year 2006.	Cumulative through end of 2004. Includes park planting, forested buffers, community open space, and street trees.	During calendar year 2004.		
DDA Forest Service	DDA Forest Service	DDA Forest Service	Delaware NPS Program	DNREC Water Resources	DNREC Water Resources

Appendix D

Environmental Information Document

WASHINGTON STREET

FLOOD CONTROL AND STORMWATER RETROFIT PROJECT

August 2nd, 2010

Prepared by:

The City of Seaford:

City Manager, Dolores J. Slatcher

George, Miles & Buhr, Consulting Engineers:

Judy Schwartz, P.E. Project Engineer

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THE WASHINGTON STREET

FLOOD CONTROL AND STORMWATER RETROFIT PROJECT

1.0 Proposed Project

The entire project consist of the installation of approximately 3,549 LF of new storm water piping ranging in sizes from 15" to 42" (see Figure 1.A). This new pipe alignment and inlet network will address a long-standing, reoccurring flooding problem in the Wilmar Village area of Seaford (See Figure 1.B). In addition, this project will also improve drainage at the intersection of Front Street (SR 13A) and Stein Highway (SR20). Incorporated into the design of this project are several "green infrastructure" improvements, as follows.

(1) A Rain Garden (with the approval of the Department of Transportation) at the intersection of Stein Highway and Front Street. This would provide much needed ground water recharge in a highly urbanized setting.

(2) Pervious Pavers and Bioretention Beds: The proposed pipe alignment crosses the property of Our Lady of Lourdes Catholic Church; the largest catholic church within the City. The proposed pipe alignment crosses a portion of the existing parking lot owned and maintained by the church. Portions of the parking lot pavement will be removed and replaced with pervious pavers and bioretention beds.

(3) Street Trees, Bioswales and/or Bioretention Areas**:** North Street, Collins Ave. and Walker Street will be retrofitted with street trees, bioswales and/or bioretention areas for capture and filtration of runoff. These practices will demonstrate the use of this innovative application to reduce parking lot and street runoff and enhance recharge the ground water resource.

(4) Stormwater Filtration Technology: The project proposes to utilize a storm water filtration technology on the new pipe out fall. The pipe alignment will outfall to the Nanticoke River and the addition of a filtration device will help to reduce pollutants discharged to the river and improve overall water quality.

Figures 2.A-2.G shows details of the green technology infrastructure projects. These green technology techniques will work together to improve the overall environment as a result of this project. The added benefit of the high visibility locations that these techniques will be located in will promote the acceptance of green technologies as a whole.

2.0 Project Purpose and Need

The area affected by the Washington Street Flood Control and Stormwater Retrofit Project is the Wil-Mar Village area of the City of Seaford. This development (constructed in the 1950 - 1960's) consists of predominantly single family, owner occupied homes, along the Washington Street, Linden Street and State Street areas of the City of Seaford. This area has experienced repetitive flooding over the last 60 years.

The City of Seaford Engineering Consultant preformed extensive hydraulic modeling of the existing storm water network in the project area. With that preliminary engineering investigation, it was evident that the existing drainage system was extremely undersized and resulted in the flooding conditions within the geographic area. This flooding also impacted an adjacent church, state maintained vehicular thoroughfares and business. The design and development of construction documents are 90% complete.

3.0 Future Environment Without the project

Based on the inadequacy of the existing storm drainage facilities in the area, rain events larger than a 2 year storm magnitude cause substantial flooding of the area. This flooding has endangered life and property. Residents have been forced to evacuate due to rising flood waters. Several basement foundations have collapsed due to flooding conditions. Several properties in the area have been inundated with flood waters in the basements that cause damage to the existing electrical and mechanical systems. This renders the dwelling unit uninhabitable for the occupying family. In addition, the flooding of the area can cause unhealthy molds to grow in buildings.

4.0 Alternatives to the Proposed Action

The following alternatives were evaluated:

(1) Improve the existing drainage facilities

(2) Install new drainage alignment to the North to Herring Run Branch

(3) Install a new drainage alignment to the south to the Nanticoke River

(4) Do nothing

4.1 Alternatives Considered

During the design development process for this project three alternatives were considered. The first consideration was to improve the existing facilities. The second alternative that was considered was to install a new drainage alignment to the north to Herring Run Branch. The

third alternative was the proposed new piping alignment to the Nanticoke River (south). After extensive engineering investigations, the first two alternatives were eliminated in favor of the proposed new piping alignment to the Nanticoke River (south) for the following reasons:

Improving the existing facilities was eliminated as an alternative based on the difficulty of construction. The existing system is installed in a very dense urban area and the existing piping would require complete replacement to obtain the necessary capacity to accommodate anticipated flows. Due to the lack of installed elevation the installation of new larger piping proved to be of limited benefit if not impossible.

Routing Flows to the North was eliminated as an alternative due to the existing capacity of Herring Run Branch. Engineering analysis of the existing Army Corps of Engineer flood study for the drainage way identified an existing box culvert installation at Bridgeville Highway that lacked sufficient capacity to accommodate the additional peak flows that would be directed toward the branch. This would require reconstruction of the stream crossing at *substantial cost* to the project. In addition a review of the Corps of Engineers detailed flood study done for the branch showed that the existing tail water condition during a 100 year flood could cause surcharging of a piping alignment to the north.

Construction cost alternatives were only developed for the feasible alternative in an effort to minimize the expenditure of engineering resources.

4.2 Feasible Alternatives

Of all the alternatives proposed the decision was made to proceed with option #3 - the proposed new piping alignment to the Nanticoke River (south). The proposed alignment was chosen based on constructability. The majority of the pipe alignment would be installed in City (or State) maintained right-of-way. Minimal construction easements from property owners' would be necessary. This fact alone made the project construction costs more controllable. In addition the proposed alignment removes storm water flows from Williams Pond, a dam controlled pond and outfalls flow direct to the Nanticoke River. This outfall to tidal waters provided the necessary drop in hydraulic grade line to eliminate the possibility of system surcharge during higher design flow conditions.

5.0 Description of the Existing Environment

The area of the project is currently well urbanized (Figure 3). The growth in the area dates to the mid part of the last century. Predominately the homes are owner occupied, single family homes at a density of approximately 5-8 dwelling units per acre. The City of Seaford Zoning classification of the Washington Street, Linden Street and State Street areas is R-2 Medium Density Residential. In addition, the project area also has a commercial corridor. Front Street

(SR 13A) and Stein Highway (SR20) are in close proximity to and affected by this project. The City of Seaford Zoning classification of the Front Street (SR 13A) and Stein Highway (SR20) is predominately C-1 General Commercial.

5.1 Air Quality

Construction of the project will be undertaken with appropriate safeguards that will avoid negative air quality impacts. The contractor will be required to dampen roads with water to minimize the creation of dust and the burning of construction generated debris will not be permitted.

5.2 Endangered Species

No endangered species/critical habitats are affected or impacted by this project. All piping is proposed to be placed in prior developed areas (particularly roadways). Therefore no impacts to endangered spices are anticipated.

5.3 Fish and Wildlife

The proposed project involves the redirecting of storm water flows from the existing (undersized outfall) to a properly sized outfall. The net effect of this project on fish and wildlife will be minimal due to this fundamental fact. In addition to the aforementioned facts the proposed addition of a filtration device at the outfall will help to reduce pollutants discharged to the river and improve overall water quality.

5.4 Floodplains

The area adjacent to the proposed outfall piping has had the 100 year flood plan locations identified. The piping will discharge at an elevation above this location. Rip Rap protection will be installed at the outfall to arrest erosion at that location.

5.5 Wetlands

The area adjacent to the proposed outfall piping has had the State and Federal 404 wetland areas delineated, (See Figure 4). The piping will discharge at an elevation above these locations. Rip Rap protection will be installed at the outfall to arrest erosion. See Figure 4 attached to this document for additional detailed information

5.6 Coastal Areas

No coastal areas are impacted by the proposed project.

5.7 Surface/Groundwater Resources

Due to some of the proposed installation depths of the piping it is anticipated that ground water could be encountered during construction. Typical construction methods such as trench shielding and dewatering are expected to be implemented to accomplish the proposed installation. Implementation of approved sediment and erosion control measures, proper construction techniques, and prompt revegetation, where applicable, will assure control of erosion and sedimentation and result in only temporary and minimal impacts to the soils/geology and water quality.

5.8 Historic Sites and Endangered Spices

No historic sites, endangered species/critical habitats, are affected or impacted by this project. All piping is proposed to be placed in prior developed areas (particularly roadways). Therefore no adverse impacts are anticipated.

5.9 Sludge Disposal

No Municipal (or other) sludge will be generated in conjunction with this project. Therefore no disposal will be required.

5.10 Important Farmland

No important farmland will be affected by the proposed project. All area affected by this project is prior developed and well urbanized.

5.11 Excessive Energy Consumption

No excessive energy consumption is anticipated with the proposed project. The proposed project relies on gravity transportation of storm water flows. No pumps, lift stations, mechanical or electrical devices are required for storm water transportation.

5.12 Visual effect/Community Amenities

During construction traffic disruption will occur. The affects of this will be minimized with the appropriate notifications and detour signage as necessary.

During construction the noise of heavy equipment could potentially affect the residents and business owners along the proposed piping route. This will be addressed by limiting the

contractors work hours and days. The City of Seaford noise ordinance prohibits excessive noise (construction equipment and activities) before 7:00 a.m. and after 9:00 p.m. In addition the contractor will be required to work a Monday thru Friday schedule. Weekend and holiday hours will be approved on a case by case basis by the City. No community amenities will be affected by the project.

5.13 Socio-economic Issues

The project is proposed in public rights-of-way and only minimal impact is anticipated. No disproportionate effects to minority or low income populations are expected related to this project.

5.14 Wildlife and Scenic Rivers

No additional effects are expected to the Nanticoke River's wildlife due to the redirection of existing storm water flows discussed earlier in this report. It is anticipated that additional benefits will occur with the enhanced filtration of the discharged effluent to the receiving waters.

5.15 Various Environmental Considerations

No additional impacts are anticipated.

6.0 Environmental Consequences of Feasible Alternatives

With the proposed piping alignment, environmental impacts should be minimal. The piping outfall location will be constructed upland of the delineated wetlands and the flood plain areas: water surface elevation of the receiving tidal water body will be unaffected.

6.1 Land Requirements

The project will require easements from Our Lady of Lourdes Catholic Church for the piping alignment and green amenities to be located on their property. Additionally the use of State of Delaware right-of-way for two of the proposed bio-infiltration areas will require approval and expansion of an existing maintenance agreement with the Department of Transportation. All other areas of proposed pipe installation will be in City or State right-of-way area.

7.0 Mitigation and Summary

The project area described in this report is in a prior developed urban area of predominately single family homes and small businesses. The area has experienced recurrent flooding over the last 60 years due to inadequate storm drainage facilities. Based on extensive hydraulic

modeling of the storm water network in the area and evaluation of several alternatives, it was determined that the best approach was to install a new (the proposed) pipe alignment properly sized with an outfall to the Nanticoke River. The chosen solution (the project described herein) was determined to be the most effective and least impactful solution to the areas often severe flooding problems. The following measures will be implemented during the project to mitigate the possible impacts to the environmental resources of the area:

(1) The contractor will be required to dampen roads with water to minimize the creation of dust and the burning of construction generated debris will not be permitted.

(2) Approved sediment and erosion control measures, proper construction techniques, and prompt re-vegetation will be implemented.

(3) During construction noise from heavy equipment will be addressed by limiting the contractors work hours and days. The City of Seaford noise ordinance prohibits excessive noise (construction equipment and activities) before 7:00 a.m. and after 9:00 p.m.

(4) Fish and marine life will be protected from contaminants by means of filtration device installed at the proposed outfall location.

The above described measures will address anticipated impacts to the environmental resources of the area. As indicated in this report, with the proper mitigation techniques implemented, impacts will be limited to short term during construction. No long term negative impacts are anticipated as a result of this project. In short the benefits of the project far outweigh the risks.

8.0 Exhibits

I.D.	RETROFIT	LOCATION	FIGURE
A	BIORETENTION / RAIN GARDEN	NORTH SIDE OF INTERSECTION RT. 20 & 13A.	2.A
B	BIORETENTION / RAIN GARDEN	SOUTH SIDE OF INTERSECTION RT. 20 & 13A.	2.B
C	MUNICIPAL GREEN STREET	WALKER STREET	2.C
D	BIORETENTION / RAIN GARDEN	NUTTER PARK	2.D
E	BIORETENTION / RAIN GARDEN	NUTTER PARK	2.E
F	RAIN GARDEN, PERVIOUS PAVERS	CHURCH PARKING LOT	2.F
G	BIORETENTION / RAIN GARDEN	CHURCH PARKING LOT	2.G

LEGEND

- NEW 15" RCP
- NEW 18" RCP
- NEW 24" RCP
- NEW 30" RCP
- NEW 36" RCP
- NEW 42" RCP
- NEW 48" RCP
- EX. STORM DRAIN
- FILTRATION DEVICE

DRAWN BY:	JTD
CK. BY:	JAS
JOB NO.:	2006255
SCALE:	1"=400'
DATE:	AUGUST 2010

GMB
GEORGE, MILES & BUHR, LLC
ARCHITECTS & ENGINEERS
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PROPOSED STORMDRAIN ALIGNMENT
WASHINGTON STREET FLOOD CONTROL
& STORMWATER RETROFIT PROJECT
SEAFORD, DELAWARE

FIGURE 1.A

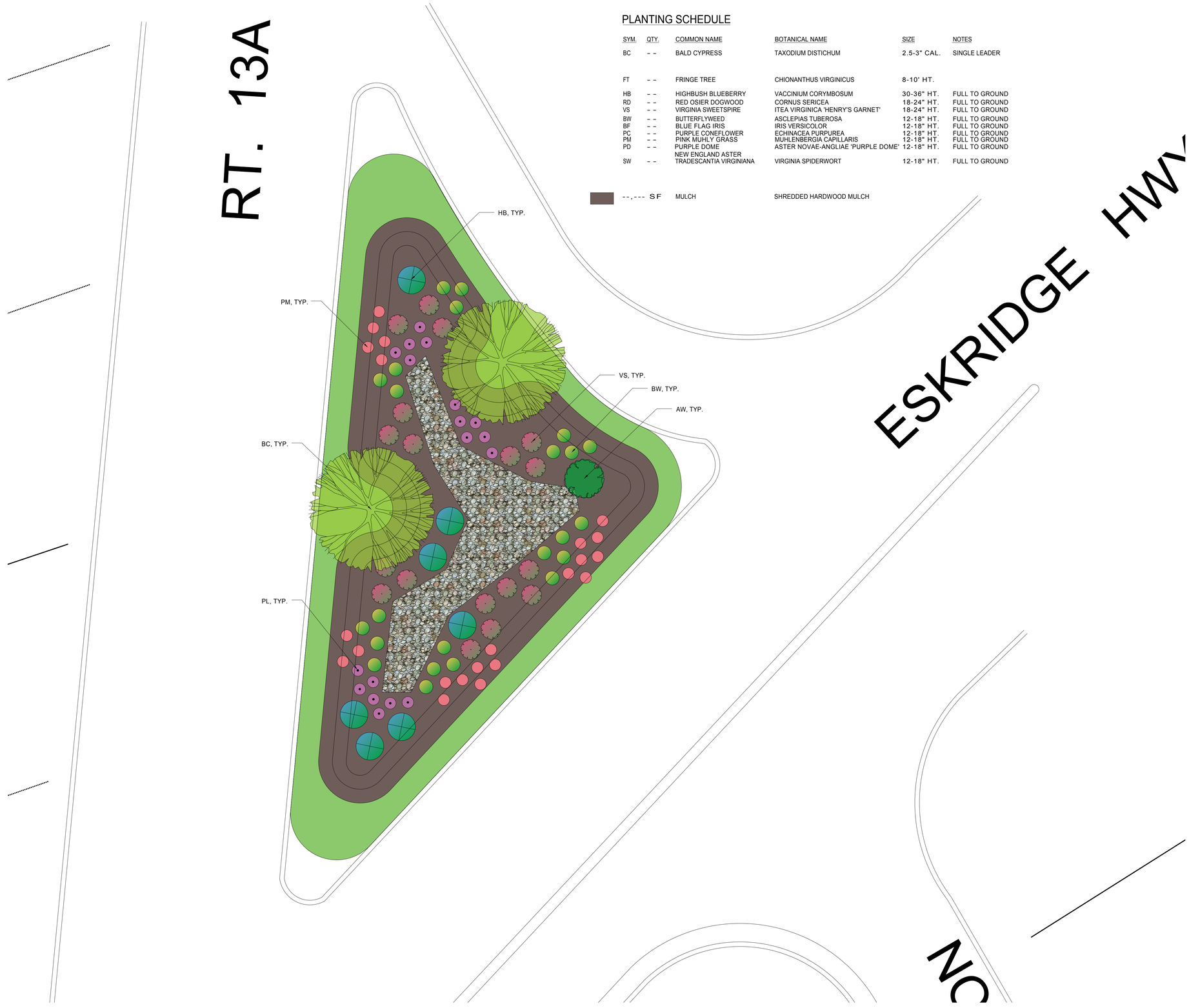
June 29, 2006

nto the

CAVE IN - This is one of the two houses on Washington Street in Seaford with a caved in basement wall. Photo by Ronald MacArthur

TROUBLES ON STREET - Volunteer fire crews work to pump off water on Washington Street in Wilmar Village in Seaford. The neighborhood was hit hard during the flood and two homes had their basements collapse. Photo by Ronald MacArthur

Figure 1B
Newspaper Documentation of Area Flooding



PLANTING SCHEDULE

SYM.	QTY.	COMMON NAME	BOTANICAL NAME	SIZE	NOTES
BC	- -	BALD CYPRESS	TAXODIUM DISTICHUM	2.5-3" CAL.	SINGLE LEADER
FT	- -	FRINGE TREE	CHIONANTHUS VIRGINICUS	8-10' HT.	
HB	- -	HIGHBUSH BLUEBERRY	VACCINIUM CORYMBOSUM	30-36" HT.	FULL TO GROUND
RD	- -	RED OSIER DOGWOOD	CORNUS SERICEA	18-24" HT.	FULL TO GROUND
VS	- -	VIRGINIA SWEETSPIRE	ITEA VIRGINICA 'HENRY'S GARNET'	18-24" HT.	FULL TO GROUND
BW	- -	BUTTERFLYWEED	ASCLEPIAS TUBEROSA	12-18" HT.	FULL TO GROUND
BF	- -	BLUE FLAG IRIS	IRIS VERSICOLOR	12-18" HT.	FULL TO GROUND
PC	- -	PURPLE CONEFLOWER	ECHINACEA PURPUREA	12-18" HT.	FULL TO GROUND
PM	- -	PINK MUHLY GRASS	MUHLENBERGIA CAPILLARIS	12-18" HT.	FULL TO GROUND
PD	- -	PURPLE DOME NEW ENGLAND ASTER	ASTER NOVAE-ANGLIAE 'PURPLE DOME'	12-18" HT.	FULL TO GROUND
SW	- -	TRADESCANTIA VIRGINIANA	VIRGINIA SPIDERWORT	12-18" HT.	FULL TO GROUND
	--,--- S F	MULCH	SHREDDED HARDWOOD MULCH		

LANDSCAPING GENERAL NOTES:

1. PLANTS SHALL CONFORM TO CURRENT "AMERICAN STANDARDS FOR NURSERY STOCK" BY AMERICAN ASSOCIATION OF NURSERYMEN (AAN). PARTICULARLY WITH REGARDS TO SITE, GROWTH AND SIZE OF BALL AND DENISTY OF BRANCH STRUCTURE.

2. CONTRACTOR IS TO ENSURE CONFORMANCE TO NATIONAL AND LOCAL BUILDING CODES AND ORDINANCES.

3. ALL PLANTS (B&B OR CONTAINER) SHALL BE PROPERLY IDENTIFIED BY WEATHERPROOF LABELS SECURELY ATTACHED HERETO BEFORE DELIVERY TO THE PROJECT SITE. LABELS SHALL IDENTIFY PLANTS BY NAME, SPECIES, AND SIZE. LABELS SHALL NOT BE REMOVED UNTIL THE FINAL INSPECTION BY THE OWNER'S REPRESENTATIVE.

4. ANY MATERIAL AND/OR WORK MAY BE REJECTED BY THE OWNER'S REPRESENATIVE IF IT DOES NOT MEET THE REQUIREMENTS OF THE SPECIFICATIONS. THE CONTRACTOR SHALL REMOVE ALL REJECTED MATERIAL FROM THE SITE.

5. THE CONTRACTOR SHALL FURNISH ALL PLANTS IN QUANTITIES AND SIZES TO COMPLETE THE WORK AS SPECIFIED IN THE PLANT SCHEDULE. THE LANDSCAPE CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY ALL PLANT QUANTITIES ON THE PLANS PRIOR TO THE COMMENCEMENT OF WORK. QUANTITIES IN THE PLANT SCHEDULE ARE FOR THE CONTRACTOR'S CONVENIENCE ONLY AND DO NOT CONSTITUTE THE FINAL COUNT.

6. SUBSTITUTION IN PLANT SPECIES OR SIZE SHALL NOT BE PERMITTED EXCEPT WITH THE WRITTEN APPROVAL OF THE OWNER OR THE OWNER'S REPRESENTATIVE.

7. PLANTS SHALL BE LOCATED AS SHOWN ON THE DRAWINGS AND BY SCALING OR AS DESIGNED IN THE FIELD BY THE OWNER OR THE OWNER'S REPRESENTATIVE.

8. CONTRACTOR SHALL LOCATE AND MARK ALL UNDERGROUND UTILITY LINES AND IRRIGATION SYSTEMS PRIOR TO EXCAVATING PLANT BEDS OR PITS. ALL UTILITY EASEMENT AREAS WHERE NO PLANTING SHALL TAKE PLACE SHALL ALSO BE MARKED ON THE SITE PRIOR TO LOCATING AND DIGGING THE TREE PITS. IF UTILITY LINES ARE ENCOUNTERED IN EXCAVATION OF TREE PITS OTHER LOCATIONS FOR THE TREES SHALL BE SELECTED BY THE OWNER OR THE OWNER'S REPRESENTATIVE. SUCH CHANGE SHALL BE MADE BY THE CONTRACTOR WITHOUT ADDITIONAL COMPENSATION. NO CHANGES OF LOCATION SHALL BE MADE WITHOUT THE APPROVAL OF THE OWNER OR THE OWNER'S REPRESENTATIVE.

9. ALL EQUIPMENT AND TOOLS SHALL BE PLACED SO AS NOT TO INTERFERE OR HINDER THE PEDESTRIAN AND VEHICULAR TRAFFIC FLOW.

10. DURING PLANTING OPERATIONS, EXCESS AND WASTE MATERIALS SHALL BE PROMPTLY AND FREQUENTLY REMOVED FROM THIS SITE.

11. ALL TREE PITS ARE TO BE EXCAVATED TO A MINIMUM DEPTH TO ALLOW THE TREE ROOT BALL TO BE A MINIMUM OF 4" HIGHER THAN FINISHED GRADE. THE TREE ROOT BALL IS TO REST ON UNDISTURBED SOIL, OR A COMPACTED BED MUST BE PREPARED FOR THE TREE ROOT BALL TO REST ON AND WHICH WILL NOT SUBSIDE CAUSING THE TREE TO SINK BELOW FINISHED GRADE. ALL TREE PITS ARE TO BE A MINIMUM OF 12" LARGER ON EVERY SIDE OF THE TREE ROOT BALL.

12. THE TOP SOIL TO BE USED TO FILL THE TREE PITS, AND ON THE SIDE SLOPES OF THE STORM WATER AREA IS TO BE OF A SPECIFIC BLEND. THE TOPSOIL SHALL CONSIST OF A MAXIMUM OF 2/3 EXISTING TOPSOIL FROM THE SITE, WHICH IS CLEANED AND FREE OF CLAY, A MINIMUM OF APPROVED ORGANIC MATERIALS OR IMPORTED NEW LOAMY TOPSOIL AND 10 % COW MANURE. ALL OF THESE MATERIALS ARE TO BE MIXED PRIOR TO PLACING IN THE PLANTER OR BACKFILLING WHEN PLANTING.

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14. ALL LAWN AREAS ARE TO BE SODDED WITH GRASS APPROPRIATE FOR EACH OF THE SUNLIGHT CONDITIONS, WHICH EXIST ON SITE.

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16. THE TREES ARE TO BE HANDLED WITH THE BEST CARE AND ATTENTION TO ENSURE THAT THE PLANTS ARE NOT BRUISED, BROKEN, TORN, DAMAGED IN ANY WAY WHICH WILL AFFECT THE PLANTS GENERAL APPEARANCE AND WELL BEING.

17. THE TREES MUST BE STAKED IN ACCORDANCE WITH ACCEPTABLE NURSERY PRACTICES TO ENSURE THAT THEY ARE SECURE IN THE GROUND AND WILL GROW STRAIGHT AND UNIFORM. THE TREES ARE TO BE WRAPPED IF THE CONTRACTOR DEEMS IT NECESSARY TO PROTECT THE TREES FROM SUN SCALD OR INSECT ATTACK.

18. THE LANDSCAPE CONTRACTOR IS TO PROVIDE A ONE YEAR WARRANTY FOR ALL PLANT MATERIAL AND OTHER WORK DONE ON SITE. THIS WARRANTY WILL BEGIN AT EITHER SUBSTANTIAL COMPLETION OR AT FINAL ACCEPTANCE AS DETERMINED BY THE OWNER.

19. THE CONTRACTOR IS TO SLIGHTLY ADJUST PLANT LOCATIONS IN THE FIELD AS NECESSARY TO BE CLEAR OF DRAINAGE SWALES AND UTILITIES. FINISHED PLANTING BEDS SHALL BE GRADED SO AS NOT TO IMPEDE DRAINAGE AWAY FROM BUILDINGS.

0 5 10 20 30

PLOT CODE

PEN-RED	PEN-YELLOW	PEN-GREEN	PEN-CYAN	PEN-BLUE	PEN-MAGENTA	PEN-WHITE
.008 INCHES (0.5mm)	.007 INCHES (0.18mm)	.010 INCHES (0.25mm)	.014 INCHES (0.35mm)	.020 INCHES (0.50mm)	.027 INCHES (0.70mm)	.039 INCHES (1.00mm)

PRINTS ISSUED FOR:
DRAWINGS STAGE

NO.	REVISIONS	DATE

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GEORGE, MILES & BUHR, LLC
ARCHITECTS & ENGINEERS
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WASHINGTON STREET GREEN RETROFITS
SEAFORD, DELAWARE

ROUTE 13 A (N)
RETROFIT

SCALE	:
DESIGN BY	: RLM
DRAWN BY	: RLM
CHECKED BY	:
GMB FILE	: 2006255
DATE	: APR 2009

SHEET NO.
2.A

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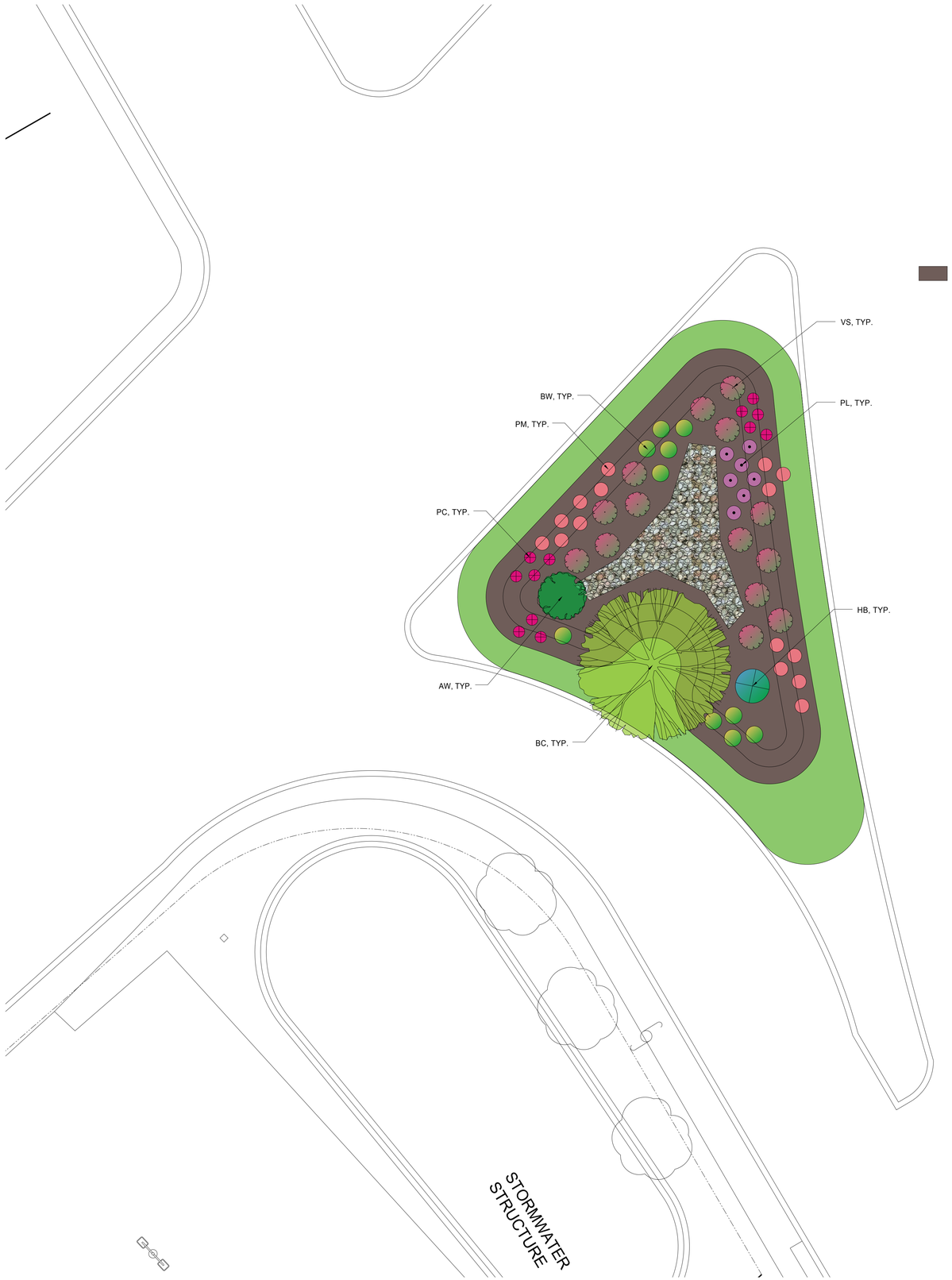

PLANTING SCHEDULE

SYM.	QTY.	COMMON NAME	BOTANICAL NAME	SIZE	NOTES
BC	- -	BALD CYPRESS	TAXODIUM DISTICHUM	2.5-3" CAL.	SINGLE LEADER
FT	- -	FRINGE TREE	CHIONANTHUS VIRGINICUS	8-10' HT.	
HB	- -	HIGHBUSH BLUEBERRY	VACCINIUM CORYMBOSUM	30-36" HT.	FULL TO GROUND
RD	- -	RED OSIER DOGWOOD	CORNUS SERICEA	18-24" HT.	FULL TO GROUND
VS	- -	VIRGINIA SWEETSPIRE	ITEA VIRGINICA 'HENRY'S GARNET'	18-24" HT.	FULL TO GROUND
BW	- -	BUTTERFLYWEED	ASCLEPIAS TUBEROSA	12-18" HT.	FULL TO GROUND
BF	- -	BLUE FLAG IRIS	IRIS VERSICOLOR	12-18" HT.	FULL TO GROUND
PC	- -	PURPLE CONEFLOWER	ECHINACEA PURPUREA	12-18" HT.	FULL TO GROUND
PM	- -	PINK MUHLY GRASS	MUHLENBERGIA CAPILLARIS	12-18" HT.	FULL TO GROUND
PD	- -	PURPLE DOME	ASTER NOVAE-ANGLIAE 'PURPLE DOME'	12-18" HT.	FULL TO GROUND
SW	- -	NEW ENGLAND ASTER TRADESCANTIA VIRGINIANA	VIRGINIA SPIDERWORT	12-18" HT.	FULL TO GROUND
	--,--- SF	MULCH	SHREDDED HARDWOOD MULCH		

LANDSCAPING GENERAL NOTES:

1. PLANTS SHALL CONFORM TO CURRENT "AMERICAN STANDARDS FOR NURSERY STOCK" BY AMERICAN ASSOCIATION OF NURSERYMEN (AAN). PARTICULARLY WITH REGARDS TO SITE, GROWTH AND SIZE OF BALL AND DENISTY OF BRANCH STRUCTURE.

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DRAWINGS STAGE

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WASHINGTON STREET GREEN RETROFITS
SEAFORD, DELAWARE

ROUTE 13 A (S)
RETROFIT

SCALE	:
DESIGN BY	: RLM
DRAWN BY	: RLM
CHECKED BY	:
GMB FILE	: 2006255
DATE	: APR 2009

SHEET NO.
2.B

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PLOT CODE
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PEN-YELLOW .007 INCHES (.18mm)
PEN-GREEN .010 INCHES (.25mm)
PEN-CYAN .014 INCHES (.35mm)
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PEN-MAGENTA .027 INCHES (.70mm)
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SCALE	:
DESIGN BY	: RLM
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SHEET NO.
2.C

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PLANTING SCHEDULE

SYM.	QTY.	COMMON NAME	BOTANICAL NAME	SIZE	NOTES
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19. THE CONTRACTOR IS TO SLIGHTLY ADJUST PLANT LOCATIONS IN THE FIELD AS NECESSARY TO BE CLEAR OF DRAINAGE SWALES AND UTILITIES. FINISHED PLANTING BEDS SHALL BE GRADED SO AS NOT TO IMPEDE DRAINAGE AWAY FROM BUILDINGS.

PRINTS ISSUED FOR:
DRAWINGS STAGE

NO.	REVISIONS	DATE

GMB
GEORGE, MILES & BUHR, LLC
ARCHITECTS & ENGINEERS
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www.gmbnet.com

WASHINGTON STREET
GREEN RETROFITS
SEAFORD, DELAWARE

NUTTER PARK A
RETROFIT

SCALE :	
DESIGN BY :	RLM
DRAWN BY :	RLM
CHECKED BY :	
GMB FILE :	2006255
DATE :	APR 2009

SHEET NO.
2.D

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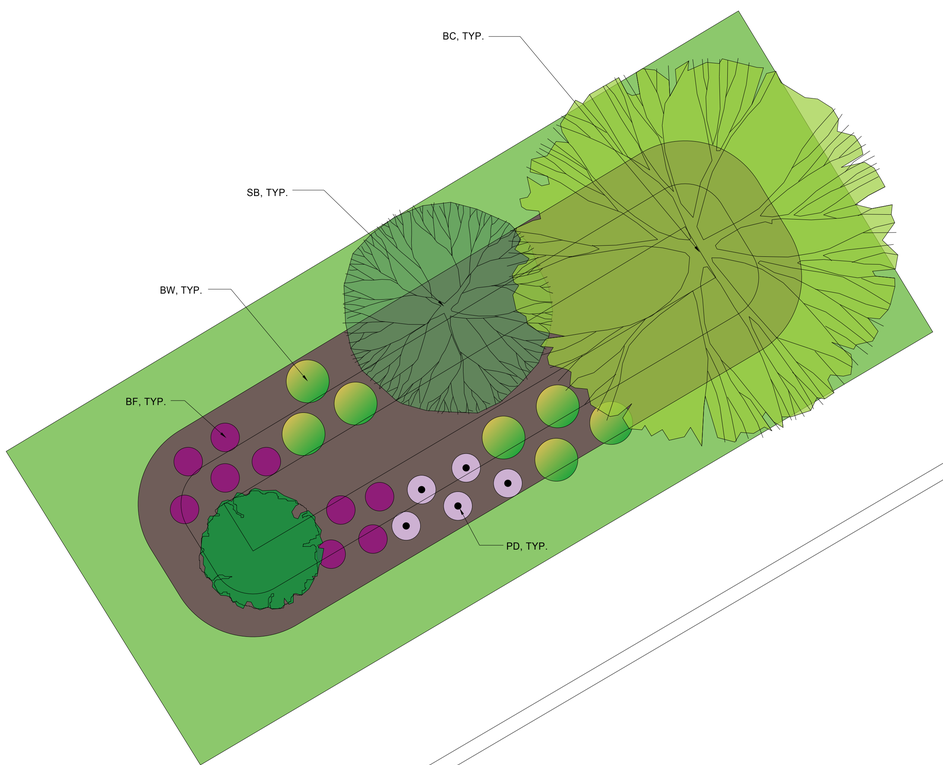
PLANTING SCHEDULE

SYM.	QTY.	COMMON NAME	BOTANICAL NAME	SIZE	NOTES
BC	- -	BALD CYPRESS	TAXODIUM DISTICHUM	2.5-3" CAL.	SINGLE LEADER
FT	- -	FRINGE TREE	CHIONANTHUS VIRGINICUS	8-10' HT.	
HB	- -	HIGHBUSH BLUEBERRY	VACCINIUM CORYMBOSUM	30-36" HT.	FULL TO GROUND
RD	- -	RED OSIER DOGWOOD	CORNUS SERICEA	18-24" HT.	FULL TO GROUND
VS	- -	VIRGINIA SWEETSPIRE	ITEA VIRGINICA 'HENRY'S GARNET'	18-24" HT.	FULL TO GROUND
BW	- -	BUTTERFLYWEED	ASCLEPIAS TUBEROSA	12-18" HT.	FULL TO GROUND
BF	- -	BLUE FLAG IRIS	IRIS VERSICOLOR	12-18" HT.	FULL TO GROUND
PC	- -	PURPLE CONEFLOWER	ECHINACEA PURPUREA	12-18" HT.	FULL TO GROUND
PM	- -	PINK MUHLY GRASS	MUHLENBERGIA CAPILLARIS	12-18" HT.	FULL TO GROUND
PD	- -	PURPLE DOME	ASTER NOVAE-ANGLIAE 'PURPLE DOME'	12-18" HT.	FULL TO GROUND
SW	- -	NEW ENGLAND ASTER TRADESCANTIA VIRGINIANA	VIRGINIA SPIDERWORT	12-18" HT.	FULL TO GROUND
	--,--- SF	MULCH	SHREDDED HARDWOOD MULCH		



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0 2.5 5 10 20

PLOT CODE

PEN-RED	PEN-YELLOW	PEN-GREEN	PEN-CYAN	PEN-BLUE	PEN-MAGENTA	PEN-WHITE
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DRAWINGS STAGE

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WASHINGTON STREET
GREEN RETROFITS
SEAFORD, DELAWARE

NUTTER PARK B
RETROFIT

SCALE	:	SHEET NO.
DESIGN BY	: RLM	2.E
DRAWN BY	: RLM	
CHECKED BY	:	
GMB FILE	: 2006255	
DATE	: APR 2009	

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WASHINGTON STREET GREEN RETROFITS
SEAFORD, DELAWARE

CHURCH PARKING LOT A RETROFIT

SCALE	:	SHEET NO.
DESIGN BY	: RLM	2.F
DRAWN BY	: RLM	
CHECKED BY	:	
GMB FILE	: 2006255	
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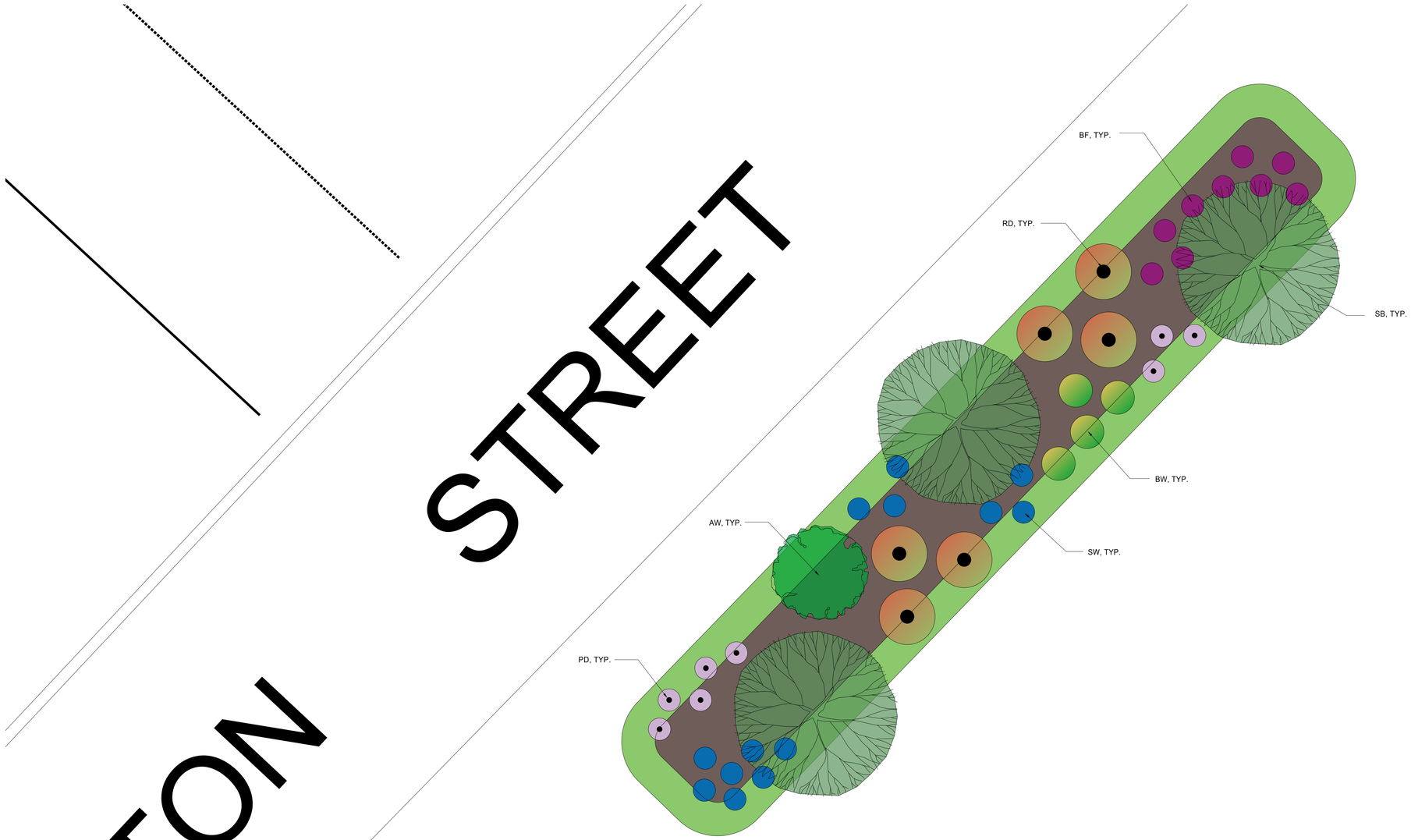

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HB	- -	HIGHBUSH BLUEBERRY	VACCINIUM CORYMBOSUM	30-36" HT.	FULL TO GROUND
RD	- -	RED OSIER DOGWOOD	CORNUS SERICEA	18-24" HT.	FULL TO GROUND
VS	- -	VIRGINIA SWEETSPIRE	ITEA VIRGINICA 'HENRY'S GARNET'	18-24" HT.	FULL TO GROUND
BW	- -	BUTTERFLYWEED	ASCLEPIAS TUBEROSA	12-18" HT.	FULL TO GROUND
BF	- -	BLUE FLAG IRIS	IRIS VERSICOLOR	12-18" HT.	FULL TO GROUND
PC	- -	PURPLE CONEFLOWER	ECHINACEA PURPUREA	12-18" HT.	FULL TO GROUND
PM	- -	PINK MUHLY GRASS	MUHLENBERGIA CAPILLARIS	12-18" HT.	FULL TO GROUND
PD	- -	PURPLE DOME	ASTER NOVAE-ANGLIAE 'PURPLE DOME'	12-18" HT.	FULL TO GROUND
SW	- -	NEW ENGLAND ASTER TRADESCANTIA VIRGINIANA	VIRGINIA SPIDERWORT	12-18" HT.	FULL TO GROUND
	--,--- SF	MULCH	SHREDDED HARDWOOD MULCH		

0 2.5 5 10 20

PLOT CODE
PENS-RED .006 INCHES (0.15mm)
PENS-YELLOW .007 INCHES (0.18mm)
PENS-GREEN .010 INCHES (0.25mm)
PENS-BLUE .014 INCHES (0.36mm)
PENS-CYAN .020 INCHES (0.50mm)
PENS-MAGENTA .027 INCHES (0.69mm)
PENS-WHITE .039 INCHES (1.00mm)

PRINTS ISSUED FOR:
DRAWINGS STAGE

NO.	REVISIONS	DATE

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WASHINGTON STREET GREEN RETROFITS
SEAFORD, DELAWARE

CHURCH PARKING
LOT B
RETROFIT

SCALE	1" = 5'
DESIGN BY	RLM
DRAWN BY	RLM
CHECKED BY	
GMB FILE	2006255
DATE	APR 2009

SHEET NO.
2.G

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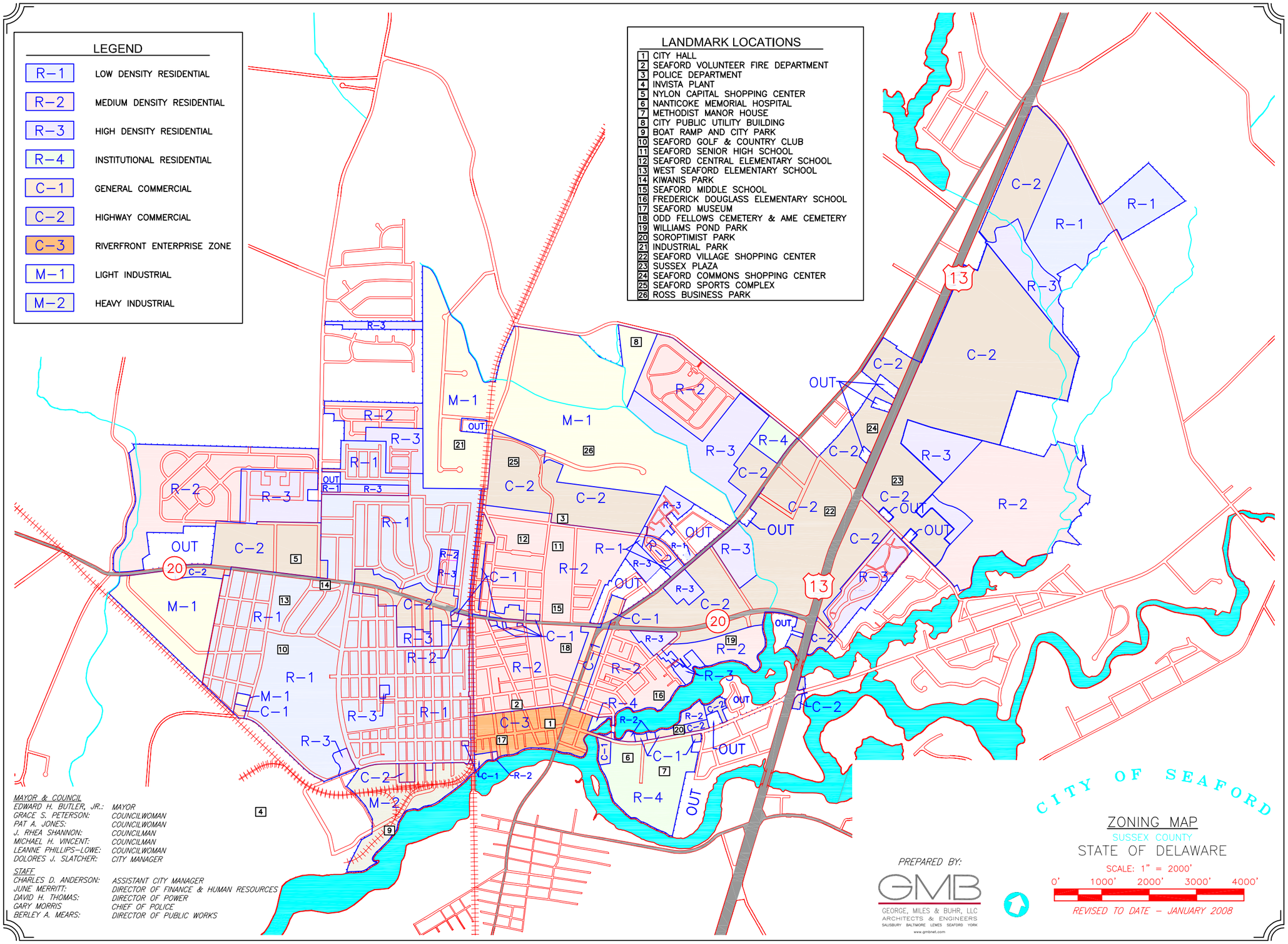
LEGEND
R-1 LOW DENSITY RESIDENTIAL
R-2 MEDIUM DENSITY RESIDENTIAL
R-3 HIGH DENSITY RESIDENTIAL
R-4 INSTITUTIONAL RESIDENTIAL
C-1 GENERAL COMMERCIAL
C-2 HIGHWAY COMMERCIAL
C-3 RIVERFRONT ENTERPRISE ZONE
M-1 LIGHT INDUSTRIAL
M-2 HEAVY INDUSTRIAL
LANDMARK LOCATIONS
1 CITY HALL
2 SEAFORD VOLUNTEER FIRE DEPARTMENT
3 POLICE DEPARTMENT
4 INVISTA PLANT
5 NYLON CAPITAL SHOPPING CENTER
6 NANTICOKE MEMORIAL HOSPITAL
7 METHODIST MANOR HOUSE
8 CITY PUBLIC UTILITY BUILDING
9 BOAT RAMP AND CITY PARK
10 SEAFORD GOLF & COUNTRY CLUB
11 SEAFORD SENIOR HIGH SCHOOL
12 SEAFORD CENTRAL ELEMENTARY SCHOOL
13 WEST SEAFORD ELEMENTARY SCHOOL
14 KIWANIS PARK
15 SEAFORD MIDDLE SCHOOL
16 FREDERICK DOUGLASS ELEMENTARY SCHOOL
17 SEAFORD MUSEUM
18 ODD FELLOWS CEMETERY & AME CEMETERY
19 WILLIAMS POND PARK
20 SOROPTIMIST PARK
21 INDUSTRIAL PARK
22 SEAFORD VILLAGE SHOPPING CENTER
23 SUSSEX PLAZA
24 SEAFORD COMMONS SHOPPING CENTER
25 SEAFORD SPORTS COMPLEX
26 ROSS BUSINESS PARK
MAYOR & COUNCIL
EDWARD H. BUTLER, JR.: MAYOR
GRACE S. PETERSON: COUNCILWOMAN
PAT A. JONES: COUNCILWOMAN
J. RHEA SHANNON: COUNCILMAN
MICHAEL H. VINCENT: COUNCILMAN
LEANNE PHILLIPS-LOWE: COUNCILWOMAN
DOLORES J. SLATCHER: CITY MANAGER
STAFF
CHARLES D. ANDERSON: ASSISTANT CITY MANAGER
JUNE MERRITT: DIRECTOR OF FINANCE & HUMAN RESOURCES
DAVID H. THOMAS: DIRECTOR OF POWER
GARY MORRIS CHIEF OF POLICE
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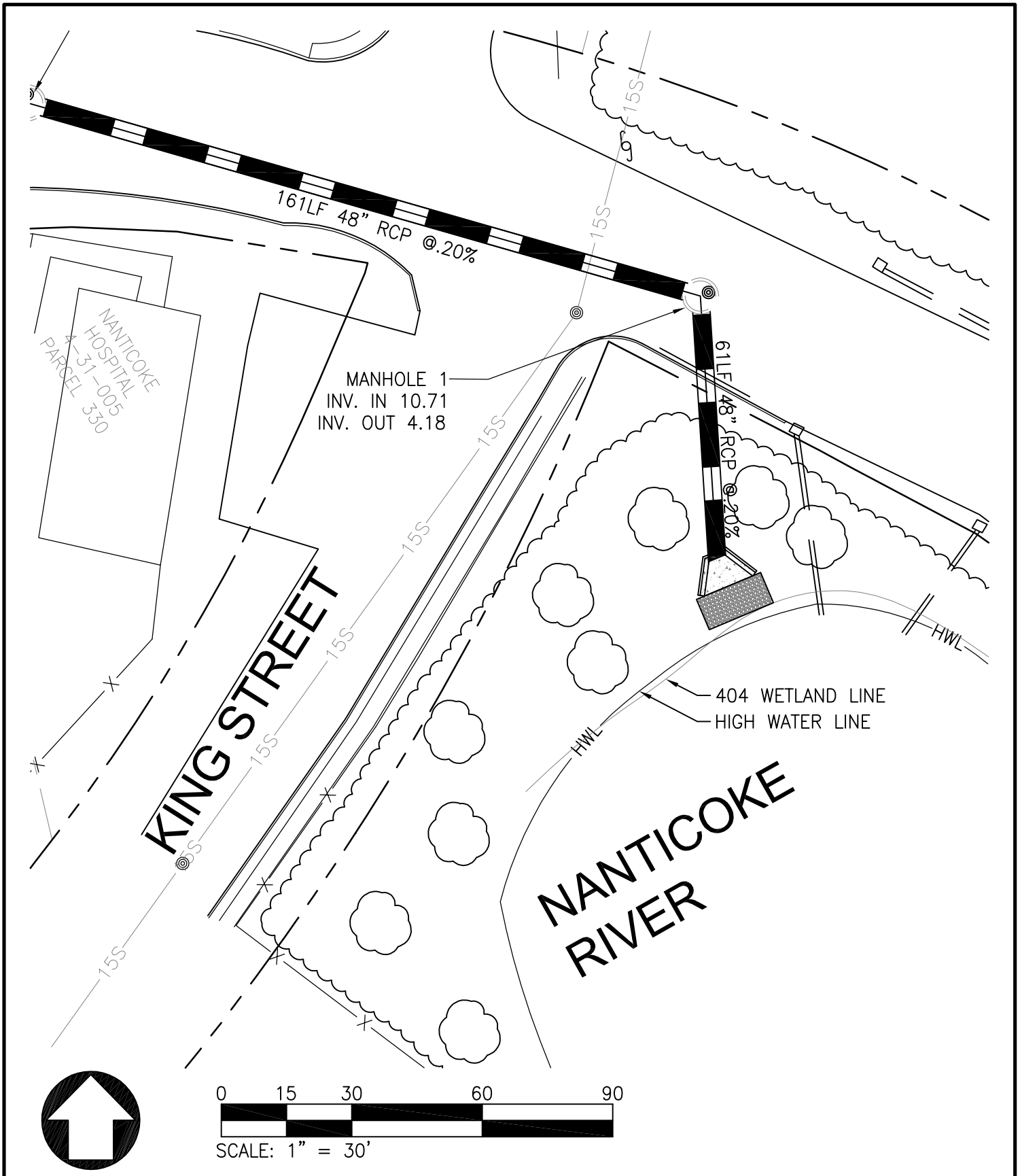
CITY OF SEAFORD
ZONING MAP
SUSSEX COUNTY
STATE OF DELAWARE
SCALE: 1" = 2000'
0' 1000' 2000' 3000' 4000'
REVISED TO DATE - JANUARY 2008

Figure 3



DRAWN BY:	JTD
CK. BY:	JAS
JOB NO.:	2006255
SCALE:	1" = 30'
DATE:	AUGUST 2010

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WETLANDS LINE AT OUTFALL
WASHINGTON STREET FLOOD CONTROL
& STORMWATER RETROFIT PROJECT
SEAFORD, DELAWARE

FIGURE
4
DRAWING NO.

Appendix E

The Modeling of Land Use Activities within the Delaware Segment of the Chesapeake Bay Watershed

Team

University of Delaware SCC Land Use Modeling Project

Carol Bason, Program Manager, SCC CommunityViz®
Richard Kautz, AICP, Land Use Planner
Tom Bason, Technical Consultant

Office of State Planning Coordination

Bryan Hall, AICP, Circuit-Rider Planner, Sussex County

Summary

The University of Delaware (UD) Sustainable Coastal Communities (SCC) Program in cooperation Delaware Department of Natural Resources and Environmental Control (DNREC) has worked to develop a land use model for the Delaware segment of the Chesapeake Bay Watershed. The model is built upon the *CommunityViz®* platform and will aid officials visualize land use issues and understand the consequences of their land use policies while working to provide necessary information to implement environmental improvements to in the Delaware portion of the Chesapeake Bay Watershed.

Project

The UD was tasked with performing the following in support of DNREC's requirements for Element 3 of its Watershed Implementation Plan: Mechanisms to Account for Future Loads:

- Use the UD Community Land Use Model and *CommunityViz®* GIS platform to apply its 100-Acre grid to the entire Delaware portion of the Chesapeake watershed. The project will utilize the UD's previous work on defining Existing Land Use in Sussex County to expand the study area to the Delaware watershed, showing current and projected land use and population changes through 2025
- Incorporate small area population projections from the Delaware Population Consortium (DPC)
- Apply statutorily required comprehensive plans from Delaware's three counties and the 14 incorporated municipalities within the watershed to growth consideration

- Assign the UD's model land use types to growth based on DPC projections for the 2005-2015[1] and 2015-2025 time frame
- Perform *CommunityViz*® Build-out and Impervious Cover analysis for each of the Delaware Chesapeake Bay subwatersheds
- Assign current and planned method of wastewater disposal by land use type to the 100A tiles in the subwatershed

This document provides a brief synopsis of the methodology, assumptions, and constraints applied to the UD Community Land Use Model for this project.

Background

The UD Community Land Use Model

The UD team evaluated *CommunityViz*®(1) to develop a cost-effective, yet powerful GIS mapping and analysis tool in order to 1) support the County's sub-regional planning efforts in working meetings between community stakeholders and 2) support future comprehensive growth planning. *CommunityViz®* met our goals in providing a visualization tool with set of "crayons" for "painting" a picture of a community's character in terms of what it has today (existing land use), what it might have (land use as per the Comprehensive Plan), and what it could have (a "what-if" vision) for the future.

Working with Sussex County's Land Use Planner, the UD Team created a representative 100-acre square geographical feature to represent land use at the community level and defined associated land use designations, ranging from low density (1 unit per 100A) to high density (8 units per acre) mixed use designations. The 100-acre tile size was selected based on the average size of Delaware State Preliminary Land Use Service (PLUS) projects in the 2007-2008 pipeline. Six of the land use designations were modeled after form-based code transects. The land use designations were backed by underlying demographic parameters at the unit level that the Team easily customized to reflect Sussex County and Delaware-based demographics for the associated summary land capacity (build-out), population, and economic projections.

[1] DNREC requested growth projections to 2017 and 2025. DPC small area projections are estimated in five year increments. It was agreed by all parties that the UD would provide growth data for years 2015 and 2025, and that DNREC would extrapolate to year 2017 if necessary. See DPC section below.

The build-out and demographic results were validated by spatial and numeric comparison to 2007 digital orthophotography, State demographic projections in transportation analysis zones, 2007 land cover, Sussex County address structures and building footprint GIS layers. Export of the 3D "painted" transect images to Google Earth finalized the analyses by providing a visualization of future land use across the County.

The Land Use Designer, associated land use "paint" capability, and demographic database presented the most likely of the *CommunityViz®* tools to meet our needs. We began by describing and defining twelve land use designations as assumptions that could be imported into the Land Use Designer database. The base mapping unit/feature for the land use was a map of 100-acre squares or tiles forming a grid across the County. The 100-acre area was chosen based on the average size of new major developments already in the Delaware State application process.

While each of the designations could be applied to the Sussex County zoning districts, the designations were defined to broadly support form-based growth principles for "what-if" visioning. The tile or "transect" represented neither zoning nor land cover, but a land use type with varying densities, residential-nonresidential ratios, and single-mixed use variations to emulate the character of the community.

Sussex County and State development standards and demographic parameters were identified and input at the unit level in the Land Use Designer models. Custom formulas for land-use-calculated dwelling units and commercial floor area were developed that substituted the County build-out results and applied them to summary demographics.

The County was "painted" in several scenarios: existing land use, existing with pipeline (PLUS[2] projects) and as defined by the Sussex County 2008 Comprehensive Plan's Future Land Use Map. Cross-County "what-if" scenarios also included agriculture preservation scenarios – land needed to maintain a viable agriculture economy while maintaining growth projections around town centers.

The numeric build-out and demographic results were "ground-truthed" using 2007 satellite orthophotography in conjunction with the County's 911 address structures GIS layer to count dwelling units; by comparing statistics between small sub-areas to known town areas; and by spatially comparing the *CommunityViz®* results with State demographic projections stored in map overlays such as transportation analysis zones, building structures and footprint files.

[2] Preliminary Land Use Service (PLUS), Office of State Planning Coordination, Delaware

Export of the "painted" transect images to Google Earth finalized the analyses by providing a 3D visualization of future land use densities.

Details of the cited model and analytical process can be found in Attachment #1) *UD-SCC Community Land Use Model.pdf* and Attachment #2) *UD-SCC Land Use Planning Matrix Chesapeake 15Aug10.xlsx.*

The Sussex County Land Use Model discussed above is being used to create two build-out scenarios for the Delaware Chesapeake Bay Watershed. Starting with the Existing Land Use the UD Team "painted" a future land use scenario for the year 2015 and a separate land use scenario for the year 2025. For this project, the UD LU Model was calibrated to the Delaware Population Consortium (DPC) 2000-2030 projections of occupied housing and became the base from which to build the Growth 2015 and Growth 2025 scenarios.

2005 Delaware Population Consortium Population Projection

The 2005 DPC Population Projection project was developed in part to support the efforts of the State to address the increasing population within the State and determine the possible location of future population centers based upon inward and outward migration of existing and future residents. The effort, now required by Delaware Code to support the school referendum process for new and existing school construction, is the most recent comprehensive study undertaken by the State to consider future population dynamics. The DPC population projection process uses a series of mathematical formulas that incorporate a variety of data sources to determine future population on 5 year increments. This process is often updated every two to three years to meet the demands of local school districts; however, the 2005 effort is consider to be a complete effort because it blended the both the art and science of predicting population growth. Thus, in order to assign growth based on the DPC Small Area Projections data, the Team will assign DPC-specified growth to UD Land Use Model for the years 2015 and 2025.

The following modification of the UD model's growth and land use statistics would provide the data to support the 2017 EPA identified timeline midpoint. This effort would use the existing model's formulas with supplemental data inputs from the US Census data to derive short term population adjustments within the normal 5 year time frame. With these existing tools in place, the determination of the 2017 EPA Chesapeake Bay TMDL effort could be developed; however, it would require the input of local jurisdictions to address the population shifts base upon possible future development projects, land use constraints, etc.

Project Methodology

The SCC Land Use Modeling Team was tasked with the land use evaluation and modeling for the over 20 river segments (e.g. subwatershed) of the Chesapeake Bay Watershed within Delaware. The Bay watershed impacts all three Counties within Delaware, with the bulk of watershed located within Sussex County. Based upon Federal requirements, DNREC requested that the model should account for all activities within the watershed statewide. As a result of this requirement, statewide parameters were applied to the model's assumptions and constraints. These parameters are described in this document.

Study Area

The Chesapeake Bay Watershed extends into each of the three Delaware counties, but not all of any. The study area boundary encompasses only the portions of Delaware within the watershed and assigns a value of "unused" to any surrounding tiles. Tiles from the 100-Acre grid were selected from the entire State of Delaware based on their location within the NCC, Kent, and Sussex Chesapeake Bay Watershed. Using GIS spatial selection, the tiles were selected if their "centroid" fell within the Chesapeake river segments layer provided by EPA. A review of the boundary was performed to synchronize the study area as closely as possible to the EPA river segment area.

Data and Assumptions

Certain model parameters were customized to meet the needs of DNREC's requirements as detailed below and under the *Process* section. These customizations were within the model's parameters and did not affect the integrity of the model. A list of the GIS data layers used for the project can be found in the Methodology Attachments.

The density parameter input into the build-out analysis (Attachment 2, Line 7, dwelling units per acre ,) was modified from the range maximum to the density mid-point for the rural land use tiles (T100, T20 and T5). The mid-point of the range was more appropriate for the base (Existing LU Scenario) due to the rural nature for most of the watershed. In addition, given that the ultimate use of the model in this instance deals with environmental issues, the Team did not want to overstate the amount of impervious area that would be developed through the various modeling scenarios.

To further ensure consistency of the impervious surface data will be consistent with the Federal TR-55 Water model, the TR 55 impervious values were added to the Matrix (lines 57,

58 and 59). All rural tiles are assigned 8,712 square feet of impervious surface (i.e. 20% of lot size). In addition, for the same reason, the Build Efficiency parameter for land use types T30-Employment and T200-Retail were revised to reflect impervious area as per TR-55 (line 22). Lastly, for mixed use land use types, a custom formula was created to accommodate impervious area of their nonresidential portions. The formula assigns TR-55 impervious area as appropriate for that tile.

For the purposes of this project, all rural areas and the T2 Suburban land uses were assumed to use septic systems. All other development is assumed to be connected to a central or community sewerage treatment system[3].

Timeframe

Near term timeframes were specified as requirements of the project. For that reason the starting point, i.e. the existing use of the land, needed to closely reflect known data. Therefore, the Team found that the Model's existing occupied dwelling unit count and total existing population counts needed to be calibrated to the controlling data, the DPC Small Area Projections for the year approximating 2005. This was accomplished by modifying the base density of the rural land use types from the maximum per tile to the midpoint per tile (see *Data* #1 above). As a result, the total number of existing occupied dwelling units in the Watershed was within three percent of the DPC estimate. Differences in geography should be kept in mind when comparing statistical differences derived from GIS spatial analysis. With this calibrated starting point, application of the added occupied dwelling units projected by the DPC for the years 2015 and 2025 should be accurately reflected in the Model.

Process

The process used to assign DPC's projected growth changes between 2005-2015 and 2015-2025 are outlined below.

Existing land use was assigned or "Painted" consistent with the most recent aerial photographs, structure data file and other available data for Kent and New Castle Counties. In Sussex County, changes in existing land use between the original "Paint" in 2008 and more current data resulted in an adjustment to the paint to reflect the new development. The data were then compared to the DPC modified grid data for the entire watershed in each County. Adjustments

[3] See Line 60: Wastewater Type in the UD Community Land Use Model Parameter Matrix

discussed above were then made to assure that the model reflected known data for the current situation. The steps for processing are outlined as follows:

- Attributes that reflected DPC projected growth 2005 to 2015 and 2015 to 2025 were added to the Small Area Population Projections database table.

- Two new scenarios were added to the Existing Land Use Scenario in the *CommunityViz*® analysis: 'Growth2015' and 'Growth2025'. Growth change was calculated and applied by time frame to each Chesapeake Bay river segment by summing the DPC projected change Land use types were assigned to the Existing Lu Scenario for all three counties using the following GIS data: 2009 NAIP orthophotography, 2007 Land Use Cover, County 911 Address structures (Kent and Sussex), and parcel data.

- Growth change in land use was assigned based on the following assumptions and criteria:
    1. PLUS projects in growth areas. If multiple PLUS projects exist in a watershed, the Team selects the projects most closely adhering to the remaining criteria to apply growth;
    2. Smart Growth criteria such as compact housing, mixed use types, "places", populated crossroads that had the potential to grow to urban villages ;
    3. County Comprehensive Plans, land use policies, or potential annexation areas;
    4. Central Sewer over on-site septic projects

- The Team first calculated the increase in the number of occupied housing units projected by the DPC in each watershed. Figures were calculated for the period 2005 to 2015 and for the period 2015 to 2025. The team then looked at the watershed and, applying the priorities discussed above, distributed the growth by tile across the watershed. Existing tiles are then replaced by the new tile selected by the team to reflect "growth" within the watershed during the appropriate period (to 2015 or to 2025). Team stops allocating growth and changing tiles within a watershed when the number of new occupied housing units exceeds the DPC projection for that area[4].
- Build-out was first run for all three scenarios using the calibrated rural density values and applying the model's net build efficiency factors that consider seasonal vacancy rates (i.e. occupied housing comparable to EPA "Households").

[4] The tile location is consistent with usual development practices. That is, the tile is not primarily out of play (wetlands, publicly held lands), avoids concentrations of agricultural easements, is near development or contains road frontage for access to development.

- Build-out was subsequently run for all three scenarios using the calibrated rural density values and applying the model's gross build efficiency factors (i.e. total dwelling units built; comparable to EPA's "Total Housing Units").
- Attributes were created to test the calculation of impervious surface based on the model's land use types. For residential impervious surface, the calculation is based on number of estimated dwelling units for the 100A tile and the model's land use type lot size. The resulting impervious surface estimate does not account for roads, sidewalks or other entities external to the residential lot. The algorithm for the calculation of nonresidential impervious surface is in progress and requires more input from DNREC. The results will be provided at a later date. Results were summarized statewide and by land use type for quality control; by EPA river segment for comparative purposes. Residential and nonresidential densities, floor area, and associated demographic summarizations were included. *(Note 23Aug10: Impervious surface calculation will be provided after discussion with DNREC re: floor area assumptions.)*
- All results were summarized statewide and by EPA river segment.
- Maps were created both statewide and countywide for each scenario: Existing Land Use, Growth 2015, and Growth 2025.

Conclusion

The land use modeling and build-out results (Methodology, Maps, and Results Tables) provided today should be considered preliminary land use and build-out findings as the first draft to the Phase I portion of the EPA Chesapeake Bay TMDL Project. The draft format was requested by DNREC in order for a review and refinement process to take place prior to delivery to EPA. The decisions regarding land use assignment to the Growth 2015 and Growth 2025 Scenarios were performed solely by the land use modeling team listed above based on their planning expertise, study area knowledge, and supporting GIS validation data. In order to refine the estimates based on jurisdictional growth specifics, future iterations of the modeling process are needed to finalize the results. Also, some jurisdictional GIS data were not available at the time of analysis and are needed to validate assumptions and land use assignments.

List of Deliverables

UD Build-Out Methodology

Chesapeake Bay Watershed Build-out Methodology_Draft1_22Aug10_UD.docx

Build-Out Results (22Aug10):: Total Housing Units[5]

1. **Indicators_ChesapeakeWS_THU_22Aug10.xlsx**

   Worksheet 1: *Growth Indicators THU Statewide*
   Worksheet 2: *THUs by River Segment*

2. **THU _Growth 2015-2025 Demographics_22Aug10.xlsx**

   Worksheet 1: *THU_ExistingLU_22Aug10_byRivSeg*
   Worksheet 2: *THU_Growth2015_22Aug10_byRivSeg*
   Worksheet 3: *THU_Growth2025_22Aug10_byRivSeg*

Build-Out Results (21Aug10): Households[6]

Indicators_ChesapeakeWS_Households_22Aug10.xlsx

Worksheet 1: *Indicators_ChesBayWS_Households*
Worksheet 2: *Households by River Segment 21Aug10*

Maps

Chesapeake_WS_Draft_Maps_21Aug10.pdf

Document Attachments

1. *UD-SCC Community Land Use Model.pdf*; presentation to DNREC on May 13, 2010
2. *UD-SCC Land Use Planning Matrix_Chesapeake_15Aug10.xlsx*
3. *List of GIS and CommunityViz® Data (File Dependency Report)*

References

1. "Sussex County Land Use Model - Crayons, *CommunityViz®* and the 100-Acre Grid" 12OCT09; University of Delaware Cooperative Extension; William McGowan, Ed.D, Carol Bason, and Richard Kautz, AICP *(unpublished)*
2. Delaware Population Consortium, Office of State Planning Coordination, State of Delaware, Small Area Population Projections, 15Jan08

[5] Total Housing Units: Full capacity of dwelling units available
[6] Households: Equivalent to 'Occupied Housing' accounting for seasonal vacancies

UD-SCC Community Land Use Model

May 13, 2010

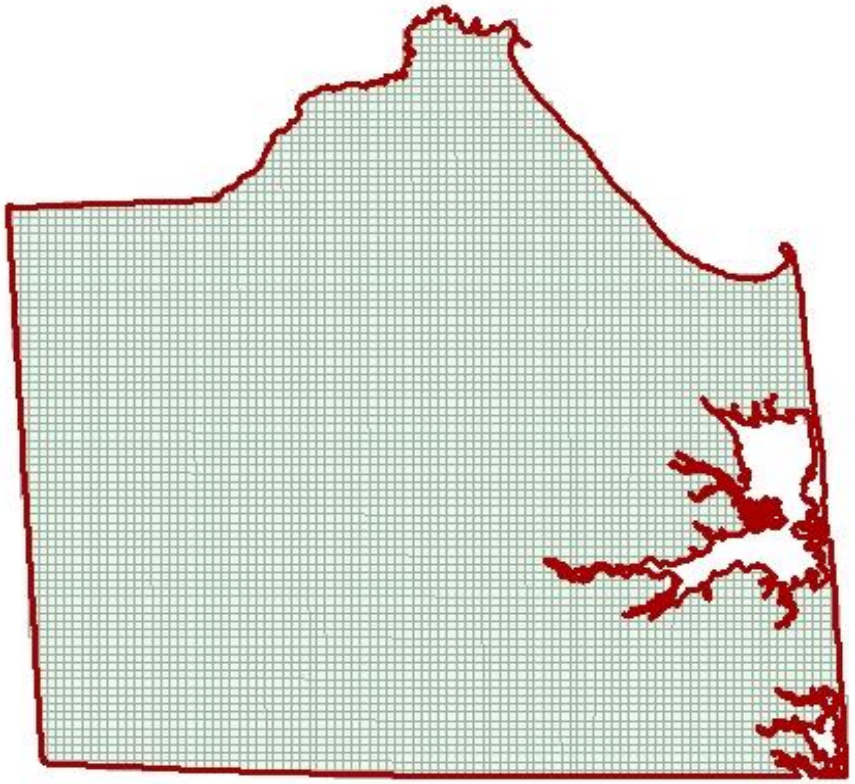
University of Delaware Team
Bill McGowan, Ed.D, County Agent, Community Development & Public Policy
Carol Bason, Program Manager, CommunityViz®
Richard Kautz, Land Use Planner

The UD-SCC Community Land Use Model

UD-SCC Community Land Use Model – What is it?

- **Geographical Feature**: 100-Acre tiles forming a cross-county grid
  - Impartial
  - Consistent
  - Reproducible
- **Land Use Designations :** Form-based and Sussex County Custom
  - "Crayons" (palette) for assigning land use types
  - Three-dimensional Google Earth representations of density
  - Associated unit-level residential & nonresidential densities
  - Associated validated custom SC demographics
- **Analysis**
  - Build-Out – Numeric, Spatial (2D), Visual (3D)
  - Associated demographic impacts
- **Assumptions**
- **Constraints**

UD-SCC Community Land Use Model
100-Acre Cross-County Grid



Model Land Use Designations

Legend

- Unused
- T1 - Rural Village
- T100A - Rural
- T2 - SubUrban
- T200K - Retail
- T20A - Rural
- T30K - Employment
- T4 - SubUrban
- T4 - SubUrban Mixed
- T5A - Rural
- T6 - Urban Mixed
- T8 - Town Center
- TM - Strip Mixed Use
- T16 - High Density Mixed

Land Use: Rural

- T100A-Rural: 1 DU
- T20A-Rural: 5 DU
- T5A-Rural: 20 DU
- T1-Village: 100 DU; Mixed

Land Use: SubUrban and Urban Mixed

- T2- SubUrban: 200 DU
- T4- SubUrban: 400 DU
- T4-Mixed SubUrban: 400 DU/Mixed Use
- T6-Urban Mixed: 600 DU/Mixed Use
- T8-Town Center: 800 DU/Mixed Use
- T16-High Density Mixed: 1600 DU/Mixed

Land Use: Non-Residential

- TM: Highway Commercial/Mixed Use
- T30: Employment Centers/ Institutional
- T200: Retail/Shopping Centers

The Model’s Toolset

Land Use Model Parameters

- Residential Dwelling Units
- Nonresidential Floor Area (and Employees)
- Demographics
  - Residents & Children Projections
  - Residential & Nonresidential Taxes
  - Commercial Employee Statistics
  - Water and Wastewater Usage
  - Vehicle Trips
- “Out-of-Play” from State Policies; Runways (Constraints)
- Land Use Efficiency: (ROW, easements, vacancy rate, etc.)

Demographic Coefficients

Land-Use Models Table

Land-Use Layer: SC_LU_Grid

Attribute Name	T2 - SubUrban	Unused	TM - Strip Mixed	T1 - Rural Village	T100A - Rural	T200K - Retail	T20A - Rural	T4 - SubUrban	T4 - SubUrban Mi	T
LU Children per DU	0.7	0	0.6	0.6	0.7	0	0.7	0.4	0.6	0.
LU Com Tax Rate	0	0	20	15	0	25	0	0	20	0
LU EE VTD	0	0	20	20	0	40	0	0	20	0
LU EE Waste Water	0	0	20	20	0	20	0	0	20	0
LU EE Water Use	0	0	25	25	0	25	0	0	25	0
LU LBCS Activity	1100	1100	9990	9990	1100	2100	1100	1100	9990	7(
LU LBCS Function	1100	1100	9990	9990	1100	2100	1100	1100	9990	5!
LU Residents per DU	2.41	0	2.41	2.41	2.45	0	2.45	2.63	2.41	2.
LU Tax Rate per DU	100	0	85	85	85	0	85	100	100	8!
LU VTD per DU	10	0	10	10	10	0	10	10	10	1(
LU Waste Water per DU	300	0	300	300	300	0	300	300	300	3(
LU Water Use per DU	300	0	300	300	300	0	300	300	300	3(

Land Use Model Palette

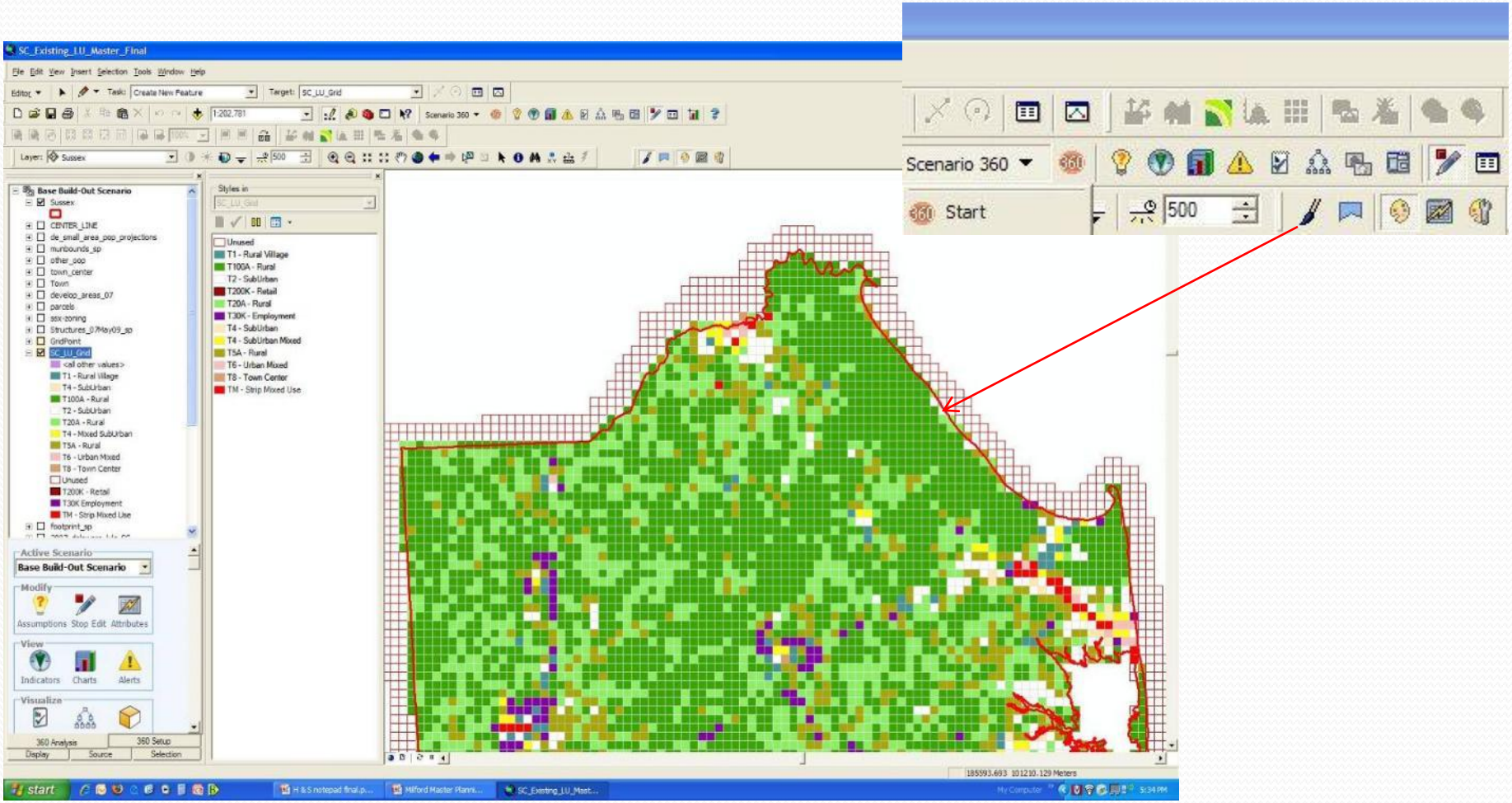
Community Land Use Type	Legend	Residential Density (Dwelling Units)	Non-residential Square Footage (per 100A)	Build Efficiency (Full Occupancy)
T100A Rural		1-4 DU / 100 A	None	100%
T20 Rural		5-20 DU / 100A	None	100%
T5 Rural		21- 50 DU / 100A	None	60%
T2 Suburban		2 DU / A	None	70%
T4 Suburban		4 DU / A	None	80%
T1 Rural		1 DU / A	9000 SQ FT	75%
T4 Suburban Mixed		4 DU / A	150,000 SQ FT	75%
T6 Urban Mixed		6 DU / A	300, 000 SQ FT	75%
T8 Town Center		8 DU / A	500, 000 SQ FT	90%
TM Strip Mixed Use		4 DU / A	700, 000 SQ FT	80%
T16 HDM		16 DU / A	50, 000 SQ FT	90%
T30 Employment		None	200, 000 SQ FT	80%
T200 Retail		None	800, 000 SQ FT	80%

The Land Use Modeling Process

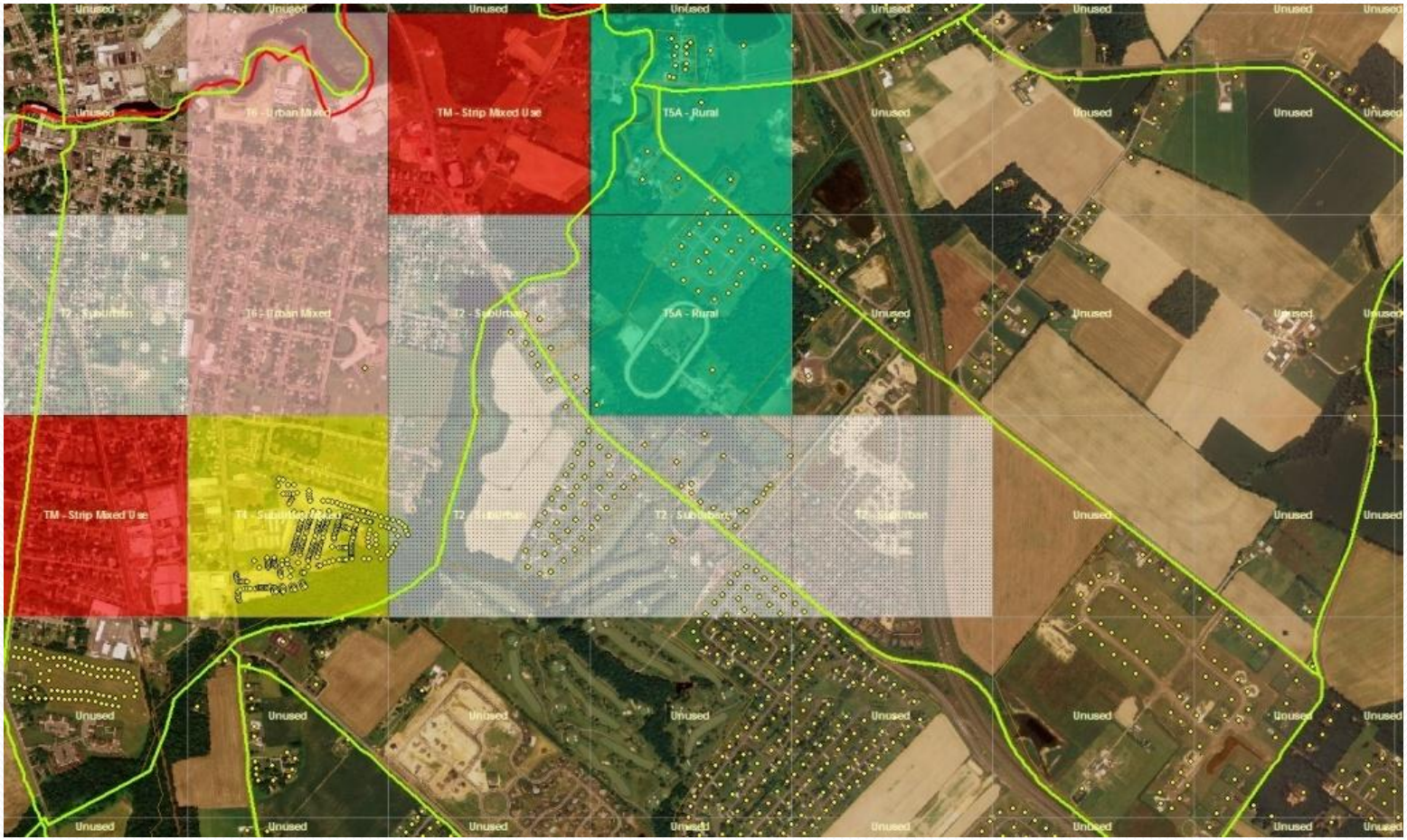
Modeling Process *in a Nutshell*

1. Define Boundary of Sub-Region/Master Plan area
2. Extract Sub-Region Grid from Sussex County Master Grid
3. Research/Compare/”Paint” Sub-Region Comprehensive Plan
4. Hold Stakeholder Workshop(s)
5. ”Paint”/Analyze/Compare Stakeholder Scenarios
6. Hold Public Workshops
7. ”Paint”/Analyze/Compare Public Scenarios
8. Define/Analyze consensus-built Composite Scenario
9. Write/Deliver Sub-Region Report & associated land use data

“Painting” the Land Use Model



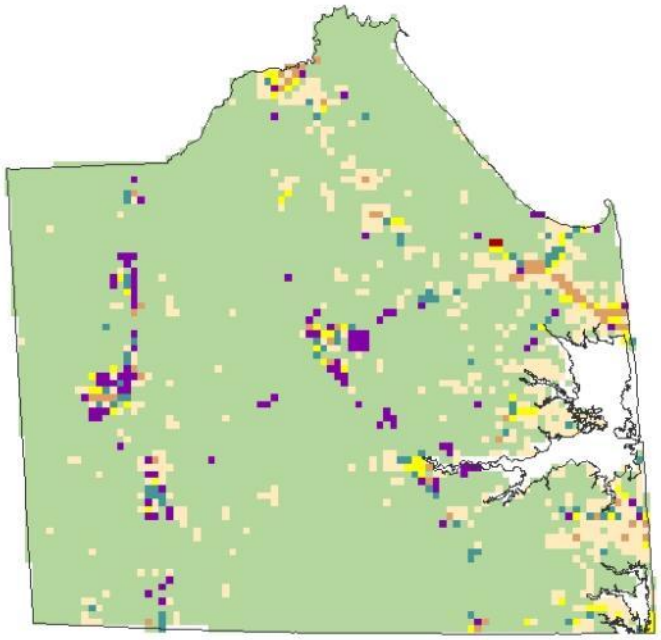
Validating the Land Use Model



GIS / Land Cover / Structures / Building Footprints / 2007/2009 Aerials / TAZ's

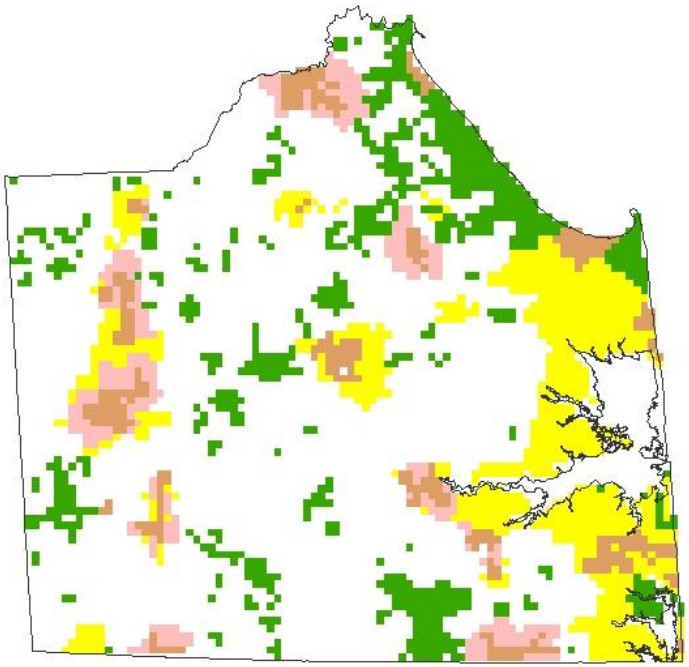
Cross-County
Existing & Comprehensive Plan Scenarios

Sussex County Land Use Comparison



Existing Land Use with Pipeline
(Rural Combined)

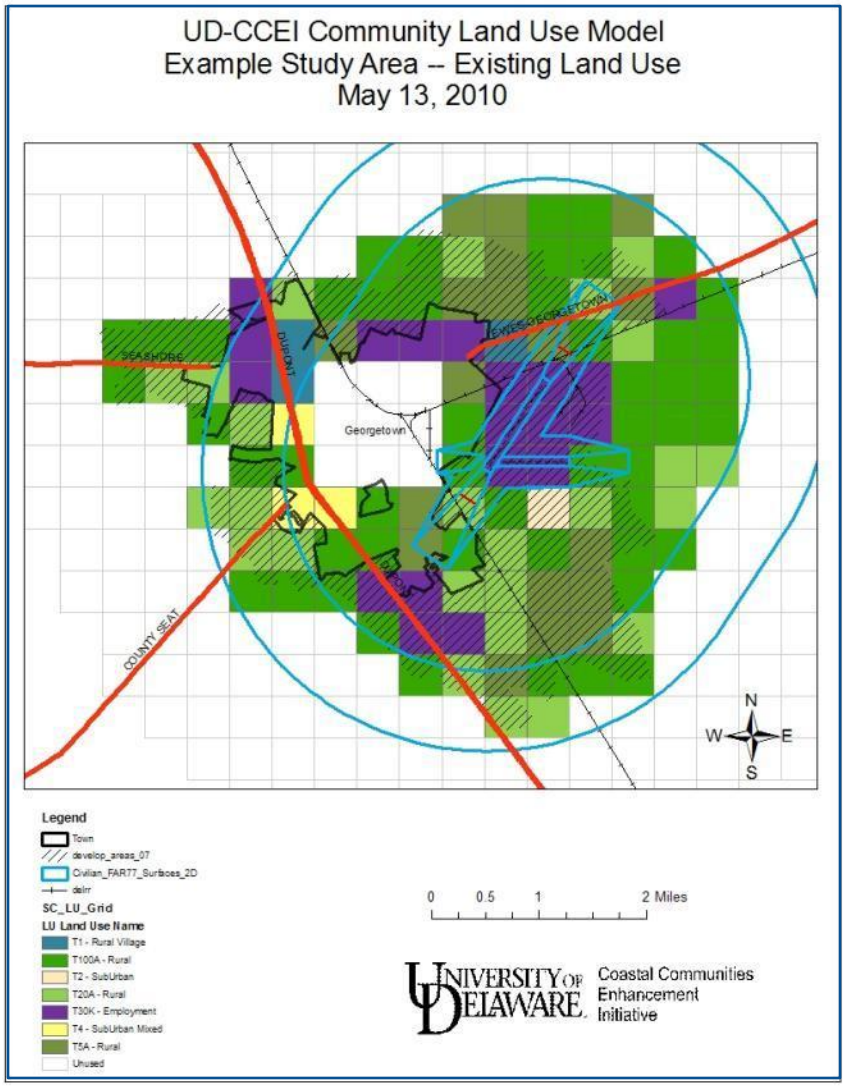
SC Growth Plan Land Use

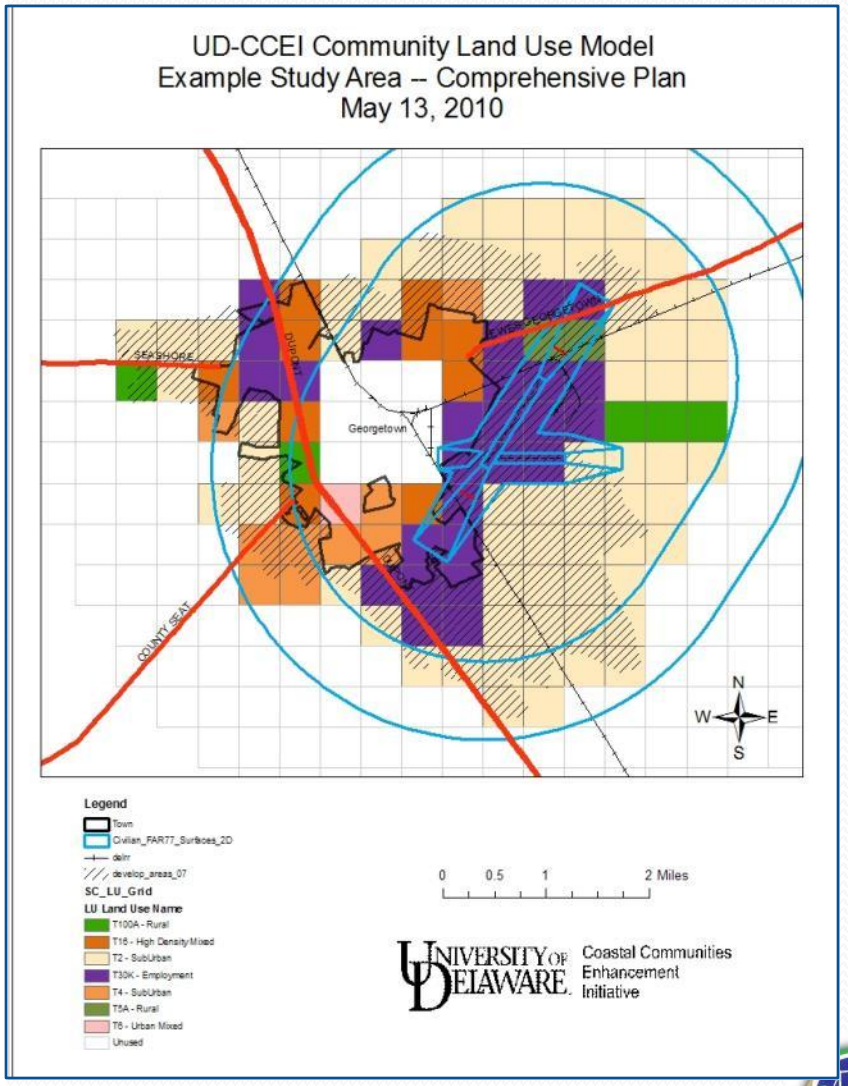


Example Study Area
Existing & Comprehensive Plan Scenarios

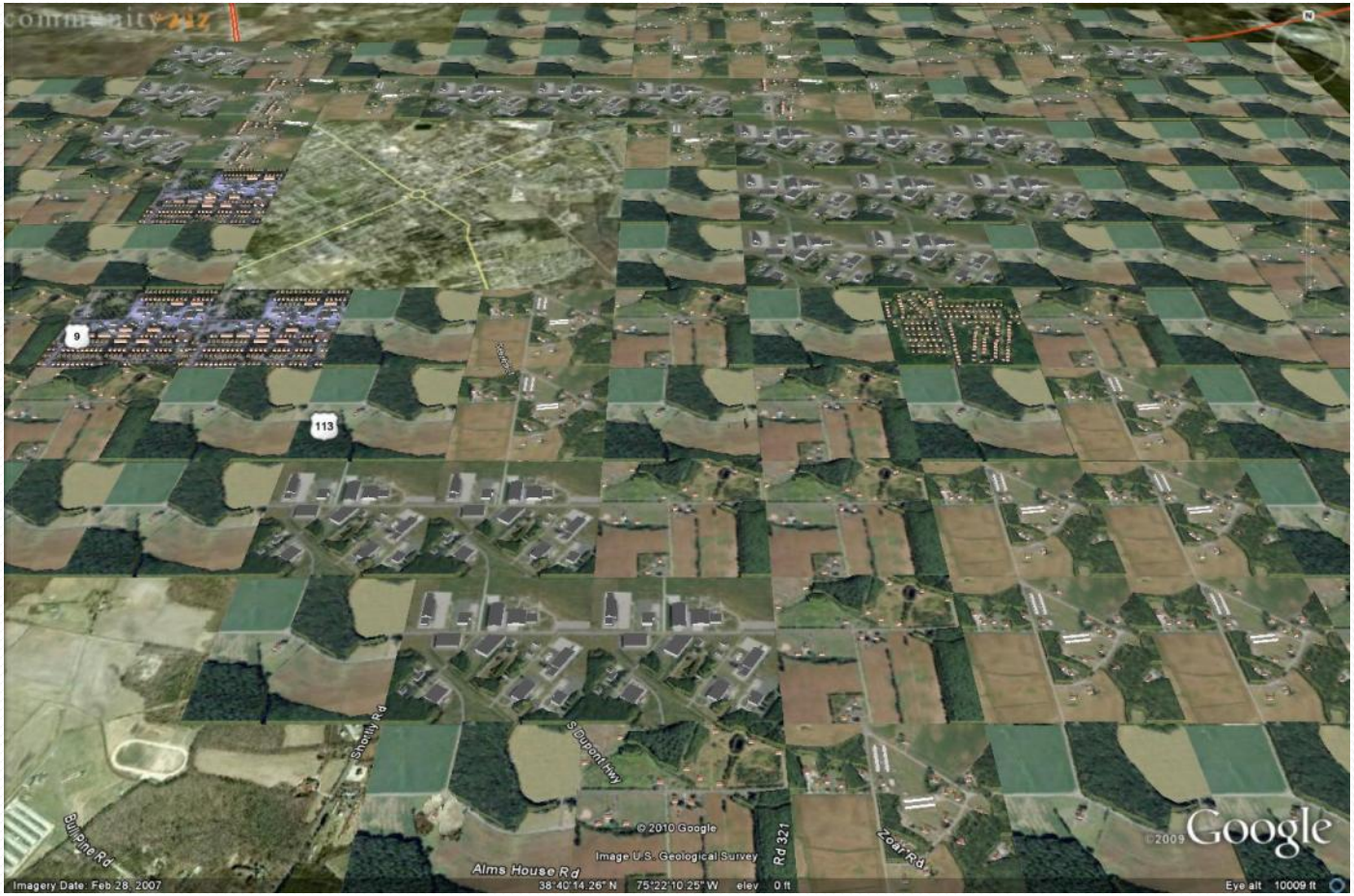
Stakeholder Workshops

Land Use Scenarios





“Existing” Land Use Density*



** Google Earth 3D representation of land use: residential and non-residential density*

Comprehensive Plan Land Use Density*

** Google Earth 3D representation of land use: residential and non-residential density*

Build-Out Analysis Example

Georgetown "Inner Circle"	Existing Land Use Scenario	Comprehensive Plan Scenario
Residential		
Dwelling Units	2,149	24,491
Residents	5,224	62,499
Children	1,416	9,874
Res Taxes	194,830	2,258,105
Res VTD	21,490	219,574
Res Waste Water	644,700	7,347,300
Res Water Use	644,700	7,347,300
Non-Residential		
NumComFloorArea	3,397,750	4,835,000
Employees	8,319	12,559
Com Taxes	168,964	236,242
Com VTD	86,835	119,625
Com Waste Water	162,835	223,625
Com Water Use	203,543	279,531

Data above are for demonstration purposes only

Benefits of the UD-SCC Land Use Model

- Stakeholder interests visualized and analyzed
- Public deliberates and makes land use choices
- “On-the-fly” instant impact analysis identifies consequences
- “What-if” process provides implementation options
- Iterative tradeoff & consensus-building visualization process leads to consensus
- Regional, State and Local-level scalable model

Visioning – *Your Turn!*

SE Neighborhood Public Workshops
Source: David Ross, Milford Beacon, October 22, 2009

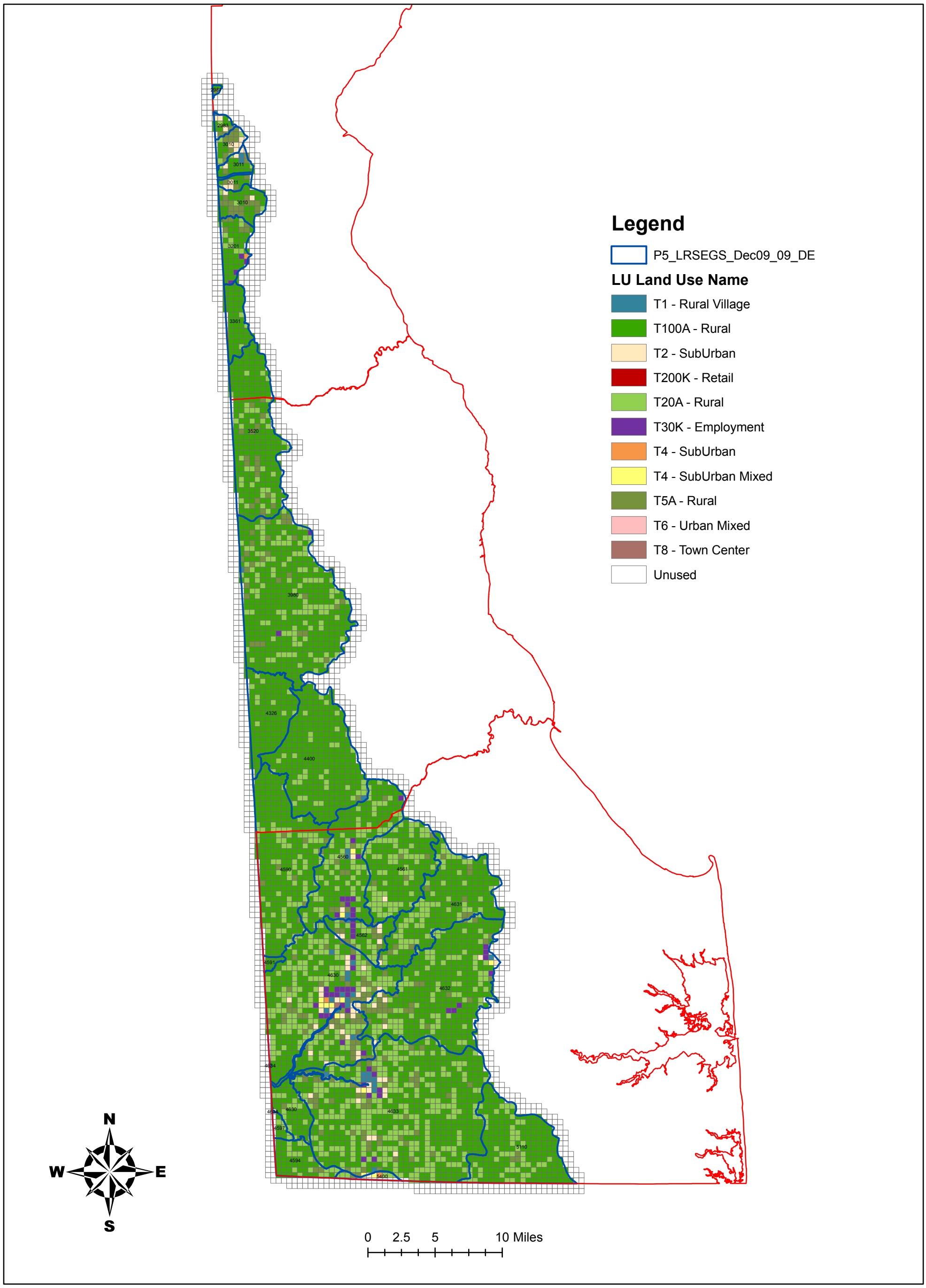
Milford, Del. – "Southeast residents speak out on planning"

After hours of hearing professional planners talk about the options for development in their neighborhood, residents of southeast Milford got a chance to draw their own vision of the future on Oct. 15. "We're having our vote now," neighborhood resident Wesley Barrows said.

After state planner David Edgell and Milford City Planner Gary Norris spoke on the options they'd come up with for zoning and development southeast of town, almost 50 local residents, farmers and businesspeople took their turn as planners, laying out their own maps of the southeast neighborhood in 100-acre blocks. Each group of five got a set of tiles, color-coded from green for the lowest density to red for the highest, to arrange however they liked.

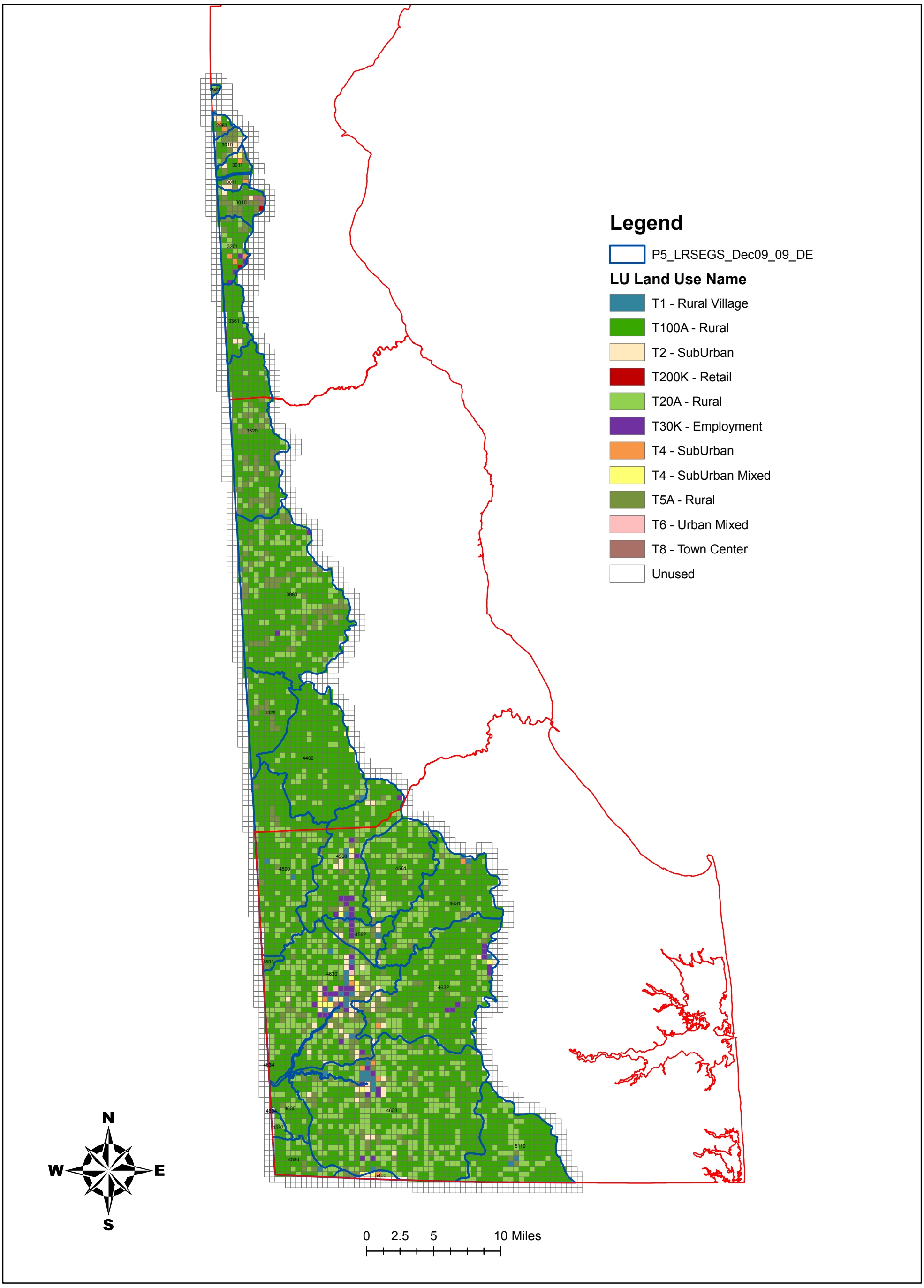
Bill Pfaffenhauser said he'd like to see more areas like the mix of stores and housing in downtown Milford, rather than blocks designated for nothing but housing or nothing but commercial. . "I like the idea of small business with apartments upstairs," he said. Apartments, to me, provide not low-income housing but more reasonable housing."

Chesapeake Bay Watershed - Delaware Buildout Scenario: Existing Land Use 2005
DRAFT: August 21, 2010



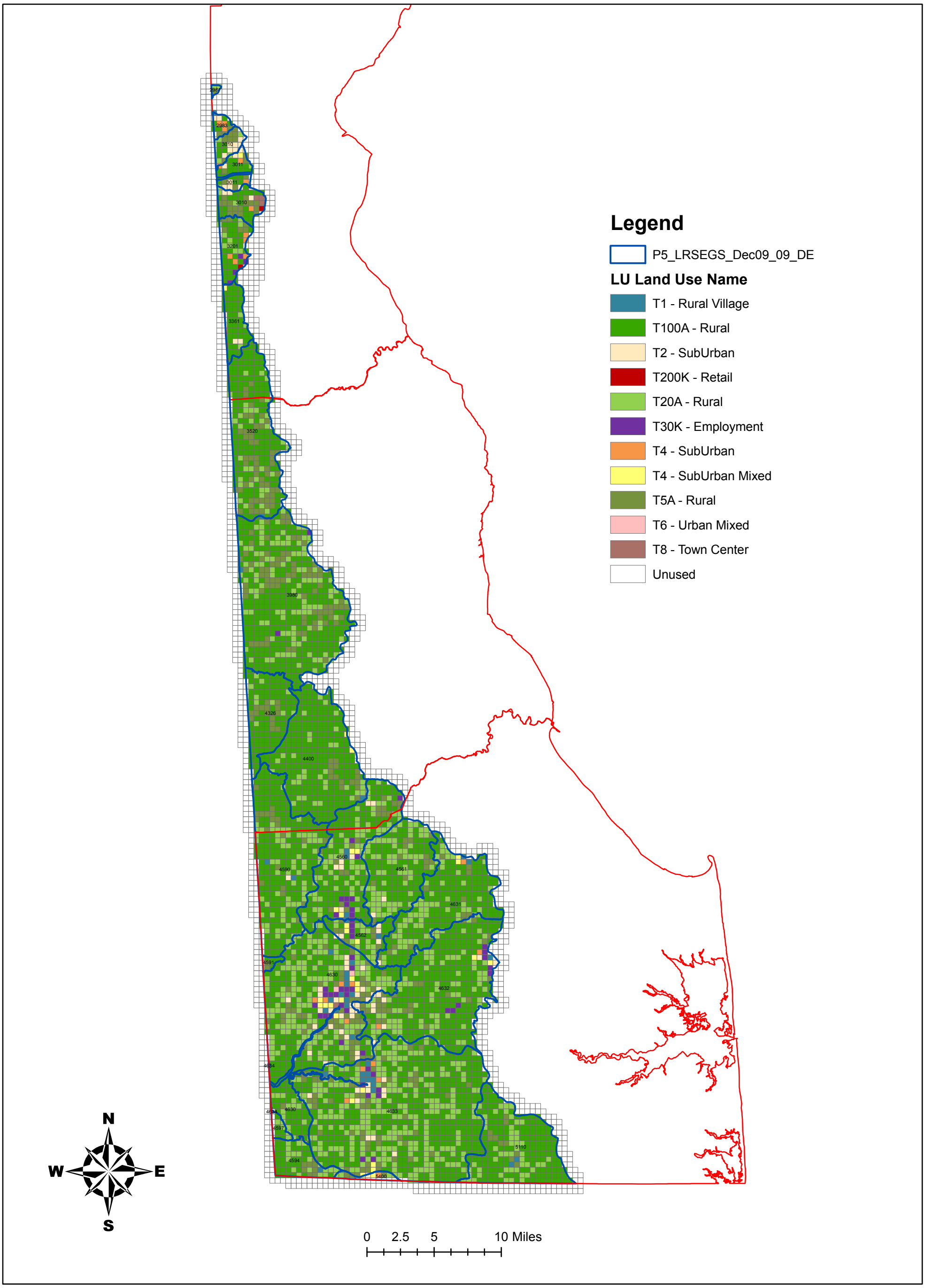
Source: University of Delaware Community Land Use Model

Chesapeake Bay Watershed - Delaware
Buildout Scenario: Growth 2015
DRAFT: August 21, 2010



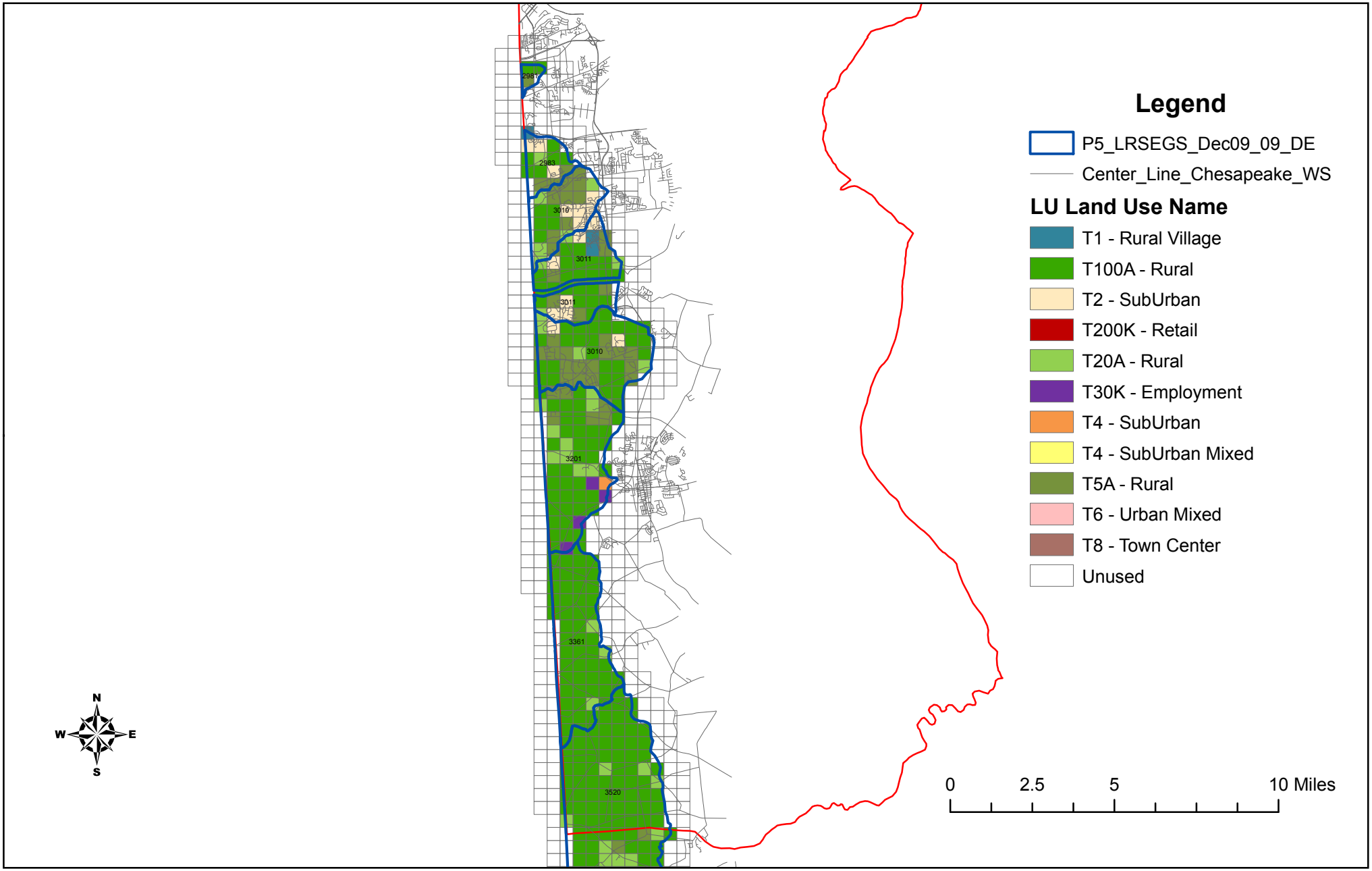
Source: University of Delaware Community Land Use Model

Chesapeake Bay Watershed - Delaware
Buildout Scenario: Growth 2025
DRAFT: August 21, 2010



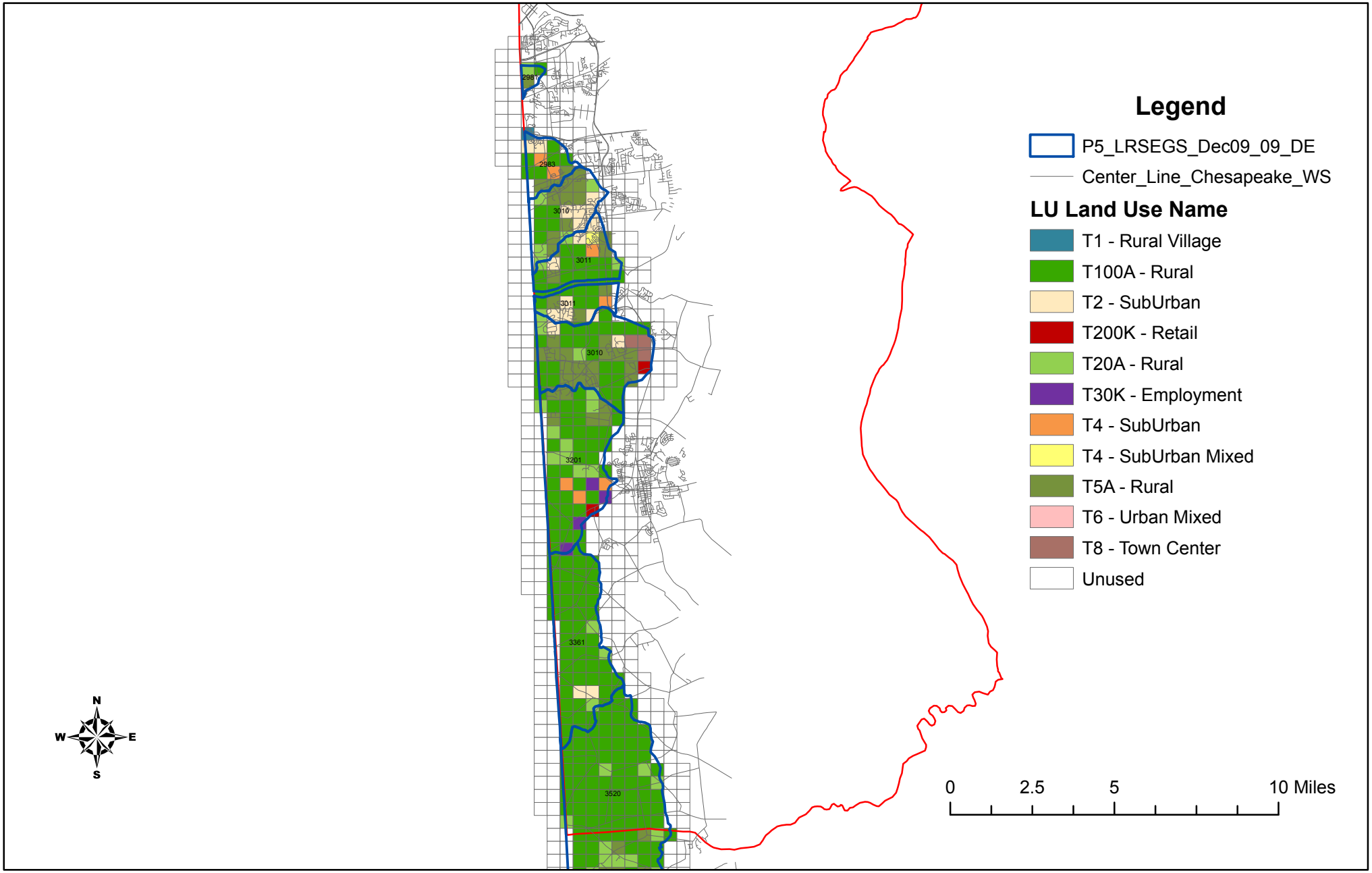
Source: University of Delaware Community Land Use Model

Chesapeake Bay Watershed - New Castle County
Buildout Scenario: Existing Land Use 2005
DRAFT: August 21, 2010



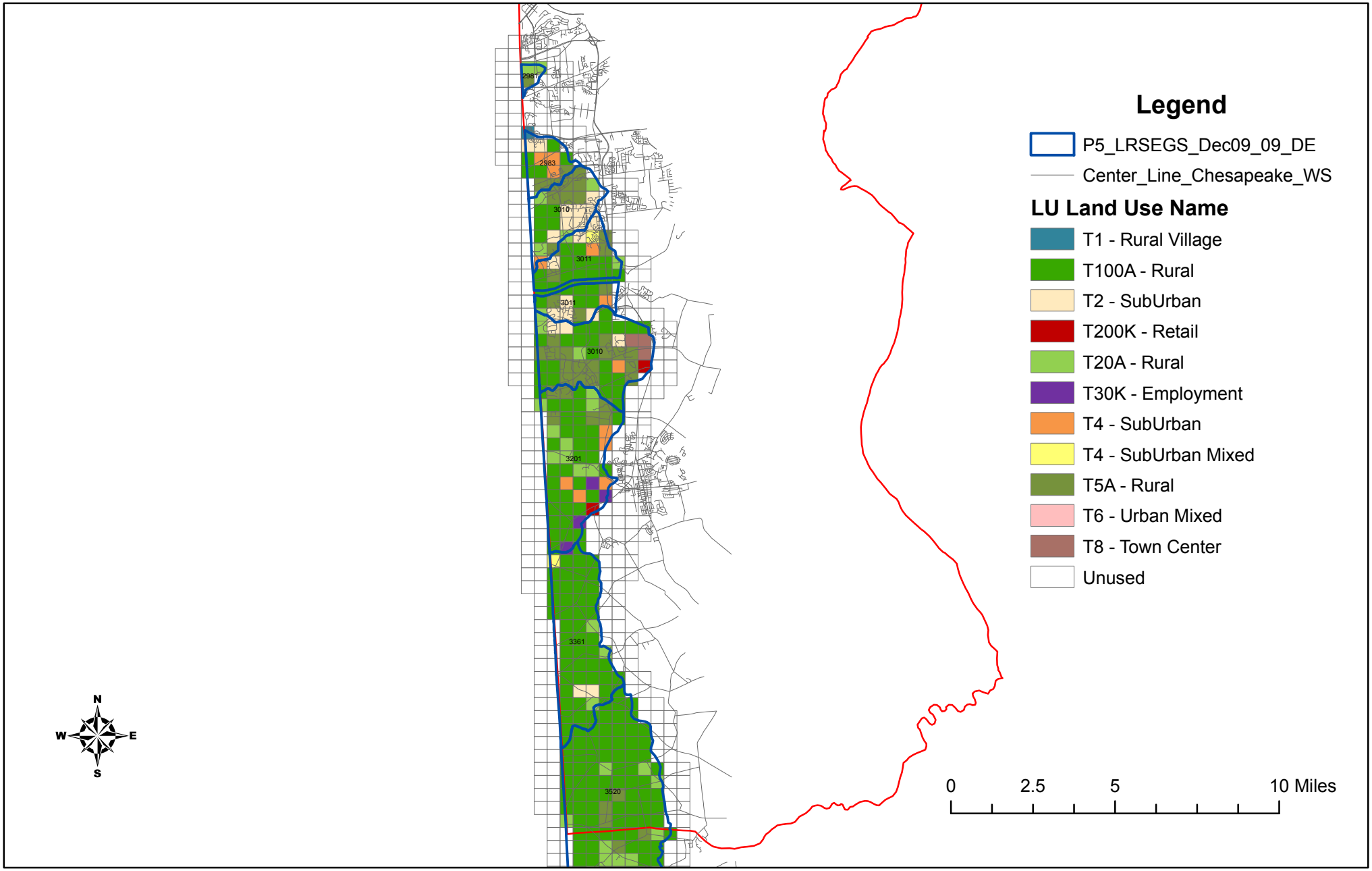
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - New Castle County
Buildout Scenario: Growth 2015
DRAFT: August 21, 2010



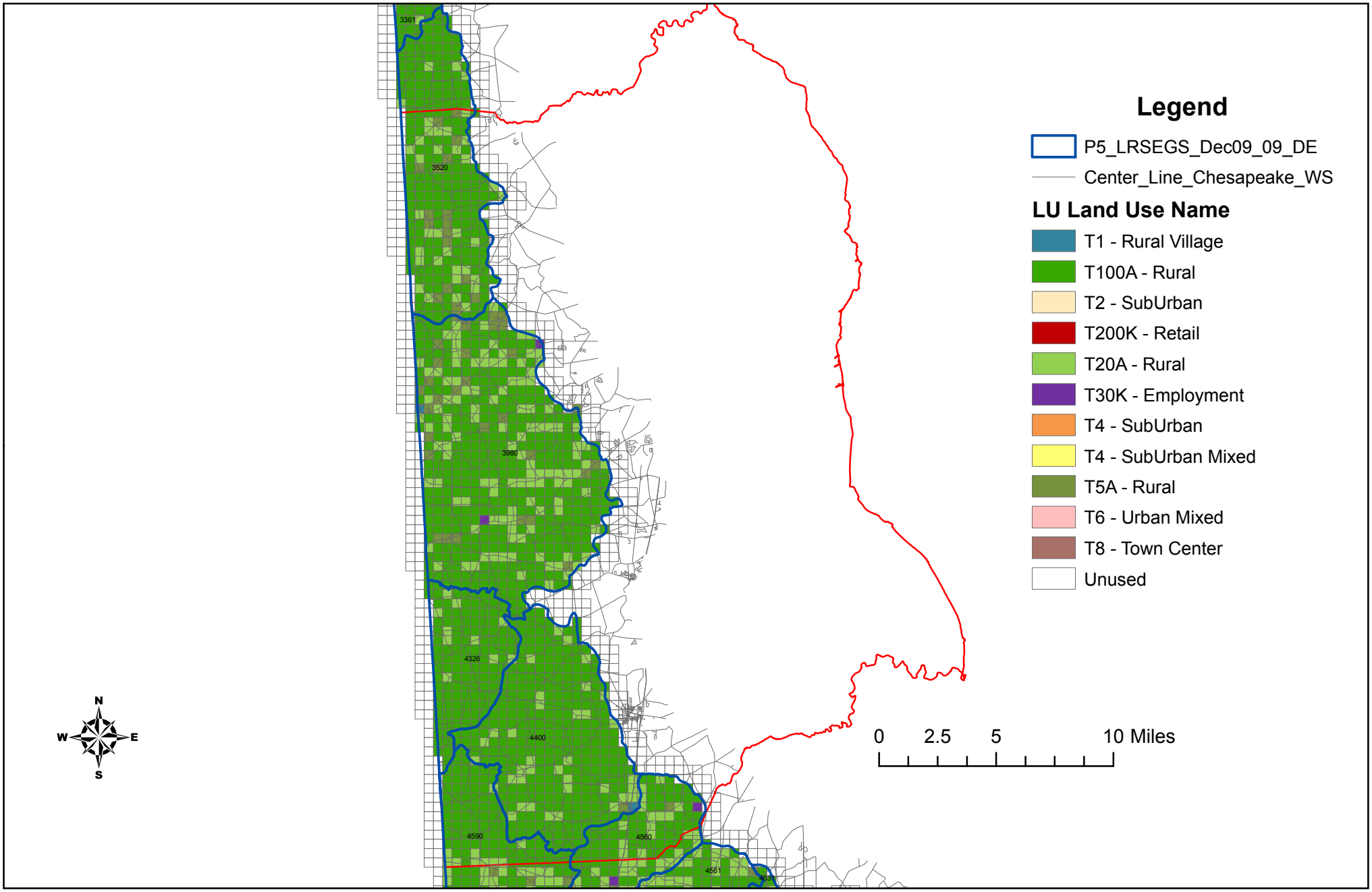
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - New Castle County
Buildout Scenario: Growth 2025
DRAFT: August 21, 2010



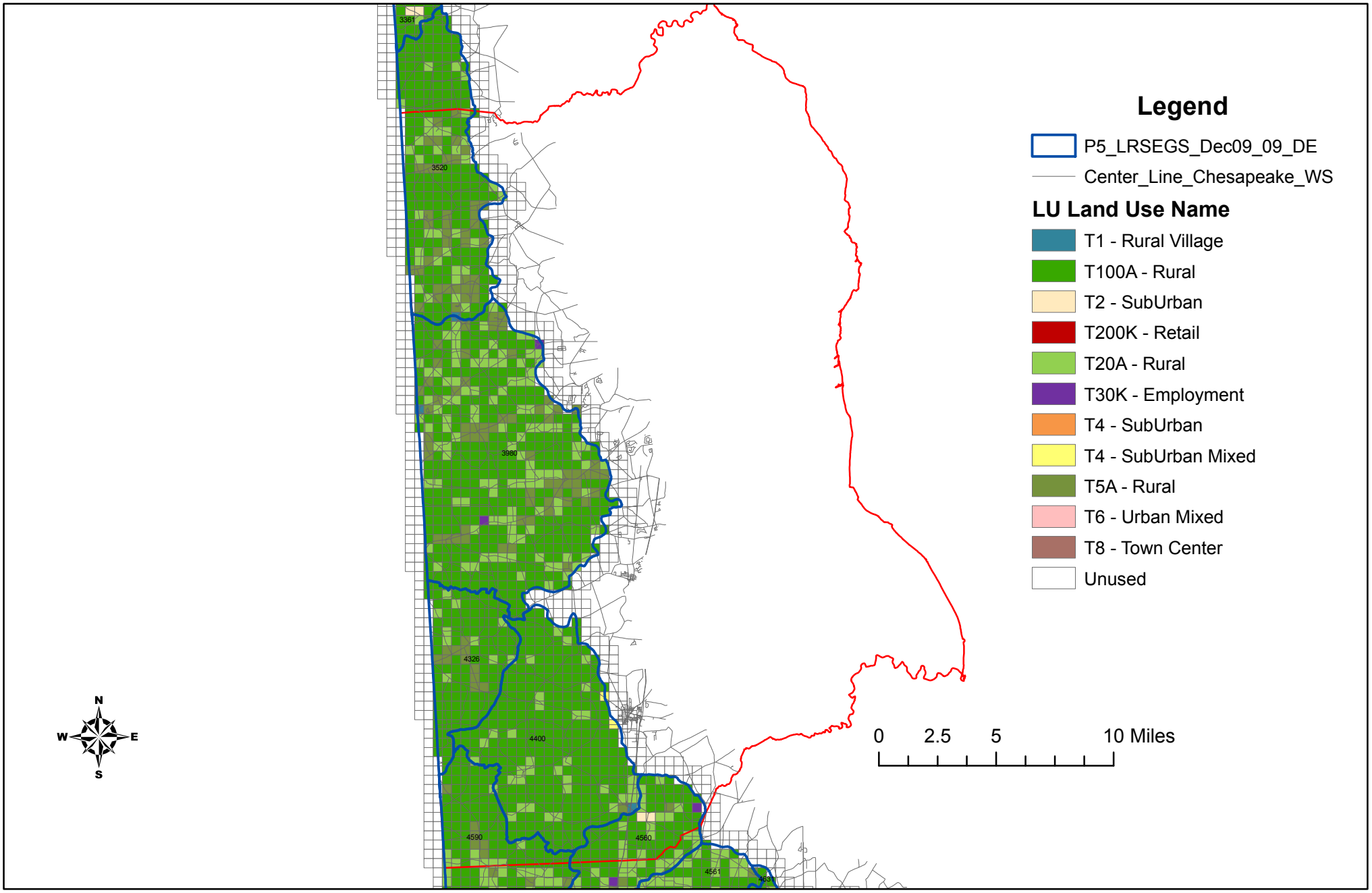
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - Kent County
Buildout Scenario: Existing Land Use 2005
DRAFT: August 21, 2010



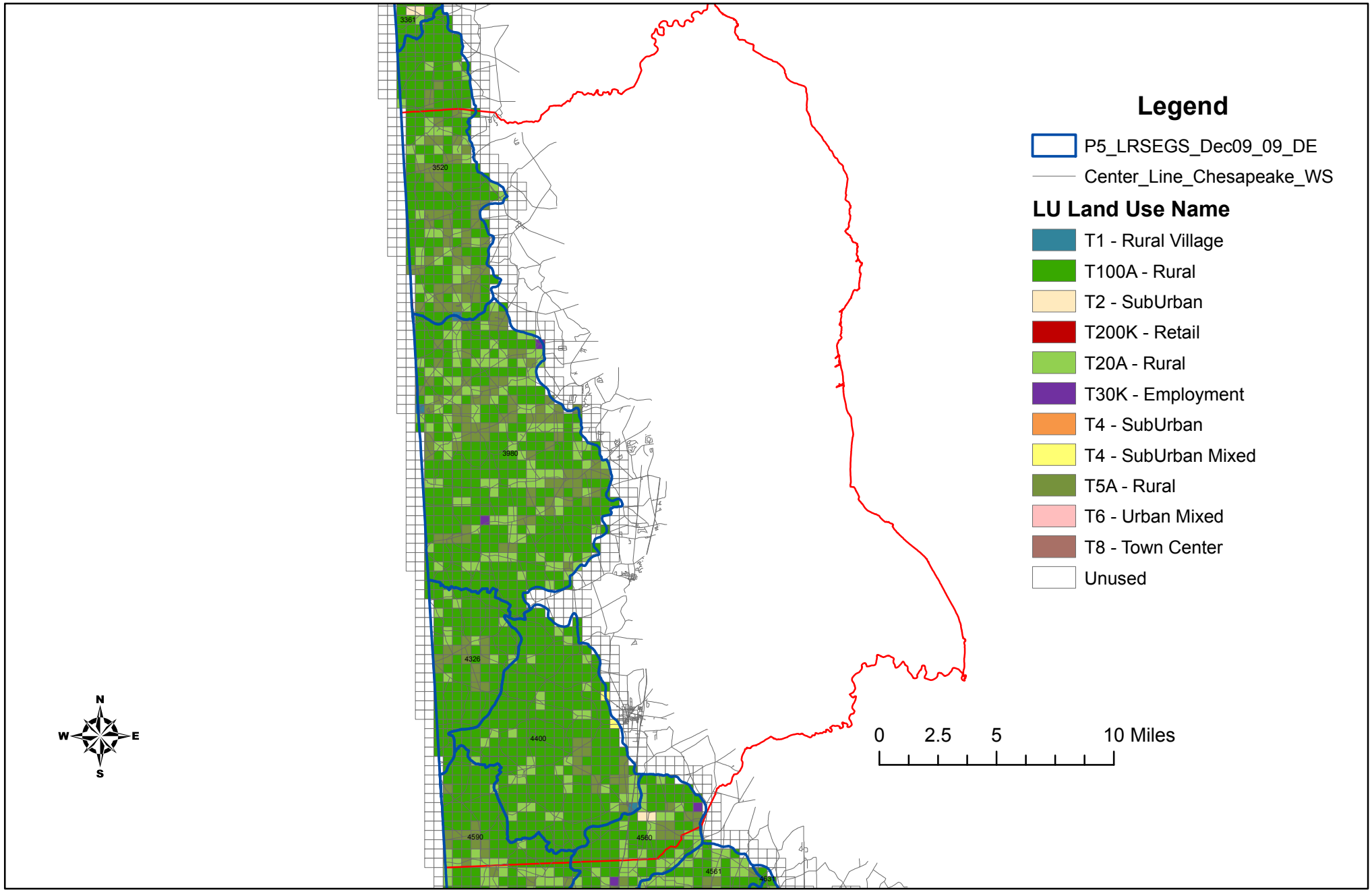
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - Kent County
Buildout Scenario: Growth 2015
DRAFT: August 21, 2010



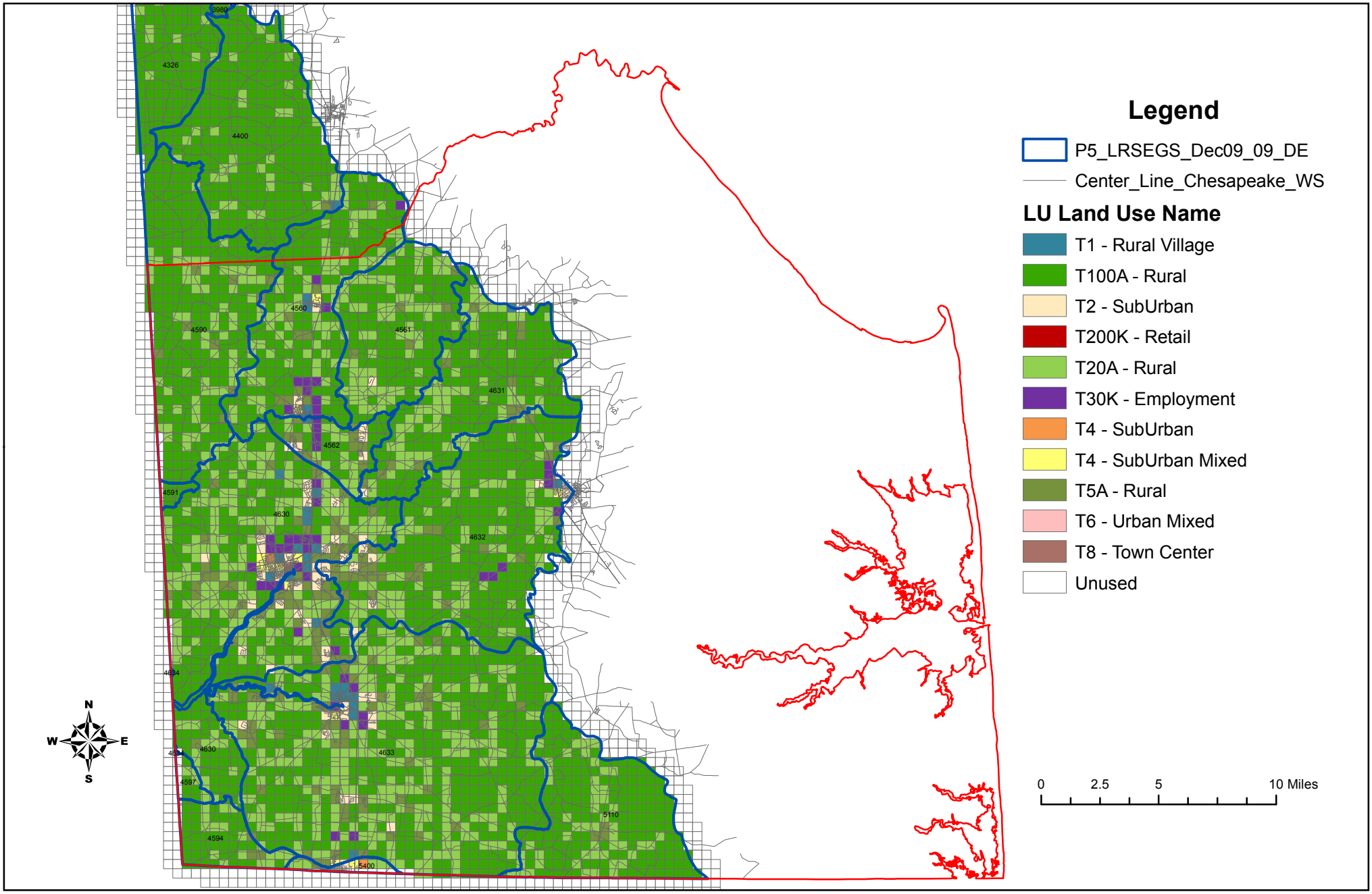
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - Kent County
Buildout Scenario: Growth 2025
DRAFT: August 21, 2010



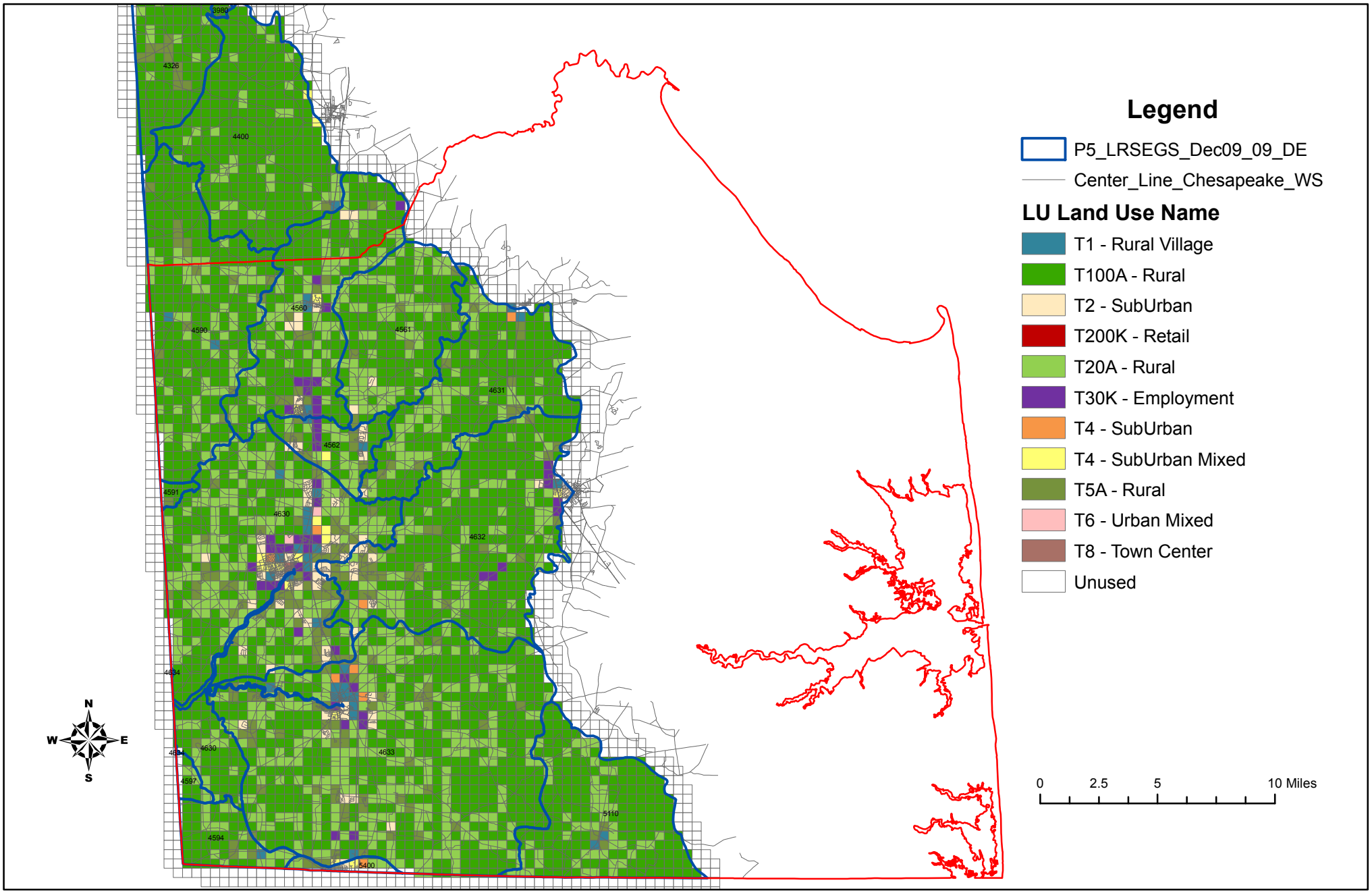
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - Sussex County
Buildout Scenario: Existing Land Use 2005
DRAFT: August 21, 2010



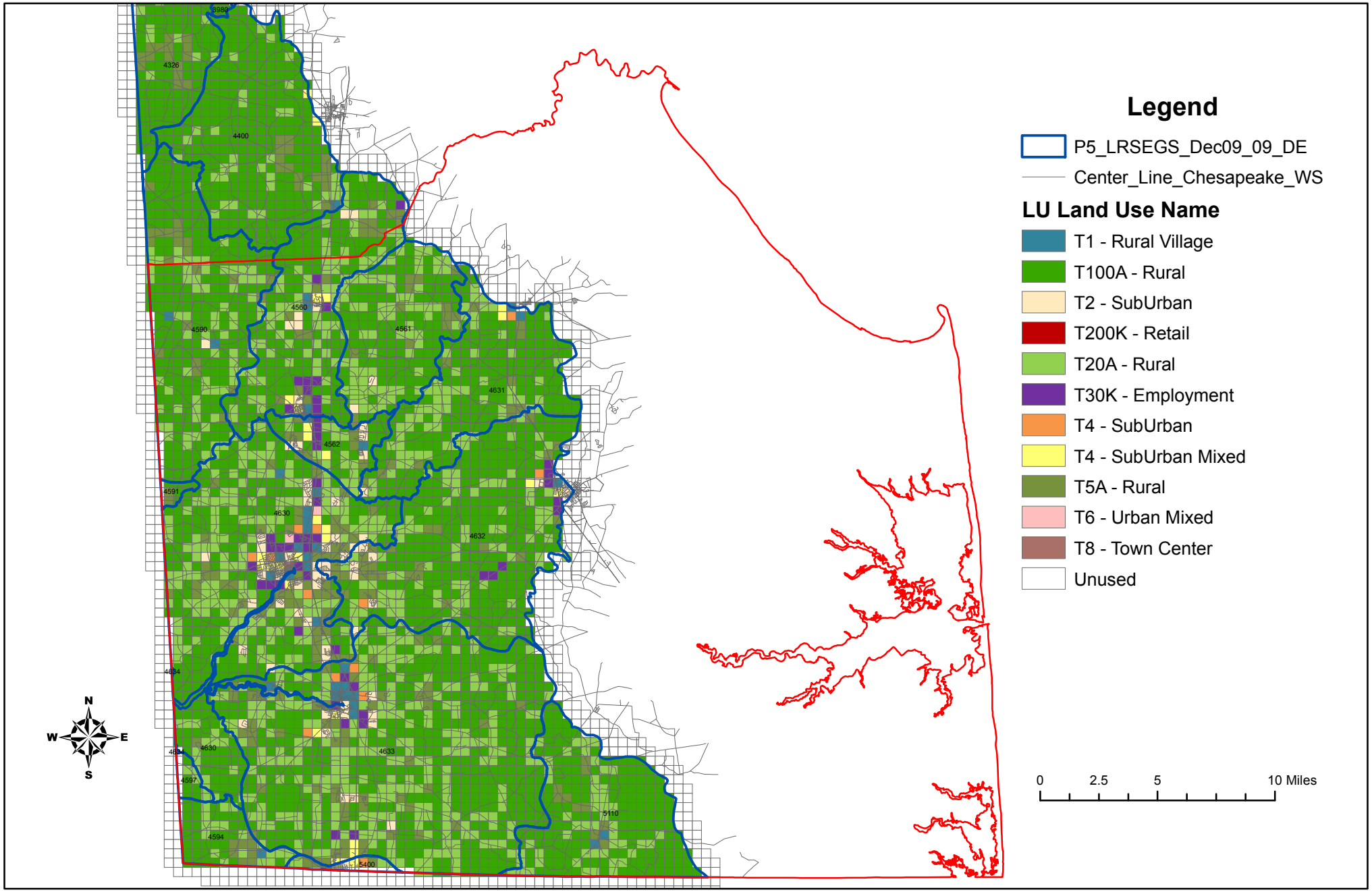
Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - Sussex County
Buildout Scenario: Growth 2015
DRAFT: August 21, 2010



Source: University of Delaware Land Use Model

Chesapeake Bay Watershed - Sussex County
Buildout Scenario: Growth 2025
DRAFT: August 21, 2010



Source: University of Delaware Land Use Model

Chesapeake Bay Watershed -- Delaware
Total Housing Units - Statewide
UD Land Use Model Build-Out - August 22, 2010

PARAMETER		Chesapeake Bay Watershed Build-Out in Total Housing Units (THU)		
CommunityViz Build-Out - Numeric Results		**Existing Land Use**	**Growth 2005-2015***	**Growth 2015-2025***
Build-Out Numeric Dwelling Units		36,227	46,149	54,040
Build-Out Numeric Floor Area		9,792,000	13,636,000	15,024,250
RESIDENTIAL				
Total Housing Units	Dwelling Units	36,227	46,149	54,040
Residents	#	88,412	113,490	133,326
Children	#	24,411	29,407	33,635
Residential VTD	trips/day	361,566	459,108	537,542
Residential Waste Water	gal/day	10,868,100	13,844,700	16,212,000
Residential Water Use	gal/day	10,868,100	13,844,700	16,212,000
Residential Impervious Area	Square Feet	TBD	TBD	TBD
NONRESIDENTIAL				
Non-residentialFloorArea	Square Feet	9,792,000	13,636,000	15,024,250
Employees	#	29,081	34,019	36,786
Non-residential VTD	trips/day	250,738	351,404	391,613
Non-residential Waste Water	gal/day	445,138	527,671	567,879
Non-residential Water Use	gal/day	556,423	659,588	709,849
Nonresidential Impervious Area	Square Feet	TBD	TBD	TBD
** Source of Build-Out: UD Community Land Use Model*		** Source of Growth Change: Delaware Population Consortium "Small Area Population Projections"*		
	DRAFT 23 August 2010			

Growth Projection Comparison by EPA River Segment
Total Housing Units

EPA_River Segment	Tile Count	Area - Acres		DU's - Existing LU	DU's - Growth 2015	DU's - Growth 2025
2981	3	300		23	33	43
2983	13	1,300		548	1,036	1,354
3010	73	7,300		1,618	2,501	3,375
3011	39	3,900		1,062	1,834	2,126
3201	57	5,700		586	1,194	1,830
3361	52	5,200		89	354	586
3520	256	25,600		930	1,313	1,736
3980	504	50,400		2,387	3,000	3,380
4326	123	12,300		230	417	493
4400	304	30,400		760	1,248	1,481
4560	263	26,300		2,116	2,821	3,376
4561	192	19,200		1,146	1,303	1,417
4562	61	6,100		954	1,259	1,709
4590	308	30,800		1,062	1,294	1,523
4591	8	800		12	31	50
4594	58	5,800		278	369	455
4597	11	1,100		65	65	65
4630	540	54,000		9,411	11,125	12,025
4631	241	24,100		1,258	1,606	2,059
4632	408	40,800		3,121	3,718	4,250
4633	771	77,100		7,007	7,895	8,847
5110	223	22,300		814	959	1,092
5400	9	900		750	774	768
Total Housing Units				36,227	46,149	54,040
Growth Change - Total Housing Units					9,922	7,891
	DRAFT 23 August 2010					
Source of Build-Out: UD Community Land Use Model						

Chesapeake Bay Watershed
Households - Statewide
UD Land Use Model Build-Out - August 22, 2010

PARAMETER	Chesapeake Watershed Build-Out in Households (Occupied Housing)			
CommunityViz Build-Out - Numeric Results		**Existing Land Use**	**Growth 2005-2015***	**Growth 2015-2025***
Build-Out Numeric Dwelling Units		28,701	36,031	42,113
Build-Out Numeric Floor Area		9,023,200	11,862,500	12,599,150
RESIDENTIAL				
NumDwellingUnits	Dwelling Units	28,701	36,031	42,113
Residents	#	70,089	88,689	104,014
Children	#	19,394	23,033	26,307
Res VTD	trips/day	286,618	358,724	419,544
ResWasteWater	gal/day	8,610,300	10,809,300	12,633,900
ResWaterUse	gal/day	8,610,300	10,809,300	12,633,900
Impervious_Area - Residential	Square Feet	TBD	TBD	TBD
NONRESIDENTIAL				
NumComFloorArea	Square Feet	9,023,200	11,862,500	12,599,150
Employees	#	27,996	31,589	33,481
Com_VTD	#	229,039	302,800	325,517
ComWasteWater	gal/day	423,439	479,067	501,783
ComWaterUse	gal/day	529,298	598,834	627,229
Impervious_Area - Nonresidential	Square Feet	TBD	TBD	TBD
** Source of Growth Change => Delaware Population Consortium "Small Area Population Projections"*				
Source of Build-Out => University of Delaware Community Land Use Model				
	DRAFT 23 August 2010			

Chesapeake Bay Watershed
Households - By River Segment
Growth 2015-2025 Comparison

Chesapeake Bay Watershed -- # Households -- Change 2015-2025

			UD Land Use Model Build-Out			Change in Households: Existing -> 2015			Change in Households 2015 -> 2025		
EPA_River Segment	**Tile Count**	**Area - Acres**	**DU's - Existing LU**	**DU's - Growth 2015**	**DU's - Growth 2025**	**Change 2005 to 2015**	**Expected Change**	**UD-DPC* Difference**	**Change 2015 to 2025**	**Expected Change**	**UD-DPC* Difference**
2981	3	300	19	28	37	9	8	1	9	5	4
2983	13	1,300	408	858	1136	450	505	-55	278	248	30
3010	73	7,300	1,235	1819	2360	584	581	3	541	531	10
3011	39	3,900	794	1368	1638	574	500	74	270	262	8
3201	57	5,700	508	1040	1596	532	518	14	556	539	17
3361	52	5,200	77	265	404	188	130	58	139	135	4
3520	256	25,600	809	1127	1465	318	364	-46	338	281	57
3980	504	50,400	2,000	2510	2830	510	563	-53	320	302	18
4326	123	12,300	194	349	413	155	88	67	64	66	-2
4400	304	30,400	651	918	1140	267	268	-1	222	222	0
4560	263	26,300	1,648	2126	2509	478	414	64	383	388	-5
4561	192	19,200	957	1071	1167	114	110	4	96	95	1
4562	61	6,100	742	931	1208	190	174	16	277	203	74
4590	308	30,800	908	1107	1283	199	121	78	176	191	-15
4591	8	800	8	24	40	16	17	-1	16	14	2
4594	58	5,800	227	306	379	79	81	-2	73	71	2
4597	11	1,100	56	56	56	0	2	-2	0	0	0
4630	540	54,000	7,086	8080	8934	994	994	0	854	856	-2
4631	241	24,100	1,050	1354	1621	304	325	-21	267	277	-10
4632	408	40,800	2,451	2916	3328	465	464	1	412	399	13
4633	771	77,100	5,618	6390	7062	772	776	-4	672	699	-27
4634		0	0	0	0	0	0	0	0	0	0
5110	223	22,300	681	807	919	126	128	-2	112	109	3
5400	9	900	574	581	588	7	10	-3	7	9	-2
Statewide	4,517		28,701	36,031	42,113	7,331	7,141	190	6,082	5,902	180
2015-2025 Change in Dwelling Units (DU)				7,330	6,082						

** Source of Growth Change => Delaware Population Consortium "Small Area Population Projections"*

Source of Build-Out => University of Delaware Community Land Use Model

DRAFT 23 August 2010

Appendix F

Scope of Work:
Modifying Delaware's Nutrient Budget Protocol
for Use as an Offset Tracking Tool in the Chesapeake Bay Watershed

July 22, 2010

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Eugenia Hart, eugenia.hart@tetratech.com, 302-645-2440

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The Department of Natural Resources and Environmental Control (DNREC) is taking the lead to develop Delaware's Watershed Implementation Plan (WIP) for the Chesapeake Bay Total Maximum Daily Load (TMDL). One of the requirements EPA has identified as a necessary component of WIPs is a method to account for growth. Growth can be addressed in one of two ways: target load for future growth or offset loads resulting from future growth. Delaware is interested in pursuing an offset program.

DNREC staff previously developed a tool known as the Nutrient Budget Protocol. The Protocol compares the loads of a parcel pre- and post-development and determines if the proposed development will achieve local TMDL required nonpoint source reductions. DNREC asked Tetra Tech to review the tool to determine its usefulness in a Chesapeake offset program. Tetra Tech concurred that Nutrient Budget Protocol would be a useful tool in support of Chesapeake Bay WIP with some modifications based on their review of similar tools in use in other parts of the US. Recommendations for these modifications are presented below under the Recommendations section.

DNREC has reviewed the recommendations and would like Tetra Tech to pursue executing the proposed modifications to the Protocol for its use as the primary tracking tool for a Chesapeake offset program. Recommendations have been amended with DNREC staff comments. Additional tasks have also been identified. DNREC requests Tetra Tech review this proposal and provide a detailed budget and schedule.

Currently, the Protocol can be used in most of the State of Delaware. DNREC would like the modified tool to maintain the statewide usability. As Tetra Tech performs work, DNREC requests that all Delaware watersheds be included in the tool. Tetra Tech should add the necessary loading rates and efficiencies for watersheds that are currently not captured that are located within the Chesapeake Watershed. For watersheds currently not in the Protocol and not within the Chesapeake Watershed, DRNEC requests that those watersheds be added so that DNREC staff can add the necessary information for those watersheds in the future.

Additionally, because DNREC's Sediment and Stormwater Program is also developing a tool, DURMM, to specifically to look at the stormwater volume and associated nutrient and sediment loads of development projects, DNREC requests linking DURMM and the Protocol. The DURMM tool should be utilized for stormwater calculations within the Protocol. This linkage will likely negate several of the technical recommendations however Tetra Tech should consult with the Sediment and Stormwater Program for thorough understanding of the DURMM tool.

Recommendations (as provided by Tetra Tech and <u>amended by DNREC</u>)

It is recommended that the Nutrient Budget Protocol go through a thorough review. The review of the Nutrient Budget Protocol spreadsheet should include review for mathematical accuracy. Given the complexity of the calculations and the frequent use of IF statements, it was difficult to verify whether the entire worksheet is performing calculations as stated. Based on that review, necessary updates should be made. The look and feel of the spreadsheet tool should also be improved since it is intended for public use.

The spreadsheet tool should be more user-friendly if it is ultimately intended for public use. Modifications should be made so that the tool is more intuitive. Equations should also be locked so the user cannot overwrite them. Specific recommendations for the technical aspects of the tool as well as user-friendliness are provided below. The recommendations are presented in order of importance. The technical recommendations are critical before application to the Chesapeake Bay watershed. The user-friendliness recommendations are not as critical and can be addressed post-application to the Bay.

Technical Recommendations

1. **Drainage areas.** To calculate the effect of BMPs accurately, the spreadsheet should have discrete drainage areas with post-developed site land area and BMP(s) assigned to each drainage area. In the current implementation, a BMP is applied to a general portion of the site; it does not target specific land uses or account for variations in development density within drainage areas. As a result, treatment can be over- or under-estimated. An effective BMP targeting a locally highly impervious drainage area might not receive proper credit.
   - <u>Since the DURMM tool will be utilized instead of existing stormwater calculations in the Protocol, Tetra Tech should consult with DNREC's Sediment and Stormwater Program for how drainage areas are handled in DURMM for stormwater BMPs.</u>

2. **Impervious area.** When a specific percent imperviousness is not entered by the user, default percent impervious values are applied regardless of density for a set of developed land use categories. This provides an incentive for not stating impervious cover – a developer could project impacts below the true loading rates. On the other hand, the assumptions overestimate loading for low density development, which would be punitive for someone who is developing low density but does not specify imperviousness. The tool should require the user to specify impervious area, even if the user is providing an estimate. The following example illustrates this point. Assume the default value for commercial development is 45% impervious. In reality, it is reasonable for impervious area for commercial development to

range widely – a range from 20% to 80% is completely reasonable, especially in a rural setting. The loading rates will differ by nearly a factor of four between 20% and 80%, but the use of a single value will calculate an identical loading rate impact from two very different sites.

- Since the DURMM tool will be utilized instead of existing stormwater calculations in the Protocol, Tetra Tech should consult with DNREC's Sediment and Stormwater Program for how impervious areas are handled in DURMM and if this component is still needed within the Protocol.

3. **BMP removal rates.** The BMP removal rates for TN and TP (Table 5, page 27 of the User's Guide) are based on older studies. A more recent and fairly local set of BMP removal rates can be found in Virginia's Runoff Reduction technical memo (http://www.dcr.virginia.gov/documents/stmrunredmethmemo.pdf). The Runoff Reduction Method is the newest and most comprehensive study of BMP nutrient effectiveness to date.
   - DNREC suggests utilizing the BMP efficiencies currently in use by the Chesapeake Bay Program in order to ensure loads between the various models are comparable. If the Bay Program does not have an efficiency for a particular BMP, DNREC supports using the Virginia values unless more local information is available and appropriate. The Protocol does not currently contain efficiencies for sediment and this needs to be added for each BMP, as appropriate.

4. **Subwatershed loading rates.** The spreadsheet cannot calculate loads for all areas of Delaware's Chesapeake Bay drainage at this point. It does not contain loading rates for the following subwatersheds within the Bay watershed: Chester River, Marshyhope Creek, Elk Creek, Sassafras River, Bohemia Creek, and a small 12 acre watershed near the canal in Newark (Personal communication with Lyle Jones 2010). Loading rates for these additional watersheds need to be included so the spreadsheet tool can be useful throughout the entire Chesapeake drainage area.
   - DNREC believes that loading rates for the Chester River and Marshyhope Creek are currently captured in the Protocol. DNREC agrees that the other watersheds in the Chesapeake need to be added to the Protocol. Tetra Tech should utilize loading rates currently in use by the Chesapeake Bay program for all Chesapeake watersheds in order to ensure loads between the various models are comparable. The Protocol does not currently contain loading rates for sediment and this needs to be added for each land use, as appropriate

5. **BMP representation.** There is a limited number of BMPs currently represented in the spreadsheet. There was some concern from the stormwater group about the Chesapeake Bay model not including BMP technologies such as green roofs, rooftop disconnection, or permeable pavement (just some examples). It appears that the Nutrient Budget Protocol doesn't include them either. If there are plans to install these types of BMPs throughout the watershed it would be useful to include them in the spreadsheet. The BMP section will need to be modified to include all BMPs that will be applied in the watershed.
   - DNREC would like all BMPS that are currently captured by the Chesapeake Bay Program model to be captured in the Nutrient Budget Protocol. DNREC would also like the ability to easily add new BMPs to the Protocol in the future. Additionally, the

Sediment and Stormwater Program is working to identify efficiencies for several of the stormwater related practices listed above and will hopefully be able to capture those BMPs in DURMM.

6. **Grass buffers.** It appears the spreadsheet could potentially over-calculate grass buffers as they are asked for under Agricultural Buffers and again as part of Grassland.

7. **Loading rate documentation.** The source and derivation of the loading rates is not sufficiently documented in the User's Guide. Specifically cite the source of the loading rates and how they were derived.
   - Agreed, better documentation is needed. Please see "Additional Tasks Requested by DNREC" below.

Recommendations for User-friendliness:

1. **Worksheet reorganization.** The input **Worksheet** needs to be reorganized to be more intuitive for the user. Suggestions include simplifying the land use and BMP input areas. A possible solution for simplification would be to provide multiple clearly named input worksheets such as one for pre-development land use, one for post-development land use, one for BMPs, and one for other components such as wastewater, buffers, and credits. This would make the input areas easier to navigate. Pre and post-development land use inputs should be simplified by clearly stating the needed land use areas. An example would be to change the pre-development land use categories to the following:
   a. Total Area
   b. Agriculture
      i. Agriculture with routine chicken manure application
   c. Golf course
   d. Urban/residential
   e. Forest (non-wetland, including buffers)
   f. Forested wetlands
   g. Tidal wetlands
   h. Non-tidal emergent wetlands
   i. Grassland (including buffers)
   j. Brushland
   k. Gravel pits

2. **Loads by land use.** The **Results** sheet doesn't show loads from all land uses. It would be helpful to see the break-down. For example, the **Results** sheet currently only shows loads from Urban Impervious. The **Results** sheet makes it appear that developed land is ultimately represented by impervious surface loading rates only, and does not include the load from the developed pervious portion. In a conversation with Lyle Jones, he stated that the loads for pervious developed land are included in the **Load Calculation** sheet. These loads should be moved to the **Results** sheet, along with loads for all other land uses, where the user can clearly see them.

3. **Potential to overwrite formulas.** It appears that the user can overwrite calculation formulas on the main data entry sheet **Worksheet**. The locking of equations is recommended to prevent accidental overwriting. Note that formulas in the range of G72:G79 refer to cell J72, which is not designated as an input cell, and the instructions appear to advise the user to overwrite the formulas in the range of B72:B79. However, as noted previously (Technical Recommendation 1) it is recommended that explicit entry of land area and BMP treatment for each site drainage area is provided, which would remove this section from the spreadsheet entirely.

4. **Buffer width.** Identify the units in which the buffer width is needed in question 9C, row 67 in the **Worksheet**.

5. **Reword Question 10a, row 69.** If the current BMP implementation is retained, this question should be reworded as: Are stormwater BMPs going to be used independently, in series, or in combination? This implies that some areas will have individual Stormwater BMPs and other areas will have stormwater BMPS in a treatment train.

Additional Tasks Requested by DNREC:

1. DNREC is interested in adding the capability to generate a report and table of output.

2. Tetra Tech should update/develop technical document and a user guide for the modified tool.

3. Tetra Tech should provide a minimum of 1 day of training to DNREC staff on the modified tool.

4. Since the Protocol will become part of a regulatory tool for an offset program, Tetra Tech should plan to attend public workshops and provide presentations on the modified tool.

Appendix G

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Cover Crop - Traditional	Plant 66,400 acres of traditionally planted cover crops annually by 2025. Cover crops are small grains such as wheat, rye or barley that is planted in the fall after the harvest of corn, soybeans and/or other summer crops to absorb residual fertilizer that may remain in the soil. Cover crops provide a ground cover that prevents winter soil erosion. Funding for cover crops is provided through the State of Delaware Cost Share Program, CWA-Section 319 Grant, Chesapeake Bay Program Grant, and USDAs Environmental Quality Incentives Program.	acres (annual)	16,600 acres	3,320 additional acres	19,920 additional acres	26,560 additional acres	66,400 acres	Range $15 - $30 acre $49,800 to $99,600
Cover Crops - Commodity	Plant 26,365 acres of early planted cover crops annually by 2025. Cover crops are small grains such as wheat, rye or barley that is planted in the fall after the harvest of corn, soybeans and/or other summer crops to absorb residual fertilizer that may remain in the soil. Cover crops provide a ground cover that prevents winter soil erosion. Funding for cover crops is provided through the State of Delaware Cost Share Program, CWA-Section 319 Grant, Chesapeake Bay Program Grant, and USDAs Environmental Quality Incentives Program.	acres (annual)	6,595 acres	7,913 acres	7,908 acres additional acres	10,544 additional acres	26,365 acres	Range $35 - $50 acre

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Nutrient Management Compliance	Assure Nutrient Management Planning Compliance of 216,290 acres of farmland and urban turf areas. Nutrient Management Plans are required by landowners to assure the efficient use of manure or fertilizer needed to grow a healthy crop and minimize the application of excessive nutrients that could be lost to the environment. The State of Delaware Nutrient Management Commission will conduct Nutrient Management Compliance Audits on 216,290 acres.	acres (annual)	216,290 acres	Maintain	Maintain	NA	216,290 acres	NA
Soil Conservation & Water Quality Plans	Develop Soil Conservation and Water Quality Plans on 194,666 acres. Develop a comprehensive plan for a farm that addresses natural resource management on agricultural lands and recommends best management practices (BMPs) that control erosions and sediment loss and manage nutrient runoff. 194,666 acres of Delaware farm land will be managed under a current Soil Conservation and Water Quality Plans	acres (annual)	194,666 acres	Maintain	Maintain	NA	194,666	NA

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Conservation Tillage	Encourage Conservation Tiilage on an aditional 6,000 acres of farmland annually. Conservation Tillage involves planting and growing crops with minimal disturbance of the surface soil. No-till farming, a form of conservation tillage, is used to seed the crop directly into vegetative cover crop residue with no disturbance of the soil surface. Minimal tillage farming involves some disturbance of the soil, but uses tillage equipment that leaves much of the vegetative cover or crop residue on the surface.	acres	197,799 acres	6,000 additional acres	227,008 (max) acres	NA	227,008 acres	$13/acre
Continuous No-Till Conservation	Of the 197,779 acres in conservation tillage, expand to 36,159 acres of continuous no-till farming by 2025. Continuous No-Tillage has the seed applied into a vegetative cover or crop residue with no disturbance of the surface soil. Conservation Tillage involves planting and growing crops with minimal disturbance of the surface soil. No-till farming, a form or conservation tillage, is used to seed crop directly into vegetative cover or crop residue with no disturbance of the soil surface. Minimal tillage farming involves some disturbance of the soil, but uses tillage equipment that leaves much of the vegetative cover or crop residue on the surface.	acres	23,159 acres	additional 1,000 acres annually	6,000 additional acres	8,000 additional acres	36,159 acres	$40/acre

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Decision/Precision Agriculture	Use Precision Agriculture on an additional 20,637 acres of farmland from 2010-2011 and achieve a maximum implementation of 227,008 acres by 2017. Precision agriculture seeks to maximize the efficiency of nutrient application to cropland, thereby minimizing waste and nutrient runoff.	acres (annual)	103,186 acres	20,637 additional acres	227,008 (max)	NA	227,008 acres	$30/acre
Heavy Use Poultry Area Pads	Construct 45 additional Heavy Use Poultry Area concrete pads for 2010-2011 and an additional 45 pads annually through 2025. Establishing a pad structure stabilizes areas frequently and intensively used by people, animal, or equipment to prevent nutrient movement into surface and groundwater. Cost-share funds are available for the installation of these structures though the State of Delaware Cost Share Program and USDAs Environmental Quality Incentives Program.	structures	227 structures	45 additional structures	270 additional structures	360 additionalstructures	857 structures	$4,661/unit

Appendix G

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Livestock Waste Structures	Construct Livestock Waste Structures. Animal waste is stored in structures to protect it from the weather until it can be used as a crop fertilizer when conditions are appropriate or transport to another location. Cost-share funding is available for the installation of these structures though the State of Delaware Cost Share Program and USDAs Environmental Quality Incentives Program.	structures	3 Swine; 7 Equine; 4 Dairy; 10 Dairy Waste; 3 Bovine	1 Swine; 3 Equine; 1 Dairy; 2 Dairy Waste; 1 Bovine	Additional Structures: 6 Swine; 18 Equine; 6 Dairy; 2 Dairy Waste; 6 Bovine	NA	Total Structures: 10 Swine; 28 Equine; 11 Dairy; 14 Dairy Waste; 10 Bovine	Swine-$25,000 Equine $15,000 Dairy $60,000 Bovine $50,000
Water Control Structures	Construct Water Control Structures on 10,846 acres by 2025. These structures are used in constructed drainage systems to control water depth and flow rates. They also increase water retention and decrease the quantity and quality of pollutants downstream. Cost-share funding is available for the installation of these structures though the State of Delaware Cost Share Program and USDAs Environmental Quality Incentives Program.	acres	50 units @ 8,343 acres	1 additional unit	6 additional units	8 additional units	65 units @ 10,846 acres	$5,000/each
Stream Protection with Fencing	Protect 258 acres of Pastureland Using Fencing by 2025. Pasture fencing keeps farm animal out of streams and prevents stream bank erosion. Cost-share funding is available for the installation of these structures though USDAs Environmental Quality Incentives Program.	acres	108 acres	10 additional acres	60 additional acres	80 additional acres	258 acres	$2.00/ft

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Stream Protection without Fencing	Utilize Stream Protection without Fencing on an additional 325 acres through 2025. Watering troughs provide a safe reliable source of water from livestock that is away from streams. The troughs help protect steams banks from erosion that may be caused by farm animals. Cost-share funding is available for the installation of these structures though USDAs Environmental Quality Incentives Program.	acres	None	25 acres	150 additional acres	150 additional acres	325 acres	$700/each
Upland Prescribed Grazing	This data has not been reported in Delaware in the past. NRCS maintains a data set which indicates that there are 214 acres of prescribed grazing in the Chesapeake.	acres	214 acres	20 additional acres	450 additional acres	450 additional acres	1,134 acres	varies
Manure Relocation	Transport an additional 48,757 tons of manure out of the Chesapeake Bay Watershed for 2010-2011 and an additional 4,000 tons annually through 2025. Excess manure is transported away from farms with high soil phosphorus levels to other farms or locations that can use the manure safely. Funding for this program is provided through CWA Section-319 Grant, Delaware Cost Share Program, Chesapeake Bay Program Grant, USDAs Environmental Quality Incentives Program and Delaware's Poultry Integrators.	tons (annual)	48,757 tons	4,000 additional tons	24,000 additional tons	32,000 additional tons	110,757 tons	average of $4.32/ ton

Appendix G

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Poultry Waste Structures	Increase current capacity to 723 Constructed Poultry Waste Structures. These structures protect poultry waste from rain so that is can be used as a crop fertilizer when conditions are appropriate or transport to another location. Cost-share funding is available for the installation of these structures though the State of Delaware Cost Share Program and USDAs Environmental Quality Incentives Program.	structures	444 structures	88 additional structures	723 (all)	NA	723 structures	$27,005 ea = $2,376,440
Run-Off Control Systems	Construct 120 Runoff Control Systems by 2025. Runoff control systems use a variety of techniques to direct rainwater to places where it won't cause nutrient runoff or soil erosion. Gutters and downspouts on barns and grading of the land are examples of ways to direct runoff from rainfall. Cost-share funding is available for the installation of these structures though the State of Delaware Cost Share Program and USDAs Environmental Quality Incentives Program.	systems	none	8 additional systems	48 additional systems	64 additional systems	120 systems	$5.25/ft average project is 2000 ft
Phytase Utilization	With the advent of phytase addition to the diet and feed for all poultry in Delaware we have realized a steady reduction in the phosphorus levels in poultry manure. Research demonstrates a 30 - 40 % reduction is easily achievable.	% reduction	30%	NA	NA	NA	NA	NA

Appendix G

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Mortality Composters or Incinerators	Require dead bird composters/Incent orators on all poultry operations for bird mortality.	structures	449 structures	95 additional structures	723 (all)	NA	723 structures	$6,618 = $595,620
Large Animal Mortality Program	Offer large animal mortality handling for operations with large animals. Program will assure off-site transport for large animal mortality.	animals	110 annually	maintain	maintain	NA	110 annually	$175 to $250 per animal
Private Lands								
Streamside Grass Buffers	Plant an additional 69 acres annually of Streamside Grass Buffers on Private Lands. Pplant an additional 1,734 acres by 2025. Grasses planted next to waterways filter and take up nutrients from run off, stabilize the soil, and provide wildlife habitat. Cost share funds are available for the implementation of grasses buffers on agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program. Costs are based on a 10 year contract agreement.	acres	699 acres	69 additional acres	414 additional acres	552 additional acres	1,734 acres	$300/acre for installation; $65/ acre/year land rental; $35.17/acre/year interest

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Streamside Forest Buffers	Plant an additional 223 acres of Streamside Forest Buffers on Private Lands annually. Plant an additional 5,571 acres by 2025. Trees planted next to waterways filter and take up nutrients from run off, stabilize the soil, and provide wildlife habitat. Cost share funds are available for the implementation of streamside forest buffers on agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program. Costs are based on a 10 year contract agreement.	acres	2,226 acres	223 additional acres	1,338 additional acres	1,784 additional acres	5,571 acres	$425/acre average for installation; $138/ acre/year land rental; $35.60/acre/year interest; $5 acre/year maintenance

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Wetland Restoration	Construct an additional 29 acres of Wetland Restoration on Private Lands annually. Establish an additional 721 acres by 2025. A wetland is an are of land where the soil is wet or covered with water. Wetlands can be in the form of bogs, swamps, or marshes. Cost share funds are available for the implementation of wetland restoration on agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program. Funding for wetland creation, restoration, and enhancement is also available from various federal sources, State and local government and nonprofit organizations. Costs are based on a 10 year contract agreement.	acres	286 acres	increase by 29 acres to 315	174 additional acres	232 additional acres	721 acres	$1,702/acre average for installation; $138/ acre/year land rental; $5 acre/year maintenance
Shoreline Erosion Control	Shore stabilization projects on private agricultural land that reduces erosion and stabilizes shorelines. Mitigation options to protect shorelines provide nutrient and sediment reductions.	feet	6,343 feet	600 additional feet	3,600 additional feet	4,800 additional feet	15,343 feet	varies

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Retire Highly Erodible Land	Retire 697 acres of Highly Erodible Land by 2025. Land that is especially vulnerable to erosion is removed from crop or hay production and is planted in either grass or forest. This land usually is not disturbed for at least 10 years. Cost share funds are available for the retirement of highly erodible agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program.	acres	0	277 acres	180 additional acres	240 additional acres	697 acres	$300/acre average cost
Land Retirement	Land retirement influences multiple environmental concerns beyond reducing soil erosion, such as improving water quality and protecting wildlife habitat. Land retirement programs include NRCS Conservation Reserve Program and, to a lesser extent, the Wetland Reserve Program.	acres	416 acres	Maintain	Maintain	NA	NA	NA
Forest Harvesting Practices	The Delaware Forest Service is the permitting agency for any logging operations that are 1 acre or larger if the land is to remain as forest afterwards. The primary laws enforced are water quality BMPs (all harvests) and adequate regeneration of commercial tree species (only when the Seed Tree Law is triggered by a harvest that is at least 10 acres, at least 25% pine and/or yellow-poplar, and not to be converted to a non-forest land use).	acres	2,070 acres	210 additional acres	1,260 additional acres	1,680 additional acres	5,220 acres	varies by BMPs

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Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Public Lands								
Tree Planting	Plant 108 trees on public lands by 2025.	acres	63 acres	3 additional acres	18 additional acres	24 additional acres	108 acres	Up to $400/acre
Wetland Restoration	Construct 15 acres of Wetland Restoration on Public Lands by 2025. A wetland is an are of land where the soil is wet or covered with water. Wetlands can be in the form of bogs, swamps, or marshes. Cost share funds are available for the implementation of wetland restoration on agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program. Funding for wetland creation, restoration, and enhancement is also available from various federal sources, State and local government and nonprofit organizations.	acres	NA	1 acre annually	6 additional acres	8 additional acres	15 acres	$1,702/acre average for installation
Streamside Forest Buffers	Plant 30 acres of Streamside Forest Buffers on Public Lands by 2025. Trees planted next to waterways filter and take up nutrients from run off, stabilize the soil, and provide wildlife habitat. Cost share funds are available for the implementation of streamside forest buffers on agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program.	acres	NA	2 additional acres	12 additional acres	16 additional acres	30 acres	$425/acre average for installation

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Streamside Grass Buffers	Plant 30 acres of Streamside Grass Buffers on Public Lands by 2025. Grasses planted next to waterways filter and take up nutrients from run off, stabilize the soil, and provide wildlife habitat. Cost share funds are available for the implementation of grasses buffers on agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program.	acres	NA	2 acres annually	12 additional acres	16 additional acres	30 acres	$300/acre for installation
Grassland	Restore 185 acres of Grassland on Public Lands by 2025. Grasses planted next to waterways filter and take up nutrients from run-off, stabilize the soil, and provide wildlife habitat. Cost share funds are available for the implementation of grasses buffers on agricultural lands through the Delaware Conservation Reserve Enhancement Program and USDAs Conservation Reserve Enhancement Program.	acres	110 acres	5 additional acres	30 additional acres	40 additional acres	185 acres	$300/acre for installation
Agriculture strategies on DNREC/DDA Lands	Adopt applicable actions and practices from Chesapeake Bay Executive Order Section 502 on Publicly Lands owned and maintained by DNREC, DDA and DelDOT. E.g. Cover Crops. Available Public owned ag lands is 4,226.	acres	0	422 additional acres	2,532 additional acres	1,272 additional acres	4,226 acres	depends on BMPs implemented

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Natural Filters on Other Public Lands	Delaware will increase partnerships with local governments, nonprofits, universities, other State of Delaware agencies to implement natural filters on Public Lands.	acres	Evolving BMP	50 additional acres	300 additional acres	400 additional acres	750 acres	$300/acre
New Farming BMPs								
CAFO Setbacks	Manure application setbacks to be implemented on the CAFO operations in accordance with State Technical Standards.	acres (annual)	0	250 additional acres	750 additional acres	750 additional acres	1,750 acres	Regulatory Conditions
Cropland Irrigation Management	Crop irrigation is used to decrease climate variability and maximize crop yields. This results in a decrease in runoff and an increase in the crop's ability to uptake nutrients therefore less available for nutrient runoff. Yields are estimated at 20% to 25% higher than non-irrigated fields. Nutrient uptake or irrigated acres are greater, resulting in less residual nutrients remaining in the soil for runoff.	acres (annual)	60,000 acres	5,000 additional acres	30,000 additional acres	40,000 additional acres	135,000 acres	None

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Vegetative Environmental Buffers	A vegetative environmental buffer is the strategic planting of combinations or trees and shrubs around poultry houses to address environmental, production, and public relations issues by providing a vegetative filter to lower emissions of ammonia, dust, odor, feathers, and noise on a potential of 222 operations. In addition to offering a practical, efficient, and cost effective means of capturing emissions, a properly designed vegetative environmental buffer program can help to conserve energy and reduce air borne pathogens by offering shade and slowing wind speeds, as well as create a more attractive landscape and screen routine operations from view.	operations	72 operations	10 additional operations	60 additional operations	80 additional operations	222 operations	$4,000 per system = $40,000
Streamside/Tax Ditch Restoration	A suite of innovative alternative practices designed to enhance the removable of nutrients once they leave the field. These include increasing vegetative buffers that protect ditches from sediment and nutrient runoff. This may include reengineering of drainage channels to reestablish floodplains or redirect storm flows to wetland areas.	linear feet	17,700 linear feet	6,000 additional linear feet	7,500 additional linear feet	10,000 additional linear feet	41,200 linear feet	$75 per linear foot

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Evolving BMPs								
5, 10, or 35-Ft Riparian Buffer Setback	Encourage a 5, 10, or 35 foot Riparian Buffer set back for the application of nutrients on all streams and secondary drainages. The potential for affect are is 852 acres with a 5 foot buffer, 1,706 with a 10 foot buffer, and 5,930 with a 35 foot buffer.	acres (annual)	Evolving BMP	250 additional acres	1,500 additional acres	2,000 additional acres	5,750 acres	TBD
P-sorbing Materials	"Phosphorous-sorbing" materials soak up dissolved phosphorus keeping it from flowing downstream on a potential --- acres. Engineered systems in which drainage water passes through phosphorus-sorbing materials, such as gypsum, drinking water residuals, or acid mine drainage residuals, can potentially remove large percentages of phosphorus as well as sediment, heavy metals, and other pollutants.	acres (annual)	Evolving BMP	TBD	TBD	TBD	TBD	TBD
Poultry Litter Treatment	A surface application of alum, an acidifier, is added to poultry litter to acidify poultry litter and maintain ammonia in the no-volatile ionized form (ammonium) for potential of 50,000 tons. Limited funding available.	tons (annual)	Evolving BMP	TBD	TBD	TBD	TBD	TBD

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
In-house Poultry Ammonia Emission Control	Ammonia emission reduction could be achieved by constructing and retrofitted poultry houses with flooring that helps reduce the creation of ammonia. Companies are researching new ventilated plenum flooring (patent pending) for poultry houses that will result in drier litter thus reducing the volume of waste by using less bedding material, lowers ammonia emissions, and promotes faster-growing and healthier chickens.	Operations	Evolving BMP	TBD	TBD	TBD	TBD	TBD
Agronomic Improvements	New seed varieties are being developed for additional nutrient efficiency. Current seed varieties are 40% to 50% efficient at utilization and up-take of nutrients. Current test varieties of some new seeds will provide up to 60% efficiency in utilizing available fertilizer.	acres (annual)	Evolving BMP	TBD	227,008 (max)	TBD	TBD	TBD
Voluntary BMPs	A program to conduct farm assessments and inventory of voluntary conservation practices that have been installed but farmers and landowners, since 2005, that are not part of current data inventories.	acres (annual)	Currently Not Measured	TBD	TBD	TBD	TBD	TBD

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Alternative Use of Manure	Livestock Manure (primarily poultry litter) generated on Delaware farms is currently applied as fertilizer to Delaware crop fields or transported to areas of need through DDA's Nutrient Relocation Program. A small percentage is pelletized and sold as an organic fertilizer for residential and commercial use through Perdue AgriRecycle. Developing alternative uses for manure produced in the Chesapeake Bay Watershed represents a large opportunity for area farmers. One potential use for the region's excess manure is energy generation. Using excess manure to feed energy generation systems could potentially result in a reduced nutrient load to the Chesapeake Bay, thus improving water quality.	tons (annual)	Evolving BMP	TBD	TBD	TBD	TBD	TBD

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Revised P-Index for Nutrient Management Planning	The Phosphorus Site Index is a site-specific assessment tool that identifies the relative risk for phosphorus losses from agriculture production fields to nearby bodies or water. The Phosphorus Site Index is currently used in the development of agriculture nutrient management plans. Delaware will support development of a revise Phosphorus Site Index that incorporates the best available science in an effort to more appropriately identify the risk for phosphorus loss from agricultural lands. The revised Phosphorus Site Index will offer site-specific management options for reducing off-site phosphorus transport. The process of revising the current Phosphorus Site Index will conducted in conjunction with the University of Delaware.	acres (annual)	Evolving BMP	NA	100,000 acres	TBD	TBD	No additional cost as practice will be included within Nutrient Management Planning
Dairy manure Incorporation Technology	Dairy manure is incorporated into the soil at the time of application utilizing low disturbance technology. Ammonia loss from incorporation will be reduced up to 95% compared to surface application.	acres (annual)	Evolving BMP	TBD	TBD	TBD	TBD	TBD
Poultry Manure Incorporation Technology	Poultry litter is incorporated into the soil at the time of application utilizing minimum disturbance technology which significantly reduces ammonia loss.	acres (annual)	Evolving BMP	TBD	TBD	TBD	TBD	TBD

Planned Activity	Description	Units	Current	2010-2011	2012-2017	2017 - 2025	Total	Cost per Unit
Carbon Sequestration/Alternative Crops	The NRCS has a practice called long term no-till which they consider a carbon sequestration practice. EPA modelers have indicated that this would instead fall under continuous no-till. Thus, there does not currently appear to be any cost-shared programs that contain this practice.	acres (annual)	Evolving BMP	TBD	TBD	TBD	TBD	TBD
Poultry Litter Windrowing	This is a relatively new practice being pushed by integrators for poultry growers which appears to reduce the amount of poultry litter produced in a year, thus reduces the amount of manure available for field application. Poultry litter/manure is windrowed within the piultry houses as a composting method. Once complete, the litter is re-used within the house to serve as litter for a second flock.	tons (annual)	Evolving BMP	TBD	TBD	TBD	TBD	TBD
Poultry House Remediation	This BMP practice decommissions abandoned poultry houses. The amount of legacy nutrients under poultry houses is sizable. This practice removes and composts the wood materials and soil below the house to eliminate this pollutant source.	operations	6 operations have been remediated	TBD	TBD	TBD	TBD	Varies based upon size

Appendix H

DELAWARE
NUTRIENT
MANAGEMENT
PROGRAM

2320 South DuPont Highway • Dover, DE 19901
1-800-282-8865 (DE Only) • 302-698-4500
Fax: 302-697-4768
Email: nutrient.management@state.de.us
Website: www.state.de.us/deptagri

******FOR DNMP USE******

Form/Control Number: _____

Date Entered: _____

Nutrient Management Annual Report for 2007, 2008 and 2009
Choptank Watershed Assessment of Practices

1. Operator Information – Please print

Operator Name: _____ Farm Name: _____

Address: _____ City: _____ State: _____

Zip Code _____ Delaware Nutrient Management Certification Number _____

2. Land You OWN in the Choptank Watershed

	2007 Owned Acres	2008 Owned Acres	2009 Owned Acres
Total Acres You Own			
Cropland Acres You Own			
Forest Acres You Own			
Wetland Acres You Own			
Conservation Grass Acres You Own			

3. Land You RENT in the Choptank Watershed

	2007 Rented Acres	2008 Rented Acres	2009 Rented Acres
Cropland Acres			
Forest Acres(Approximate)			
Wetland Acres (Approximate)			
Conservation Grass Acres (Approximate)			

4. Total Conservation Tillage Acreage in Choptank Watershed

	2007 Acres	2008 Acres	2009 Acres
Vertical Tillage Acres (Turbo Till or True-Tandem)			
No-Till Acres (> 3 years)			
No-Till Acres (< 3 years)			
Subsoiler/Ripper Acres			
Other _____ Acres			

5. Total Conventional Tillage Acreage in Choptank Watershed

	2007 Acres	2008 Acres	2009 Acres
Moldboard Plow Acres			
Chisel Plow Acres			
Disk Acres			
Other_____ Acres			

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6. Hay and Pasture Acreage in Choptank Watershed			
	2007 Acres	**2008 Acres**	**2009 Acres**
Hay – Grass Only Acres			
Hay - Grass and Legume Mix Acres			
Pasture – Grass Only Acres			
Pasture - Grass and Legume Mix Acres			

7. Corn Grown in the Choptank Watershed						
	2007		**2008**		**2009**	
Total Acres						
Irrigated Acres						
Dry Land Acres						
	Irrigated	**Dry Land**	**Irrigated**	**Dry Land**	**Irrigated**	**Dry Land**
Average Yield (Dry Weight)						
Average Commercial Nitrogen Fertilizer Applied Per Acre (lbs/A)						
Average Commercial Phosphorus Fertilizer Applied Per Acre (lbs/A)						
Acres Receiving Manure						
Manure Type						
Average Manure Rate (T/A)						
Average Biosolids Rate (T/A)						
Average Other Nitrogen Credits from Past Organic Inputs/Crops (lbs/A)						

8. Soybeans Grown in the Choptank Watershed						
	2007		**2008**		**2009**	
Total Acres						
Irrigated Acres						
Dry Land Acres						
	Irrigated	**Dry Land**	**Irrigated**	**Dry Land**	**Irrigated**	**Dry Land**
Average Yield (Dry Weight)						
Average Commercial Nitrogen Fertilizer Applied Per Acre (lbs/A)						
Average Commercial Phosphorus Fertilizer Applied Per Acre (lbs/A)						
Acres Receiving Manure						
Manure Type						
Average Manure Rate (T/A)						
Average Biosolids Rate (T/A)						
Average Other Nitrogen Credits from Past Organic Inputs/Crops (lbs/A)						

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9. Small Grains Grown in the Choptank Watershed						
	2007		2008		2009	
Total Acres						
Irrigated Acres						
Dry Land Acres						
	Irrigated	Dry Land	Irrigated	Dry Land	Irrigated	Dry Land
Average Yield (Dry Weight)						
Average Commercial Nitrogen Fertilizer Applied Per Acre (lbs/A)						
Average Commercial Phosphorus Fertilizer Applied Per Acre (lbs/A)						
Acres Receiving Manure						
Manure Type						
Average Manure Rate (T/A)						
Average Biosolids Rate (T/A)						
Average Other Nitrogen Credits from Past Organic Inputs/Crops (lbs/A)						

10. Other Crops Grown in the Choptank Watershed If you grow a crop that was not identified above please account for it here. Name of Crop:_____						
	2007		2008		2009	
Total Acres						
Irrigated Acres						
Dry Land Acres						
	Irrigated	Dry Land	Irrigated	Dry Land	Irrigated	Dry Land
Average Yield (Dry Weight)						
Average Commercial Nitrogen Fertilizer Applied Per Acre (lbs/A)						
Average Commercial Phosphorus Fertilizer Applied Per Acre (lbs/A)						
Acres Receiving Manure						
Manure Type						
Average Manure Rate (T/A)						
Average Biosolids Rate (T/A)						
Average Other Nitrogen Credits from Past Organic Inputs/Crops (lbs/A)						

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11. Other Crops Grown in the Choptank Watershed

If you grow a crop that was not identified above please account for it here. Name of Crop:_____

	2007		2008		2009	
Total Acres						
Irrigated Acres						
Dry Land Acres						
	Irrigated	**Dry Land**	**Irrigated**	**Dry Land**	**Irrigated**	**Dry Land**
Average Yield (Dry Weight)						
Average Commercial Nitrogen Fertilizer Applied Per Acre (lbs/A)						
Average Commercial Phosphorus Fertilizer Applied Per Acre (lbs/A)						
Acres Receiving Manure						
Manure Type						
Average Manure Rate (T/A)						
Average Biosolids Rate (T/A)						
Average Other Nitrogen Credits from Past Organic Inputs/Crops (lbs/A)						

12. Other Crops Grown in the Choptank Watershed

If you grow a crop that was not identified above please account for it here. Name of Crop:_____

	2007		2008		2009	
Total Acres						
Irrigated Acres						
Dry Land Acres						
	Irrigated	**Dry Land**	**Irrigated**	**Dry Land**	**Irrigated**	**Dry Land**
Average Yield (Dry Weight)						
Average Commercial Nitrogen Fertilizer Applied Per Acre (lbs/A)						
Average Commercial Phosphorus Fertilizer Applied Per Acre (lbs/A)						
Acres Receiving Manure						
Manure Type						
Average Manure Rate (T/A)						
Average Biosolids Rate (T/A)						
Average Other Nitrogen Credits from Past Organic Inputs/Crops (lbs/A)						

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13. Do you use any of the tests below in the Choptank Watershed? Yes of No			
	2007	**2008**	**2009**
Pre-Sidedress Nitrate Testing (Yes or No)			
Tissue Analysis (Yes or No)			
Stalk Nitrate Testing (Yes or No)			

14. Do you grow cover crops in the Choptank Watershed?			
	2007	**2008**	**2009**
Cover Crop (type)			
Acres			
Planting Date			
Did you receive cost share?			
Another Cover Crop (type)			
Acres			
Planting Date			
Did you receive cost share?			

15. Do you have wetlands, buffers and waterways on your farms in the Choptank Watershed?			
	2007	**2008**	**2009**
Constructed Wetland (Acres or Dimensions)			
Did you receive cost share for the constructed wetland? (Yes or No)			
Restored Wetland (Acres or Dimensions)			
Did you receive cost share for the restored wetland? (Yes or No)			
Riparian Buffer – Grass (Acres or Dimensions)			
Did you receive cost share for the grass riparian buffer? (Yes or No)			
Riparian Buffer – Trees (Acres or Dimensions)			
Did you receive cost share for the tree riparian buffer? (Yes or No)			
Grass Waterway (Acres or Dimensions)			
Did you receive cost share for the grass waterway? (Yes or No)			

16. Do you have any water control structures on your farms in the Choptank Watershed? **Number of** _____ **structures**

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Notes :_____

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Appendix I

Socioeconomic Value of the Chesapeake Bay Watershed in Delaware

Draft September 1, 2010

(insert final cover design with UD and DNREC logo)

Prepared for:

Delaware Department of Natural Resources and Environmental Control
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Socioeconomic Value of the Chesapeake Bay Watershed in Delaware

draft September 1, 2010

Abstract

Ecosystems and habitat in the Delaware portion of the Chesapeake Bay watershed (1) contribute over $1 billion in annual economic activity from agriculture, water quality, water supply, ecotourism/recreation, and climate control benefits, (2) provide an annual ecosystem value of natural goods and services of at least $3.4 billion (2010$) with a net present value (NPV) of $109.6 billion over a perpetual life time, and (3) are directly/indirectly for 47,000 jobs with $1.2 billion in annual salaries.

Delaware occupies 702 sq mi or just 1% of the 64,000 sq mi Chesapeake Bay watershed while the Chesapeake watershed covers about 35% of Delaware's land area of 1,953 sq mi. Over 140,000 residents live in the Delaware portion of the bay watershed or 16% of the First State's total population (885,000). Over 41,800 people work in the Delaware portion of the Chesapeake watershed or 11% of total state employment.

Total economic activity in the Delaware portion of the Chesapeake Bay from agriculture, water quality, water supply, ecotourism/recreation, and climate control benefits exceeds $1 billion annually from Agriculture (Cropland/livestock/poultry $520,000,000), Water quality (Clean Water Act bay restoration $ 1,500,000), Chesapeake Bay improvement $22,200,000, and water treatment by forests $ 550,000), Water supply (Public drinking water $ 50,400,000 and irrigation water $ 12,500,000, Ecotourism (Hunting, fishing, and bird/wildlife $ 122,000,000), and Climate Control (Carbon storage $854,600,000, Carbon Sequestration $ 2,960,000, Air Pollution Removal $ 27,210,000, Building Energy Savings $5,730,000, and Avoided Carbon Emissions $310,000)

The estimated value of natural goods and services provided by ecosystems in the Chesapeake Bay watershed in Delaware is $3.4 billion (2010$) with a net present value of $109.6 billion. based on an annual discount rate of 3% over a perpetual life time (over 100 years). Forests, freshwater wetlands, and then farms provide the highest ecosystems goods and services values. Natural goods are commodities that can be sold such as water supply, farm crops, fish, timber, and minerals). Natural services are ecological benefits to society such as flood control by wetlands, water filtration by forests, and fishery habitat by wetlands. Ecosystem services areas within the Chesapeake Bay watershed in Delaware are comprised of habitats such as farmland (55%), forests (23%), and freshwater wetlands (18%). Only 4% of the bay watershed in Delaware is urban/suburban.

Ecosystems that provided the highest natural good values are farmland ($0.6 billion or $2,446 ac/yr), followed by forest ($28 million or $275 ac/yr) and freshwater wetlands ($22 million or $270 ac/yr). The highest natural ecosystem services values are provided by forests ($1.4 billion or $13,887/ac) followed by freshwater wetlands ($1.1 billion or $13,351/ac), and farmland ($203 million or $827/ac). The Nanticoke River ($786 million), Broad Creek ($557 million), and Choptank River ($490 million) watersheds provide the highest values of annual ecosystem services. Watersheds with the highest value of annual ecosystem services per acre include the

Elk Creek ($11,209/ac), Gravelly Branch ($9,559/ac), Pocomoke ($8750/ac), and Chester River ($8,704/ac) as these systems have high amounts of forests plus wetlands (over 75%).

Total jobs and salaries in New Castle, Kent, and Sussex counties within the Chesapeake Bay watershed in Delaware are 41,824 with wages of $1.2 billion annually. Jobs and salaries pertaining to activities directly associated with the bay and its Delaware tributaries (such as farming, fishing, hunting, recreation, tourism) are 15,000 with $0.4 billion in wages. Ecotourism such as fishing, hunting, and bird/wildlife associated recreation accounts for about 3,700 jobs in the Delaware portion of the Chesapeake Bay watershed. Farming and agricultural habitat conservation accounts for at least 2,500 jobs in the Delaware portion of the Chesapeake Bay watershed.

1. Introduction

Objectives

This report summarizes the socioeconomic value of natural resources and ecosystems in the Chesapeake Bay watershed in Delaware by tabulating:

- Economic activity including market use and nonuse value of agriculture, water supply, fishing, hunting, recreation, boating, ecotourism, and aesthetic benefits in the watershed,
- Natural capital or ecosystem services value of natural goods and services provided by habitat such as wetlands, forests, farms and open water,
- Jobs and salaries associated with the bay watershed in Delaware.

Chesapeake Bay TMDL

On September 1, 2010, the six Chesapeake Bay states (including Delaware) and the District of Columbia submitted draft Watershed Implementation Plans (WIPs) to EPA as part of a federal-state partnership to develop a pollution diet to restore the water quality of the bay and its tidal waters by 2025, with 60 percent of the work to be completed by 2017. By September 24, EPA will announce the Chesapeake Bay watershed's Total Maximum Daily Load (TMDL) – pollution limits for nitrogen, phosphorus, and sediment for waterways within each of the watershed states. A TMDL is the maximum amount of pollution a body of water can receive and still meet federal and state water quality standards for a safe, swimmable and fishable waterway. The bay TMDL will require Delaware and all watershed states to significantly reduce pollutants from entering Chesapeake waterways.

On July 1, 2010 EPA announced draft TMDL allocations for nitrogen and phosphorus (the pollution diet) to meet water quality standards in the Chesapeake Bay and watershed tributaries. In May 2009, President Barack Obama issued an Executive Order that recognizes the Chesapeake Bay as a "national treasure" and called for a renewed effort by EPA and the bay states to restore the nation's largest estuary.

The Chesapeake Bay Watershed Blue Ribbon Finance Panel (2004) postulated that the Chesapeake Bay might be worth over a trillion dollars while referencing the following studies. Recreational boating in the entire state of Maryland was measured at $2 billion per year. Fishing activities in Pennsylvania resulted in $4.7 billion a year in expenditures generating 43,000 jobs in outfitting, guiding, and lodging fishermen. In 1988, the University of Maryland estimated the value of the Chesapeake Bay was $678 billion ($1.23 trillion in $2010 at 3% annually).

The Watershed

Delaware occupies 702 sq mi or just 1% of the 64,000 sq mi Chesapeake Bay watershed while the Chesapeake watershed covers about 35% of Delaware's land area of 1,953 sq mi (Figure 1). Over 140,000 residents live in the Delaware portion of the bay watershed or 16% of the First State's total population (885,000). Over 41,800 people work in the Delaware portion of the Chesapeake watershed or 11% of total state employment (Table 1).

Table 1. Land area, population, and employment in the Chesapeake Bay watershed in Delaware

Jurisdiction	Area (sq mi)	Population	Employment
New Castle County		32,503	6,630
Kent County		35,726	8,595
Sussex County		71,460	26,598
Total	**702**	**139,689**	**41,823**

In the Chesapeake watershed, Delaware is a headwaters state where rivers such as the Sassafras, Chester, Choptank, and Nanticoke flow west from the Delmarva Peninsula through the Eastern Shore of Maryland to the bay (Table 2 and Figure 2).

Table 2. Watersheds in the Chesapeake Bay watershed in Delaware

Watershed	Area (sq mi)	%
Elk Cr.	0	0.1%
Perch Cr.	2	0.3%
C & D Canal West	17	2.5%
Bohemia Cr.	9	1.2%
Sassafras R.	8	1.1%
Chester R.	40	5.6%
Choptank R.	97	13.8%
Marshyhope Cr.	96	13.7%
Nanticoke R.	144	20.5%
Gum Branch	30	4.3%
Gravelly Br.	38	5.5%
Deep Cr.	63	9.0%
Broad Cr.	120	17.0%
Wicomico	2	0.3%
Pocomoke R.	35	4.9%
Total	**702**	**100.0%**

Figure 1. Delaware portion of the Chesapeake Bay watershed

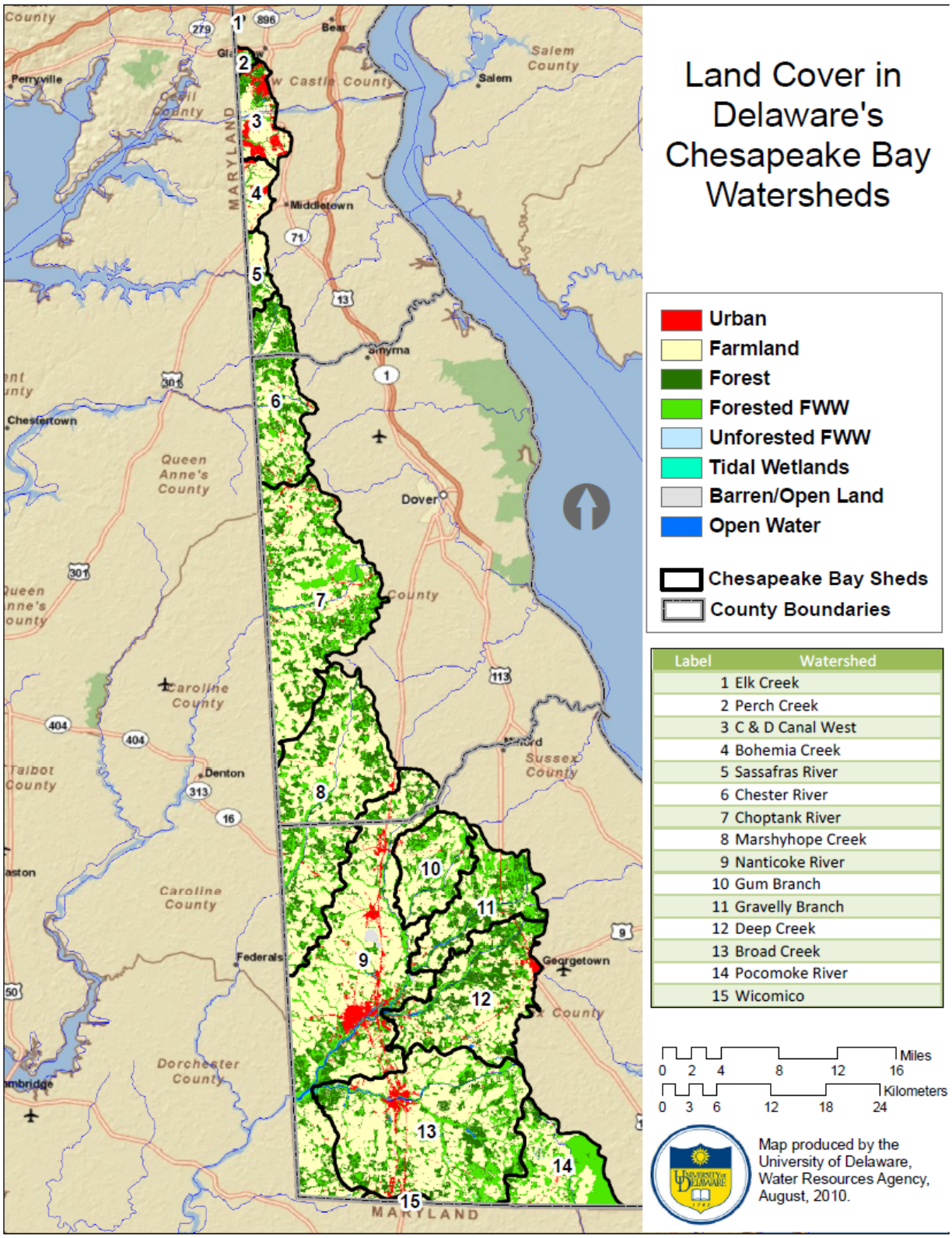


Figure 2. Land cover of Delaware watersheds in the Chesapeake Bay watershed (NOAA CSC 2006)

2. Methods

The socioeconomic value of the Chesapeake Bay watershed in Delaware was derived from published studies in the literature that employed the following economic valuation methods.

Avoided Cost – Society sustains costs if certain ecosystems were not present. For instance the loss of wetlands may increase financial flood damage.

Replacement Cost – Natural services are lost and replaced by more expensive manmade systems. For instance, forests provide water filtration benefits that would be replaced by costly water filtration plants.

Net Factor Income by Enhancement of Income – Improved water quality water enhances fisheries and crabbing industries.

Travel Cost – Visitors are willing to pay to travel and visit ecosystems and natural resources for hunting, fishing, and birding.

Hedonic Pricing Process - People will pay more for property values that may be higher along bay and river coast lines.

Contingent Valuation – Valuation by survey of individual different preferences to preserve ecosystems. People may be willing to pay more for preservation of bay water quality.

1. Define and map area of interest – The area of interest is defined as the 702 sq mi watershed of the Chesapeake Bay within the western portions of New Castle, Kent, and Sussex counties in Delaware. In the study area, the University of Delaware Water Resources Agency developed ESRI Arc Map GIS map layers of population census blocks, watershed boundaries, and land use/land cover to perform the analysis.

2. Literature review – Gather a database of published literature, internet resources and socioeconomic data relevant to the Chesapeake Bay watershed. Databases include the U. S. Census, U. S. Department of Labor Bureau of Labor Statistics, U. S. Department of Agriculture, U. S. Forest Service, and U. S. Fish and Wildlife Service and Delaware Department of Labor.

3. Economic activity – Estimate the direct/indirect value of agriculture, water quality, water supply, fishing, hunting, recreation, boating, ecotourism, and aesthetic benefits in the Chesapeake Bay watershed in Delaware using indicators such as population/population density (2010), employment, industrial activity, and land use data. Total economic activity is estimated by the sum of direct and indirect use, option, and non use values (Ingraham and Foster 2008). Direct use values are benefits directly realized from natural resources such as withdrawals from aquifers for drinking water, boating, recreation, and commercial fishing. Indirect values are economic benefits provided by ecosystems such as water filtration by forests and flood control and habitat protection from wetlands. Option demand is a willingness to pay by the public to maintain or enhance benefits from water quality or scenic value of the water resource. Nonuse

(existence) values are derived by a public who may never visit the resource but are willing to pay to preserve the existence of the resource.

These published references were consulted to estimate total economic activity.

Agriculture
- U. S. Department of Agriculture - National Agricultural Statistics Services
- U. S. Department of Agriculture – Census of Agriculture

Water quality
- University of Delaware College of Marine Studies
- University of Maryland Department of Agricultural and Resource Economics

Water supply
- University of Delaware Water Resources Agency
- Delaware DNREC
- U. S. Environmental Protection Agency
- Trust for Public Land
- American Water Works Association

Fishing, hunting, and wild-life associated recreation (ecotourism)
- U. S. Fish and Wildlife Service

Carbon storage, carbon sequestration, air pollution removal
- U.S. Forest Service
- Delaware Center for Horticulture

4. Ecosystem Services – Tabulate the market value of natural resources (ecosystem services value) in the watershed for habitat such as wetlands, forests, farmland, and open water. Prepare GIS based data sets and mapping. Ecosystem services (ecological services) are provided by nature and represent benefits such as water filtration, flood reduction, and drinking water supply.

Using the UDWRA GIS system, define ecosystem areas within each county and watershed in the Chesapeake Bay watershed in Delaware using 2006 NOAA CSC land cover data merged into the following classifications: (a) Freshwater wetlands, (b) Marine, (c) Farmland, (d), Forest, (e) Barren, (f) Saltwater wetland, (g) Urban, (h) Beach/dune, (i) Open freshwater, and (j) Riparian buffer.

Search research studies and gather relevant value ($/acre) data for following ecosystem services: (a) carbon sequestration, (b) flood control, (c) drinking water supply, (d) water quality filtration, (e) waste treatment and assimilation, (f) nutrient regulation, (g) fish and wildlife habitat, (h) recreation and aesthetics. Ecosystem services were estimated using value (benefit) transfer where published data and literature are reviewed and applied in the context of the resource in question. Value transfer is used to estimate ecosystem goods and services for the Delaware portion of the Chesapeake Bay watershed.

Compute ecosystem services value by multiplying land use area (ac) by ecosystem value ($/ac). The value transfer techniques employed here involves selecting data from published literature from another watershed or study area and applying the $ per ac values to land use areas computed by GIS in Delaware. While primary research data from the watershed in question (the Chesapeake Bay) is preferable and is used in some cases in this report, value transfer is the next best practical way to value ecosystems especially when in the absence of such data the worth of ecosystems have previously been deemed zero. Future economic valuation survey research is recommended to develop primary ecosystem service values for the Chesapeake Bay watershed in general and Delaware in particular.

4. Jobs and salaries – Obtain data from the Delaware Department of Labor, U. S. Department of Labor Bureau of Labor Statistics, and U. S. Census Bureau. Calculate the number of direct/indirect jobs and employment in the Chesapeake Bay watershed in Delaware organized by North American Industry Classification System (NAICS) codes such as shipbuilding, marine transportation/ports, fisheries (shellfish, finfish), recreation, minerals, trade, agriculture, and others. Total jobs and salaries were summarized for each of the three counties in Delaware and then prorated for the Delaware portion of the Chesapeake Bay watershed based on population census block data from the U. S. Census Bureau. The NAICS data was supplemented with farm jobs data estimated from the USDA agricultural statistics bureau and U. S. Fish and Wildlife Service ecotourism data.

5. Report – Prepare a report and GIS mapping (draft due Sep 1, 2010) summarizing the direct and indirect economic values of goods and services provided by the Chesapeake Bay watershed in Delaware updated to 2010 levels.

3. Economic Activity

Agriculture

In Delaware, the USDA National Agricultural Statistics Service (2010) estimates the real estate value of farms is $8,100 per acre and the cropland value is $7,700 per acre. The annual market value of agricultural products sold in Delaware is $1.083 billion on 510,253 acres (797 sq mi) for crops (corn, wheat, oats, barley, soybeans, potatoes, and vegetables) and livestock and poultry. On 245,509 ac (384 sq mi) of farm land in the Chesapeake Bay watershed in Delaware, the prorated annual market value of agricultural products sold is $0.52 billion. The Chesapeake Bay watershed covers just 35% of Delaware's land area yet accounts for nearly 50% of farm products sold in the state.

Water Quality

Parsons, Helm, and Bondelid (2003) from the University of Delaware measured the economic benefits of water quality improvements to recreational users in the northeastern states and found annual average per person benefits for improvements due to the Clean Water Act (CWA) ranged from $0.47 for viewing, $0.62 for boating, $2.40 for fishing, to $5.59 for swimming. Table 3 summarizes total water quality benefits to recreational users in the Delaware portion of the Chesapeake Bay watershed by transferring the benefits in $2003 to $2010 assuming an annual rate of 3% and then multiplying the $2010 benefits by the bay watershed population in Delaware. Total 2010 recreation benefits due to Clean Water Act water quality improvements in the Delaware portion of the Chesapeake Bay are $1.5 million per year or $11.18 per person. Swimming (62%) and fishing (26%) are the highest valued recreational benefits followed by boating (7%) and viewing (2%).

Table 3. Annual water quality benefits due to Clean Water Act improvements for recreational users in the Chesapeake Bay watershed in Delaware

Recreational Benefit	$2003 (per person)	$2010 (per person)	Chesapeake watershed pop. in Del.	Total Benefit	% of Benefit
Viewing	$0.47	$0.58	138,689	$80,440	5%
Boating	$0.62	$0.76	138,689	$105,404	7%
Fishing	$2.40	$2.95	138,689	$409,133	26%
Swimming	$5.59	$6.88	138,689	$954,180	62%
Total	**$9.09**	**$11.18**	**138,689**	**$1,550,543**	**100%**

Bockstael, McConnell, and Strand (1989) from the University of Maryland estimated the public's annual willingness to pay for a moderate improvement in the water quality of the Chesapeake Bay to be $10 to $100 million in 1984 dollars ($21.6 to $216 million in $2010 at 3% annually). The study found 43% of the respondents were users (boaters, fishermen) of the Chesapeake Bay and were willing to pay $121 per year to make the bay water quality "acceptable". About 57% of respondents were nonusers, those who do not visit or use the bay's resources but were willing to pay $38 per year to restore the bay. Using similar proportions of

users/nonusers and given the population is 139,689, aggregate willingness to pay to make the Bay water quality acceptable for the public within the Chesapeake Bay in Delaware is $22.2 million ($2010). Total willingness to pay in Delaware for acceptable Chesapeake Bay water quality = (0.43) (139,689) ($121/yr) + (0.57) (139,689) ($38/yr) = $10.3 million ($1984) = $22.2 million ($2010 at 3% annually).

The Trust for Public Land and American Water Works Association (2004) found for every 10% increase in forested watershed land, drinking water treatment and chemical costs are reduced by approximately 20% (Table 4). If the public drinking water supply is 28.9 mgd and forests cover 160 sq mi or 23% of the Delaware portion of the Chesapeake Bay watershed, then loss of these forests would increase drinking water treatment costs by $52 per mgd or $1,503 per day = $550,000 per year.

Table 4. Drinking water treatment and chemical costs based on percent of forested watershed (Trust for Public Land and AWWA 2004)

% of Watershed Forested	Water Treatment/ Chemical Costs (per mil gal)	% Change in Costs
0%	$139	21%
10%	$115	19%
20%	$93	20%
30%	$73	21%
40%	$58	21%
50%	$46	21%
60%	$37	19%

Water Supply

Aquifers in the Delaware portion of the Chesapeake Bay have significant water supplies for drinking water and irrigation purposes. Table 5 provides a framework for measuring the economic benefits of groundwater reserve stock to generate ecosystem services (USEPA 1995).

Table 5. Groundwater services and effects (USEPA 2005)

Services	Effects
Drinking Water	Increase of decrease in availability of drinking water Change in human health or health risks
Water for Crop Irrigation	Change in value of crops or production costs Change in human health or health risks
Water for Livestock/Poultry	Change in Value of livestock products or production Change in human health or health risks

The annual value of raw (untreated) groundwater for drinking water in the Delaware portion of the Chesapeake Bay watershed (28.9 mgd) is $10.5 million. When treated and delivered to customers the value is $50.4 million (Table 6). Water purveyors in Delaware estimate the value of raw water supply is $1.00/1000 gal according to cost of services studies for rate setting by the Public Service Commission. The average value of treated drinking water based on rates set by public and private water purveyors in Delaware is $4.78/1000 gal (Corrozi and Seymour 2008).

In Delaware, 104,562 acres of farm land were irrigated (USDA 2007). Approximately 48% of Delaware farmland is in the Chesapeake Bay watershed therefore about 50,200 acres are irrigated. If irrigation water needs from June through September are 9 inches in the bay watershed and the value of irrigation water is $250 per acre-foot, annual value of water supply (102 mgd) to irrigate 50,200 acres for agriculture, golf courses, and nurseries is $12.5 million. Value of irrigation water supply = (9 in/12 in/ft) (50,200 ac) ($250/ac-ft) = $12,550,000.

Table 6. Value of drinking water supply in Delaware portion of Chesapeake Bay watershed.

Watershed	PWS	Capacity (gpm)	Capacity (gpd)	Value/day untreated ($1/1000 gal)	Value/year untreated ($1/1000 gal)	Value/year treated ($4.78/1000 gal)
Chester River	C	0	0	0	0	0
	NTNC	0	0	0	0	0
	TNC	0	0	0	0	0
Choptank River	C	230	331,200	331	120,888	577,845
	NTNC	225	324,000	324	118,260	565,283
	TNC	0	0	0	0	0
	Subtotal	455	655,200	655	239,148	1,143,127
Marshyhope Cr.	C	20	28,800	29	10,512	50,247
	NTNC	50	72,000	72	26,280	125,618
	Subtotal	70	100,800	101	36,792	175,866
Nanticoke River	C	8,580	12,355,200	12,355	4,509,648	21,556,117
	NTNC	4,695	6,760,800	6,761	2,467,692	11,795,568
	TNC	140	201,600	202	73,584	351,732
	Subtotal	13,415	19,317,600	19,318	7,050,924	33,703,417
Gum Branch	C	0	0	0	0	0
	NTNC	60	86,400	86	31,536	150,742
	TNC	0	0	0	0	0
	Subtotal	60	86,400	86	31,536	150,742
Gravelly Branch	C	0	0	0	0	0
	NTNC	20	28,800	29	10,512	50,247
	TNC	0	0	0	0	0
	Subtotal	20	28,800	29	10,512	50,247
Deep Creek	C	1,650	2,376,000	2,376	867,240	4,145,407
	NTNC	105	151,200	151	55,188	263,799
	TNC	35	50,400	50	18,396	87,933
	Subtotal	1,790	2,577,600	2,578	940,824	4,497,139
Broad Creek	C	4,250	6,120,000	6,120	2,233,800	10,677,564
	NTNC	22	31,680	32	11,563	55,272
	Subtotal	4,272	6,151,680	6,152	2,245,363	10,732,836
Total		**20,082**	**28,918,080**	**28,918**	**10,555,099**	**50,453,374**

Fishing, Hunting, and Wild-life Associated Recreation (Ecotourism)

In Delaware, the U. S. Fish and Wildlife Service (2001) estimated the annual economic value of fishing, hunting, and birding/wild-life associated recreation as $261 million (or $339 million in $2010 at 3% annually). Trip related expenditures are food and lodging, transportation, and hunting, fishing, and wildlife watching equipment. Much if not all of fishing, hunting, and birding/wildlife orientated recreation occurs on farm, forest, wetlands, and open water ecosystems. Converting to $2010 and then prorating for the ratio of bay watershed to total state land area (702 sq mi/1953 sq mi = 36%), the estimated economic value of fishing, hunting, and wild-life associated recreation in the Delaware portion of the Chesapeake Bay watershed is $122 million annually (Table 7).

Table 7. Annual economic value of fishing, hunting, and wild-life associated recreation in Delaware and the Delaware portion of the Chesapeake Bay watershed (USFWS 2001)

Recreation Activity	State of Delaware ($2001)	State of Delaware[1] ($2010)	Delaware portion Chesapeake watershed[2] ($2010)
Wildlife associated	**130,350,000**	**169,455,000**	**61,003,800**
Trip Related	48,268,000	62,748,400	22,589,424
Equipment	66,366,000	86,275,800	31,059,288
Other	15,716,000	20,430,800	7,355,088
Fishing and Hunting	**88,012,000**	**114,415,600**	**41,189,616**
Trip Related	33,981,000	44,175,300	15,903,108
Equipment	45,283,000	58,867,900	21,192,444
Other	8,748,000	11,372,400	4,094,064
Wildlife-watching	**42,338,000**	**55,039,400**	**19,814,184**
Trip Related	14,287,000	18,573,100	6,686,316
Equipment	21,083,000	27,407,900	9,866,844
Other	6,968,000	9,058,400	3,261,024
Total	**260,600,000**	**338,910,000**	**122,007,600**

1. $2010 estimated at 3% annually.
2. Prorated based on ratio of bay watershed to state land area (702 sq mi/1953 sq mi = 36%).

Carbon Storage, Carbon sequestration, Air Pollution Removal

The U. S. Forest Service and Delaware Center for Horticulture (Nowak et al. 2008) estimated 7,137 acres of forests in New Castle County have a structural (replacement) value of $1.2 billion ($170,000/ac), carbon storage of $5.9 million ($827/ac), and air pollution removal of $1.9 million ($266/ac//yr). Applying these multipliers, 102,306 acres of forests in the Delaware portion of the Chesapeake Bay watershed have a structural (replacement) value of $17.4 billion,

carbon storage of $854 million, and air pollution removal of $27 million. In addition, forests in the Chesapeake Bay watershed in Delaware provide environmental benefits by regulating climate change, cooling, and air emissions control including 4 million tons of carbon storage capacity, 143,000 tons of carbon sequestration, 4,000 tons of air pollution removal, 14,000 tons of avoided carbon emissions capacity (Table 8).

Table 8. Economic and environmental benefits of forests in the Delaware portion of the Chesapeake Bay watershed.

Feature	**Forests in New Castle County[1]**		**Forests in Delaware portion of Chesapeake Bay watershed[2]**	
	Environmental Benefits (tons/ac)	Economic Benefits ($/ac)	Environmental Benefits (tons)	Economic Benefits ($)
Carbon storage	40	$827	4,092,240	$854,607,062
Carbon Sequestration	1.4	$29	143,228	$2,966,874
Air Pollution Removal	0.04	$266	4,092	$27,213,396
Building Energy Savings		$56	0	$5,729,136
Avoided Carbon Emissions	0.14	$3	14,323	$306,918
Structural Value		$170,000	0	$17.4 billion

1. Nowak et al. 2008
2. Computed for 102,306 acres of forests

Annual Economic Activity

Total economic activity in the Delaware portion of the Chesapeake Bay from agriculture, water quality, water supply, ecotourism, and climate control benefits exceeds $1 billion (Table 9).

Table 9. Annual economic activity in the Delaware portion of the Chesapeake Bay

Activity	2010 ($/year)	Source
Agriculture		
Cropland/livestock/poultry	$520,000,000	USDA (2010)
Water quality		
Clean Water Act bay restoration	$1,500,000	University of Delaware College of Marine Studies (2003)
Chesapeake Bay improvement	$22,200,000	University of Maryland (1989)
Water treatment by forests	$550,000	Trust for Public Land, American Water Works Association (2004)
Water supply		
Public drinking water	$50,400,000	University of Delaware Water Resources Agency and Delaware DNREC
Irrigation water	$12,500,000	UD Water Resources Agency, Del. DNREC, USDA Agriculture Census (2007)
Ecotourism		
Hunting, fishing, and bird/wildlife watching	$122,000,000	U. S. Fish and Wildlife Service (2001)
Climate Control		
Carbon storage	$854,600,000	U.S. Forest Service and Delaware Center for Horticulture (2008)
Carbon Sequestration	$2,960,000	U.S. Forest Service and Delaware Center for Horticulture (2008)
Air Pollution Removal	$27,210,000	U.S. Forest Service and Delaware Center for Horticulture (2008)
Building Energy Savings	$5,730,000	U.S. Forest Service and the Delaware Center for Horticulture (2008)
Avoided Carbon Emissions	$310,000	
Total	**> $1 billion/yr**	

4. Ecosystem Services

Data from the following studies were used to estimate ecosystem services values for the Chesapeake Bay watershed in Delaware.

- Cecil County Green Infrastructure Plan by the Conservation Fund, Annapolis, Md.
- New Jersey Department of Environmental Protection with the University of Vermont
- U.S. National Wildlife Refuge System by University of Maryland and Nature Conservancy
- Economic Value of Ecosystem Services in Massachusetts by the Audubon Society.
- Ecosystem Services Value of Forests by the Wilderness Society

Other Studies

Ecosystem services include air filtration, water filtration, recycling nutrients, soil conservation, pollinating crops and plants, climate regulation, carbon sequestration, flood and stormwater control, and hydrologic cycle regulation (Table 10). These ecological resources provide marketable good and services such as timber, fish and wildlife recreation, hiking, and boating/kayaking. A Cecil County, Md. study found the largest ecosystem services values result from stormwater/flood control, water supply, and clean water functions (Weber 2007).

Table 10. Ecosystem services values for Cecil County (Weber 2007)

Ecosystem Service	Upland Forest ($/ac/yr)	Riparian Forests/ Wetlands ($/ac/yr)	Nonriparian Wetlands ($/ac/yr)	Tidal Marsh ($/ac/yr)
Carbon sequestration	31	65	65	65
Clean air	191	191	191	
Soil and peat formation	17	946	450	1,351
Stormwater/flood control	679	32,000	32,000	1,430
Water supply	8,630	8,630	8,630	
Clean water	1,100	1,925	1,100	11,000
Erosion/sediment control	151	3,418	151	12,700
Water temperature regulation		4,450		
Pest control	50	50	50	
Pollination	75	75	75	
Wood products	142			
Recreation, fish, wildlife habitat	486	534	534	544
Community services savings	439	439	439	439
Increase in property values	42	42		
Total	**12,033**	**52,765**	**43,685**	**28,146**

The New Jersey Department of Environmental Protection (2007) partnered with the University of Vermont and estimated the value of New Jersey's natural capital was $20 billion/year plus or minus $9 billion/year in $2004 with a net present value of $681 billion based on a discount rate of 3% calculated in perpetuity (over 100 years in the future). Natural capital is the sum of goods (commodities like water, crops, and timber that can be sold) and services (functions like flood control, water filtration, and wildlife/fisheries habitat) provided by watershed ecosystems such as wetlands, forests, farms, and open water. In addition to these direct benefits, ecosystems also provide indirect benefits such as ecotourism by hunters, fishermen, boaters, and hikers that spend money to visit natural sites and realize value from improved water quality and habitat. Table 11 summarizes total ecosystem goods and services in New Jersey. Farm products, fish, minerals, and water supply provide the most ecosystem goods and nutrient cycling, soil disturbance regulation, water regulation, habitat, aesthetic/recreational, waste treatment, and water supply provides the highest ecosystem services.

Table 11. Ecosystem goods and services provided by New Jersey natural capital (NJDEP 2007).

Ecosystem	$ million/yr	%
Natural Goods	**$5,864**	**100%**
Farm products	3,676	63%
Commercial/recreational fish	958	16%
Minerals	587	10%
Raw Water	381	7%
Sawtimber	147	3%
Fuelwood	95	2%
Game/fur animals	21	1%
Ecoservice	**$19,803**	**100%**
Nutrient cycling	5,074	26%
Disturbance regulation	3,383	17%
Water regulation	2,433	12%
Habitat	2,080	11%
Aesthetic/recreational	1,999	10%
Waste treatment	1,784	9%
Water supply	1,739	9%
Cultural//spiritual	778	4%
Gas/climate regulation	246	1%
Pollination	243	1%
Biological control	35	<1%
Soil formation	8	<1%

An analysis for the Wilderness Society (Krieger 2001) concluded forests ecosystem services values for climate regulation, water supply, water quality, and recreation benefits totaled $392/ac in $1994 or $631/ac in $2010 at 3% annually (Table 12).

Table 12. Forest ecosystem service values for U.S. temperate forests (Krieger 2001)

Ecosystem Good or Service	1994 Value ($/ac)	2010 Value[1] ($/ac)
Climate regulation	57.1	91.9
Disturbance regulation	0.8	1.3
Water regulation	0.8	1.3
Water supply	1.2	1.9
Erosion and sediment control	38.8	62.5
Soil formation	4.0	6.4
Nutrient cycling	146.1	235.2
Waste Treatment	35.2	56.7
Biological Control	0.8	1.3
Food Production	17.4	28.0
Raw Materials	55.8	89.8
Genetic Resources	6.5	10.5
Recreation	26.7	43.0
Cultural	0.8	1.3
Total	392.1	631.3

1. $2010 computed at 3% annually.

According to the 2007 USDA Census of Agriculture (2009) the total market value of agricultural crops sold from 510,253 acres of farm land in Delaware was $1,083 billion ($210.6 million in crops and 872.4 million in poultry and livestock). With 245,509 acres of farmland, the prorated value of agricultural crops sold in the Delaware portion of the Chesapeake Bay watershed was $520 million or $2,119 per acre.

Table 13 compares ecosystem services values ($/acre) from several applicable studies. Values from the NJDEP and University of Vermont study were used for value transfer since the Chesapeake Bay watershed in Delaware shares a similar climate (humid continental), similar physiographic province (Coastal Plain), and similar aquifers, soils, and ecosystem and represents the closest geographical area where data is available. Cecil County lies in the Chesapeake Bay watershed and utilized ecosystem values on a per acres basis are higher than the other studies. Use of NJDEP data results in ecosystem service area estimates are lower than if Cecil County values were employed but higher than the U. S. Wildlife Refuge and Massachusetts Audubon Studies. Farmland values of ecosystem goods ($2,119) from the Delaware agriculture census (2007) and forest service values from the Cecil County study ($12,033) were substituted for the

NJDEP data. Values were adjusted to $2010 based on 3% annually. Net present values were derived based on a discount rate of 3% calculated in perpetuity (over 100 years in the future).

Table 13. Comparison of ecosystem service value studies

Ecosystem	New Jersey DEP 2004 ($/ac/yr)	Cecil Co. Maryland 2006 ($/ac/yr)	US Wildlife Refuge 2008 ($/ac/yr)	Mass Audubon 2003 ($/ac/yr)	USDA Del. Ag Census (2007) ($/ac/yr)
Freshwater wetlands	11,802	43,685	6,268	15,452	
Marine	8,670				
Farmland	6,229			1,387	2,119[1]
Forest land	1,714	12,033	845	984	
Saltwater wetland	6,269	28,146		12,580	
Barren land	0				
Urban	296				
Beach/dune	42,149				
Open freshwater	1,686		217	983	
Riparian buffer	3,500	52,765			

1. Value of ecosystem goods only measured by agricultural crops, livestock, and poultry sold.

Chesapeake Bay Watershed in Delaware

The estimated value of natural goods and services provided by ecosystems in the Chesapeake Bay watershed in Delaware (702 sq mi or 449,174 ac) is $3.4 billion (2010$) with a net present value (NPV) of $109.6 billion (Table 14). NPV is based on an annual discount rate of 3% over a perpetual life time (over 100 years). Natural goods are commodities that can be sold such as water supply, farm crops, fish, timber, and minerals). Natural services are ecological benefits to society such as flood control by wetlands, water filtration by forests, and fishery habitat by beach and marine areas. Ecosystem services areas within the Chesapeake Bay watershed in Delaware are comprised of farmland (55%), forests (23%), and freshwater wetlands (18%). Only 4% of the bay watershed in Delaware is urban/suburban (Figure 3).

Forests, freshwater wetlands, and farms provide the highest total ecosystems goods and services values (Figure 4). Ecosystems that provided the highest natural good values are farmland ($0.6 billion or $2,446 ac/ yr), followed by forest ($28 million or $275 ac/yr) and freshwater wetlands ($22 million or $270 ac/yr). The highest natural ecosystem services values are provided by forests ($1.4 billion or $13,887/ac) followed by freshwater wetlands ($1.1 billion or $13,351/ac), and farmland ($203 million or $827/ac).

The Nanticoke River ($786 million), Broad Creek ($557 million), and Choptank River ($490 million) watersheds provide the highest values of annual ecosystem services (Figure 5). Watersheds with the highest value of annual ecosystem services per acre include the Elk Creek

($11,209/ac), Gravelly Branch ($9,559/ac), Pocomoke ($8750/ac), and Chester River ($8,704/ac) as these systems have high amounts of forests plus wetlands (over 75%).

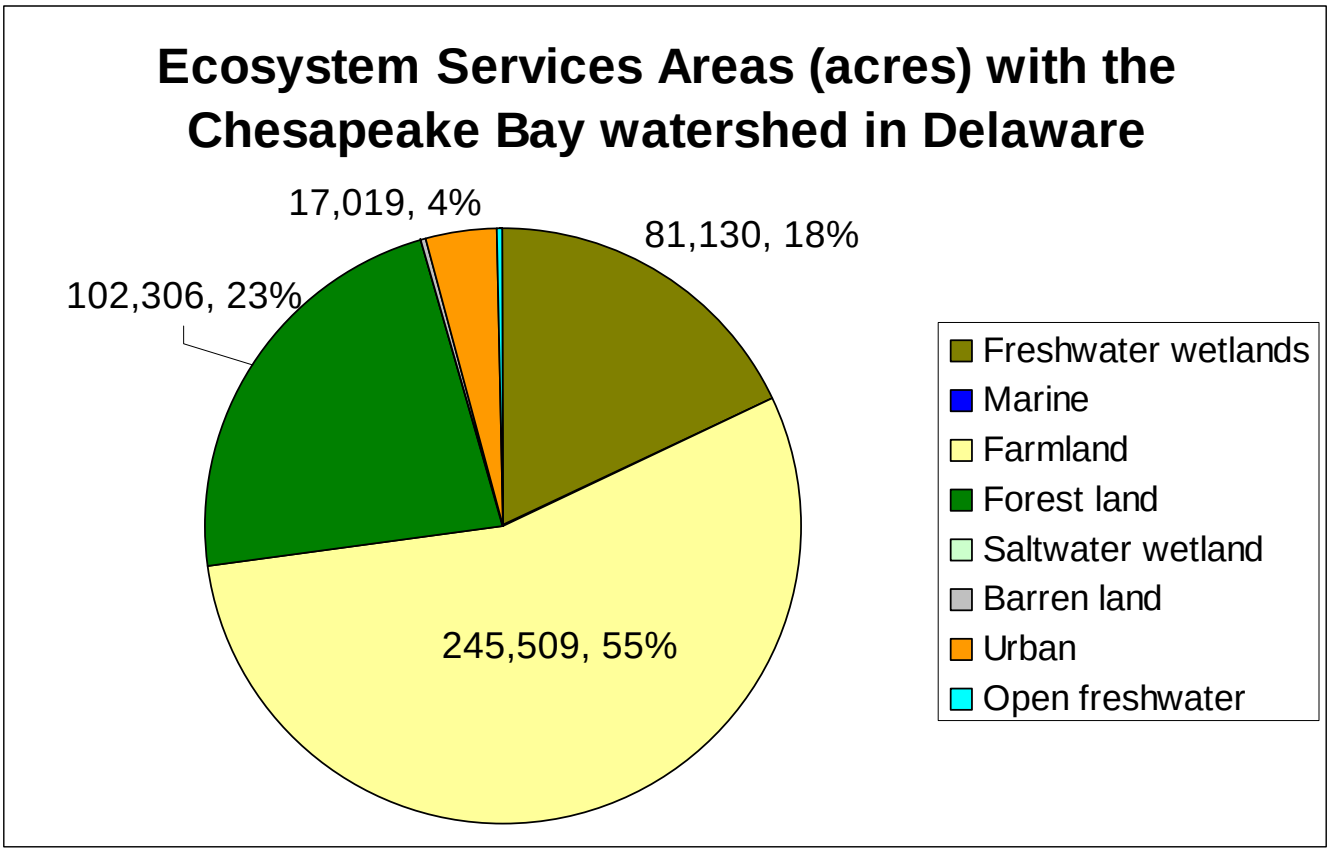
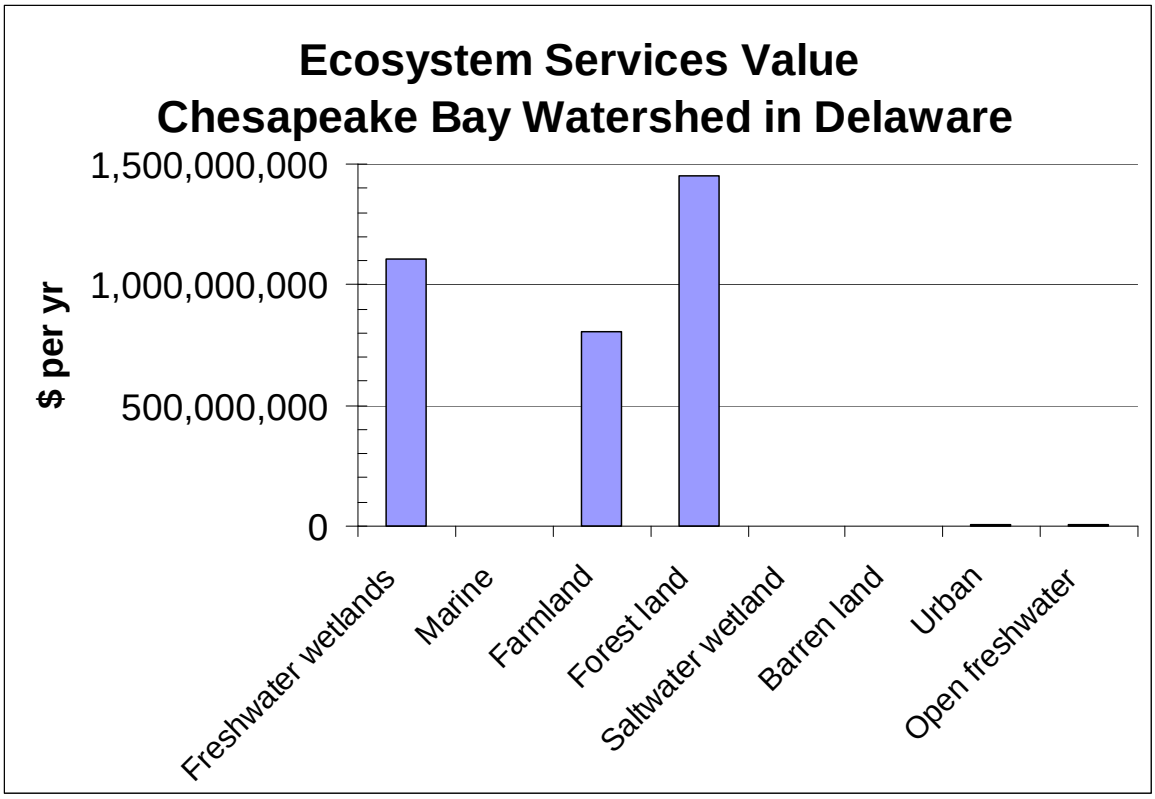


Figure 3. Ecosystem service areas within the Chesapeake Bay watershed in Delaware

Table 14		Natural Goods					
Ecosystem	**Area (ac)**	**$/ac/yr 2004**	**$/yr 2004**	**$/ac/yr 2010**	**$/yr 2010**	**NPV $**	**PV $/ac**
Freshwater wetlands	81,130	234	18,984,442	270	21,909,907	712,071,979	270
Marine	233	1,125	261,697	1,298	302,024	9,815,796	1,298
Farmland	245,509	2,119	520,234,508	2,446	600,401,605	19,513,052,155	2,446
Forest land	102,306	238	24,348,792	275	28,100,892	913,279,000	275
Saltwater wetland	353	139	49,120	160	56,689	1,842,383	160
Barren land	844	0	0	0	0	0	0
Urban	17,019	13	221,242	15	255,335	8,298,387	15
Open freshwater	1,780	921	1,638,979	1,063	1,891,543	61,475,134	1,063
Total	449,174		**565,738,780**		**652,917,995**	**21,219,834,834**	
		Natural Services					
Ecosystem	**Area (ac)**	**$/ac/yr 2004**	**$/yr 2004**	**$/ac/yr 2010**	**$/yr 2010**	**NPV $**	**PV $/ac**
Freshwater wetlands	81,130	11,568	938,512,949	13,351	1,083,135,918	35,201,917,330	4,010,739
Marine	233	7,544	1,754,885	8,707	2,025,309	65,822,545	1,560
Farmland	245,509	717	176,030,270	827	203,156,182	6,602,575,930	83,072
Forest land	102,306	12,033	1,231,046,285	13,887	1,420,748,055	46,174,311,792	5,172,463
Saltwater wetland	353	6,131	2,166,559	7,076	2,500,421	81,263,686	15,587
Barren land	844	0	0	0	0	0	0
Urban	17,019	283	4,816,269	327	5,558,446	180,649,496	370,482
Open freshwater	1,780	765	1,361,367	883	1,571,151	51,062,407	1,478
Total	449,174		**2,355,688,583**		**2,718,695,483**	**88,357,603,185**	
		Natural Goods & Services					
Ecosystem	**Area (ac)**	**$/ac/yr 2004**	**$/yr 2004**	**$/ac/yr 2010**	**$/yr 2010**	**NPV $**	**PV $/ac**
Freshwater wetlands	81,130	11,802	957,497,392	13,621	1,105,045,825	35,913,989,309	276
Marine	233	8,669	2,016,582	10,005	2,327,334	75,638,340	1,492
Farmland	245,509	2,836	696,264,778	3,273	803,557,787	26,115,628,085	9,673
Forest land	102,306	12,271	1,255,395,077	14,162	1,448,848,947	47,087,590,792	280
Saltwater wetland	353	6,270	2,215,678	7,236	2,557,110	83,106,069	164
Barren land	844	0	0	0	0	0	0
Urban	17,019	296	5,037,511	342	5,813,781	188,947,882	16
Open freshwater	1,780	1,686	3,000,346	1,946	3,462,694	112,537,541	2,343
Total or avg.	449,174		**2,921,427,364**		**3,371,613,478**	**109,577,438,019**	



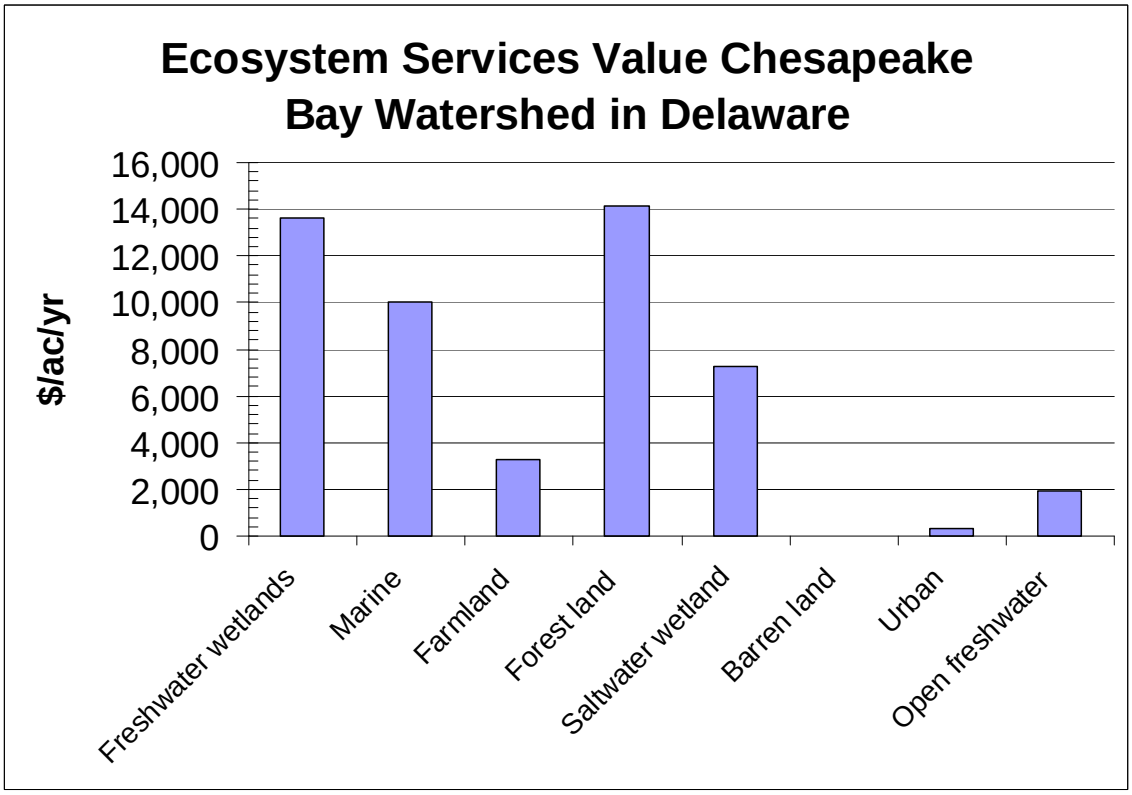
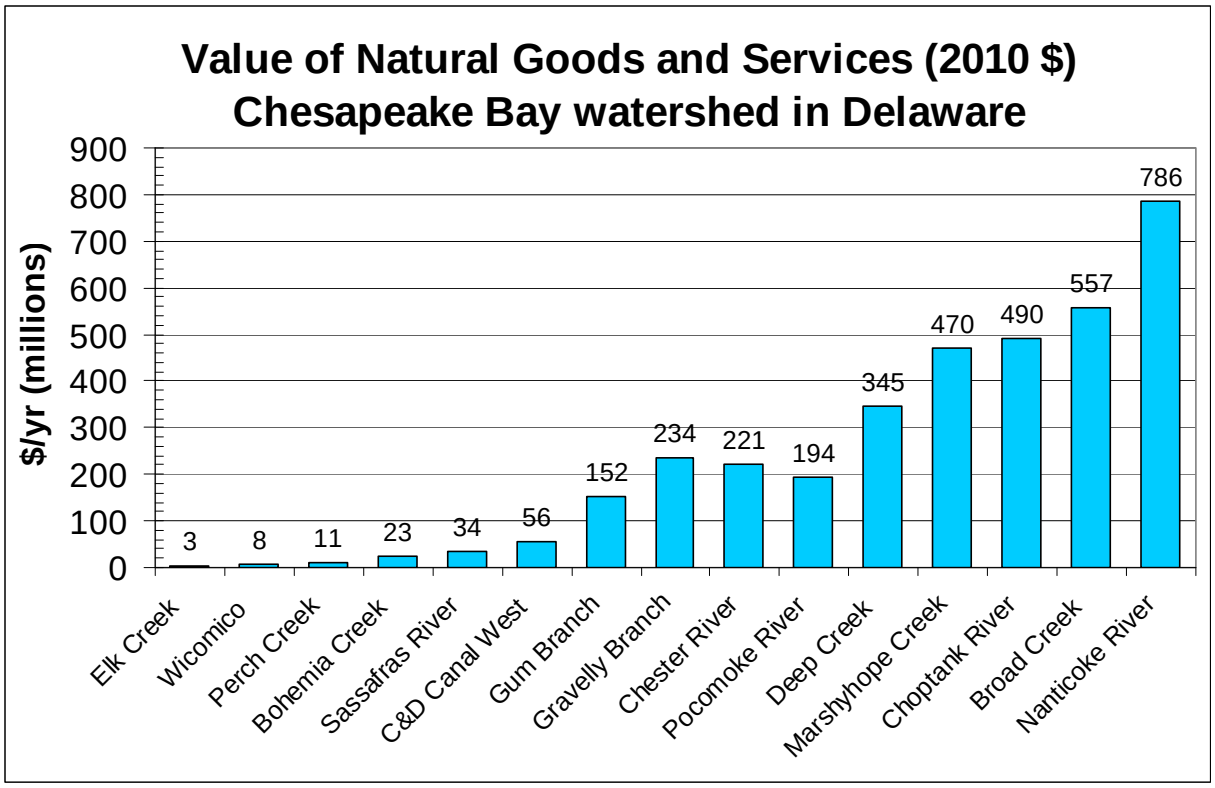


Figure 4. Ecosystem service values (2010$) in the Chesapeake Bay watershed in Delaware



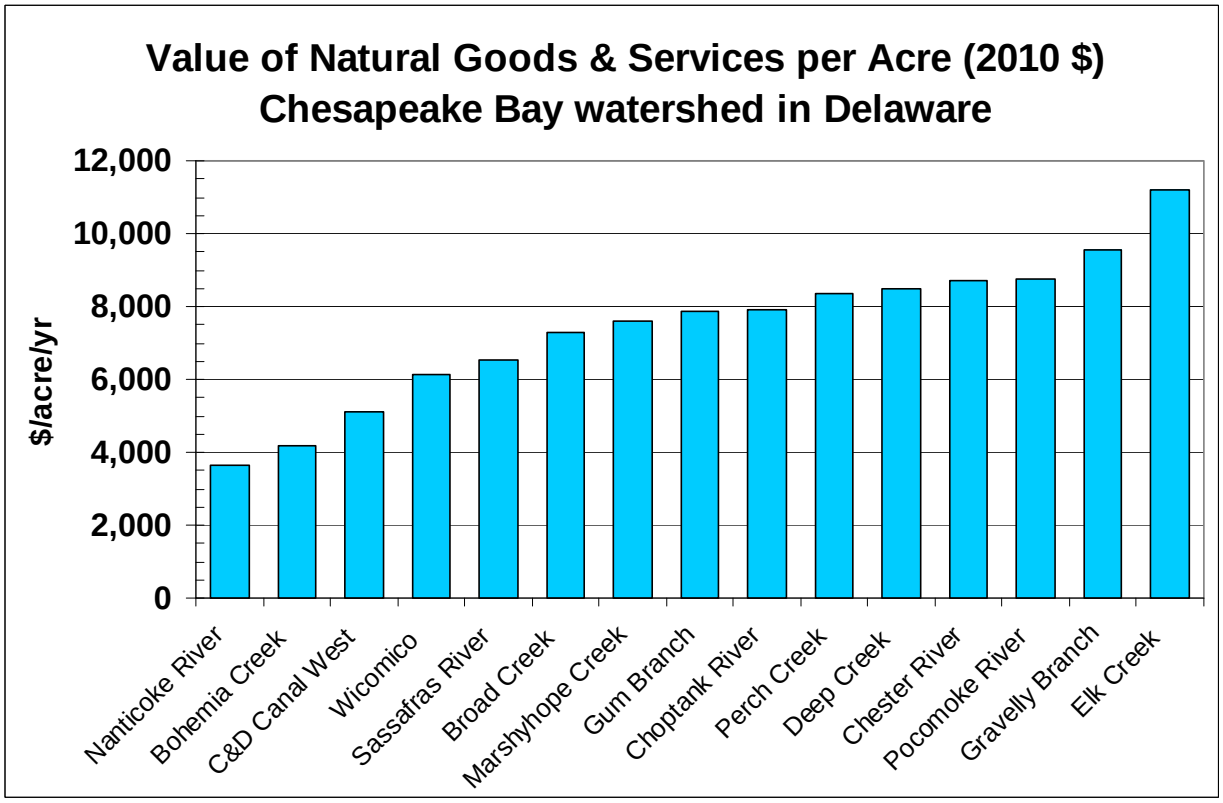


Figure 5. Value of natural goods and services by watershed within the Delaware portion of the Chesapeake Bay watershed.

5. Jobs and Salaries

According to data from the U. S. Department of Labor Bureau of Labor Statistics, U. S. Census Bureau, and Delaware, the total number of jobs and salaries within New Castle, Kent, and Sussex counties within the Chesapeake Bay watershed in Delaware are 41,824 with wages of $1.2 billion annually. Jobs and salaries pertaining to activities directly associated with the bay and its Delaware tributaries (such as farming, fishing, hunting, recreation, tourism etc.) are 15,000 with $0.4 billion in wages (Table 15).

Table 15. Jobs and salaries (2009) in (a) Delaware, (b) Chesapeake Bay watershed, and (c) directly associated with bay watershed.

Socioeconomic Activity Area	Jobs	Annual Salaries
State of Delaware	**380,603**	**$10.4 billion**
New Castle County	160,056	$6.9 billion
Kent County	69,760	$1.5 billion
Sussex County	69,760	$2.0 billion
Chesapeake Bay watershed in Del.	**41,824**	**$1.2 billion**
New Castle County	6,630	$0.2 billion
Kent County	8,596	$0.2 billion
Sussex County	26,598	$0.8 billion
Directly associated with Chesapeake bay watershed	**15,000**	**$0.39 billion**
New Castle County	1,000	$0.04 billion
Kent County	4,000	$0.09 billion
Sussex County	10,000	$0.26 billion

The 2007 NJDEP study estimates the average annual salary and wages per ecotourism job is $32,843 using figure from the 2001 U.S. Fish and Wildlife Service report on fishing, hunting, and wildlife associated recreation. If fishing, hunting, and bird/wildlife associated recreation in the Delaware portion of the Chesapeake Bay watershed accounts for $122 million in annual economic activity ($2010), then ecotourism accounts for about 3,700 jobs.

In 2007 there were 2,546 farms in Delaware or 1,222 farms estimated in the Delaware portion of the Chesapeake Bay watershed (0.48) (2,546). The USDA estimates farms employ about 2.1 full time equivalent jobs per farm so farming and agricultural habitat conservation accounts for at least 2,500 jobs. in the Delaware portion of the bay watershed.

Table 16. Delaware Employment by Industry by County, 2009 (U. S. Bureau of Labor Statistics)

Industry			NAICS Code
Agriculture, Forestry, Fishing and Hunting			11
	Crop Production		111
	Animal Production		112
		Aquaculture	1125
	Forestry and Logging		113
	Fishing, Hunting and Trapping		114
		Fishing	1141
	Support Activities for Agriculture and Forestry		115
Mining, Quarrying, and Oil and Gas Extraction			21
	Oil and Gas Extraction		211
	Mining (except Oil and Gas)		212
		Nonmetallic Mineral Mining and Quarrying	2123
	Support Activities for Mining		213
Utilities			22
	Utilities		221
		Electric Power Generation, Transmission and Distribution	2211
		Natural Gas Distribution	2212
		Water, Sewage and Other Systems	2213
Construction			23
	Construction of Buildings		236
		Residential Building Construction	2361
		Nonresidential Building Construction	2362
	Heavy and Civil Engineering Construction		237
		Land Subdivision	2372
		Highway, Street, and Bridge Construction	2373
		Other Heavy and Civil Engineering Construction	2379
	Specialty Trade Contractors		238
Manufacturing			31
	Food Manufacturing		311
		Seafood Product Preparation and Packaging	3117
	Beverage and Tobacco Product Manufacturing		312
	Textile Mills		313
	Textile Product Mills		314
	Apparel Manufacturing		315
		Apparel Knitting Mills	3151
	Leather and Allied Product Manufacturing		316
	Wood Product Manufacturing		321
	Paper Manufacturing		322
	Petroleum and Coal Products Manufacturing		324
	Chemical Manufacturing		325
		Basic Chemical Manufacturing	3251
		Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	3252
		Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	3253

		Pharmaceutical and Medicine Manufacturing	3254
		Paint, Coating, and Adhesive Manufacturing	3255
		Soap, Cleaning Compound, and Toilet Preparation Manufacturing	3256
		Other Chemical Product and Preparation Manufacturing	3259
	Plastics and Rubber Products Manufacturing		326
	Nonmetallic Mineral Product Manufacturing		327
		Cement and Concrete Product Manufacturing	3273
		Lime and Gypsum Product Manufacturing	3274
		Other Nonmetallic Mineral Product Manufacturing	3279
	Primary Metal Manufacturing		331
	Fabricated Metal Product Manufacturing		332
	Machinery Manufacturing		333
	Computer and Electronic Product Manufacturing		334
		Computer and Peripheral Equipment Manufacturing	3341
		Communications Equipment Manufacturing	3342
		Audio and Video Equipment Manufacturing	3343
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	Electrical Equipment, Appliance, and Component Manufacturing		335
	Transportation Equipment Manufacturing		336
		Motor Vehicle Manufacturing	3361
		Motor Vehicle Body and Trailer Manufacturing	3362
		Motor Vehicle Parts Manufacturing	3363
		Aerospace Product and Parts Manufacturing	3364
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6. Summary

1. Ecosystems and habitat in the Delaware portion of the Chesapeake Bay watershed:

- Contribute over $1 billion in annual economic activity from agriculture, water quality, water supply, ecotourism/recreation, and climate control benefits,
- Provide an annual ecosystem value of natural goods and services of at least $3.4 billion (2010$) with a net present value (NPV) of $109.6 billion over a perpetual life time,
- Are directly/indirectly for 47,000 jobs with $1.2 billion in annual salaries.

2. Delaware occupies 702 sq mi or just 1% of the 64,000 sq mi Chesapeake Bay watershed while the Chesapeake watershed covers about 35% of Delaware's land area of 1,953 sq mi. Over 140,000 residents live in the Delaware portion of the bay watershed or 16% of the First State's total population (885,000). Over 41,800 people work in the Delaware portion of the Chesapeake watershed or 11% of total state employment.

3. In the Chesapeake watershed, Delaware is a headwaters state where rivers such as the Sassafras, Chester, Choptank, and Nanticoke flow west from the Delmarva Peninsula through the Eastern Shore of Maryland to the bay.

4. Total economic activity in the Delaware portion of the Chesapeake Bay from agriculture, water quality, water supply, ecotourism/recreation, and climate control benefits exceeds $1 billion annually.

Agriculture	
Cropland/livestock/poultry	$520,000,000
Water quality	
Clean Water Act bay restoration	$ 1,500,000
Chesapeake Bay improvement	$ 22,200,000
Water treatment by forests	$ 550,000
Water supply	
Public drinking water	$ 50,400,000
Irrigation water	$ 12,500,000
Ecotourism	
Hunting, fishing, and bird/wildlife	$ 122,000,000
Climate Control	
Carbon storage	$ 854,600,000
Carbon Sequestration	$ 2,960,000
Air Pollution Removal	$ 27,210,000
Building Energy Savings	$ 5,730,000
Avoided Carbon Emissions	$ 310,000

5. The estimated value of natural goods and services provided by ecosystems in the Chesapeake Bay watershed in Delaware is $3.4 billion (2010$) with a net present value of $109.6 billion. based on an annual discount rate of 3% over a perpetual life time (over 100 years). Forests, freshwater wetlands, and then farms provide the highest ecosystems goods and services values (Table 17). Natural goods are commodities that can be sold such as water supply, farm crops, fish, timber, and minerals). Natural services are ecological benefits to society such as flood control by wetlands, water filtration by forests, and fishery habitat by wetlands.

Table 17. Ecosystem goods/services in the Delaware portion of the Chesapeake Bay watershed.

Ecosystem	Area (ac)	$/ac/yr 2010	$/yr 2010	NPV $
Freshwater wetlands	81,130	13,621	1,105,045,825	35,913,989,309
Marine	233	10,005	2,327,334	75,638,340
Farmland	245,509	3,273	803,557,787	26,115,628,085
Forest land	102,306	14,162	1,448,848,947	47,087,590,792
Saltwater wetland	353	7,236	2,557,110	83,106,069
Barren land	844	0	0	0
Urban	17,019	342	5,813,781	188,947,882
Open freshwater	1,780	1,946	3,462,694	112,537,541
Total or avg.	449,174		**3,371,613,478**	**109,577,438,019**

6. Ecosystem services areas within the Chesapeake Bay watershed in Delaware are comprised of habitats such as farmland (55%), forests (23%), and freshwater wetlands (18%). Only 4% of the bay watershed in Delaware is urban/suburban.

7. Ecosystems that provided the highest natural good values are farmland ($0.6 billion or $2,446 ac/ yr), followed by forest ($28 million or $275 ac/yr) and freshwater wetlands ($22 million or $270 ac/yr). The highest natural ecosystem services values are provided by forests ($1.4 billion or $13,887/ac) followed by freshwater wetlands ($1.1 billion or $13,351/ac), and farmland ($203 million or $827/ac).

8. The Nanticoke River ($786 million), Broad Creek ($557 million), and Choptank River ($490 million) watersheds provide the highest values of annual ecosystem services. Watersheds with the highest value of annual ecosystem services per acre include the Elk Creek ($11,209/ac), Gravelly Branch ($9,559/ac), Pocomoke ($8750/ac), and Chester River ($8,704/ac) as these systems have high amounts of forests plus wetlands (over 75%).

9. Total jobs and salaries in New Castle, Kent, and Sussex counties within the Chesapeake Bay watershed in Delaware are 41,824 with wages of $1.2 billion annually. Jobs and salaries pertaining to activities directly associated with the bay and its Delaware tributaries (such as farming, fishing, hunting, recreation, tourism) are 15,000 with $0.4 billion in wages.

10. Ecotourism such as fishing, hunting, and bird/wildlife associated recreation accounts for about 3,700 jobs in the Delaware portion of the Chesapeake Bay watershed.

11. Farming and agricultural habitat conservation accounts for at least 2,500 jobs in the Delaware portion of the Chesapeake Bay watershed.

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