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BROADKILL RIVER WATERSHED IMPLEMENTATION PLAN

February 2009

Prepared for:

State of Delaware
Department of Natural Resources and Environmental Control
Division of Water Resources
Watershed Assessment Section
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Project No. 3362.WC

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Executive Summary

The State of Delaware (State) initiated a watershed study of the Broadkill River basin. This study was initiated to develop a plan to reduce pollutants in the Broadkill River Watershed (Watershed) to the Total Maximum Daily Loads (TMDLs) established by the State of Delaware Department of Natural Resources and Environmental Control (DNREC) in December 2006. The study is comprised of three (3) steps. The "Broadkill River Watershed Baseline Assessment Technical Memorandum," by Duffield Associates, Inc. (Duffield Associates), dated October 2008, was completed as the first step. The second step was an inventory of potential pollution control opportunities targeted at the identified impairments. Duffield Associates produced a memorandum detailing the natural or ecological pollution control approaches titled "Broadkill River Watershed Management Water Quality Technologies Opportunities," dated August 2008. The Center for Watershed Protection (CWP) produced a memorandum detailing upland pollution control approaches titled "Broadkill Upland Restoration Opportunities," dated August 5, 2008. These memoranda provided the data for the second report titled "Broadkill River Watershed Pollution Control Opportunities: Technical Memorandum," by Duffield Associates, dated October 2008 which includes a synthesis of pollution control strategies evaluated by Duffield Associates and the CWP. This report, the Implementation Plan, is the final step. The Implementation Plan contains strategies and potential prioritization to achieve the pollution control goals using the opportunities identified.

The Implementation Plan details strategies, which are broken into three (3) approaches: ranking; technology; and sub-watershed:

- Ranking strategy utilizes the scores of each identified pollution control opportunity site to prioritize project implementation;
- Technology strategy utilizes prioritization based on individual technologies reviewed; and
- Sub-watershed strategy focuses on an individual sub-watershed with the highest potential to reap implementation benefits.

Specific measures directed toward agriculture are not included in the strategies. DNREC is implementing agricultural best management practices through other initiatives.

It is recommended that the sub-watershed approach be the preferred implementation strategy. Further, because of possible future stressors, it is recommended that the Wagamons Pond sub-watershed be the highest priority sub-watershed. Descriptions of the five (5) recommended WMWQ and five (5) recommended upland restoration opportunities [four (4) of which are in Wagamons Pond sub-watershed] are in Attachment A.

Although the sub-watershed strategy is the recommended priority approach, it is also recommended to implement other high priority opportunities in other sub-watersheds as funding becomes available and willing land owners are identified. It is also recommended that specific high priority sites for preservation, in each of the sub-watersheds be identified, within the recommended preservation corridors and subsequently, evaluated for potential pollution prevention and preservation/conservation potential.

This plan and the supporting documents (the Baseline Assessment and the Pollution Control Opportunities) are intended for distribution to and for use by, stakeholders in the Watershed that will be preparing plans, reviewing proposed developments, and implementing pollution control projects. It is also intended to provide pollution control project ideas for any member of the Watershed community. This plan does not contain all possible project ideas or all ongoing, current projects. It is recognized that new or different projects may be better suited for particular sites. This plan is intended to provide a preliminary framework, with which, to approach Watershed projects. A stakeholder meeting was held on December 15, 2008, and the comments received at that meeting have been addressed.

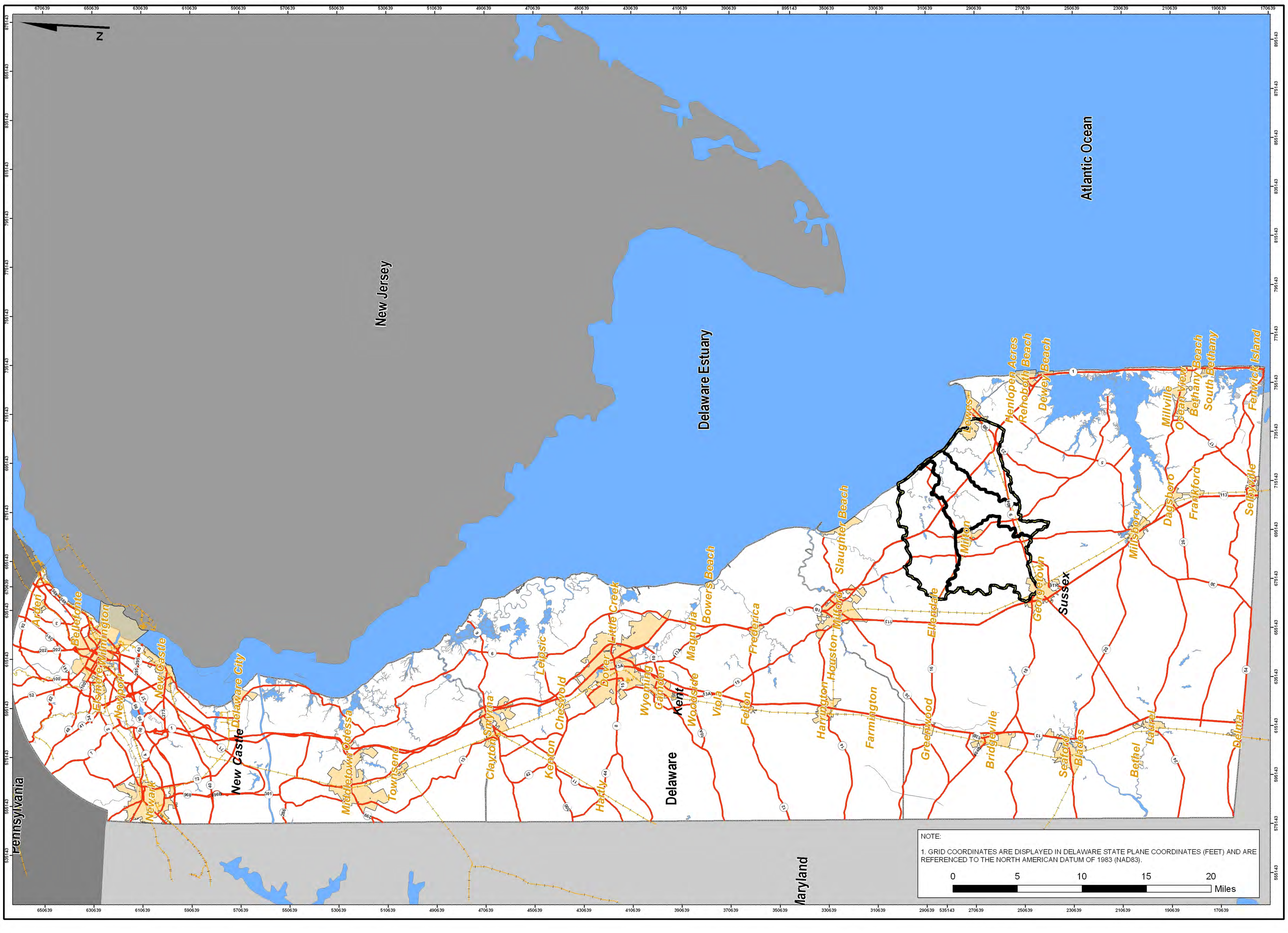
I. INTRODUCTION

A. BACKGROUND

The State of Delaware (State) initiated a watershed study of the Broadkill River basin (see Figure 1). This study was initiated to develop a plan to reduce pollutants in the Broadkill River Watershed (Watershed) to the Total Maximum Daily Loads (TMDLs) established by the State of Delaware Department of Natural Resources and Environmental Control (DNREC) in December 2006. The study, also referred to as The Watershed Plan, is comprised of three (3) steps. The "Broadkill River Watershed Baseline Assessment Technical Memorandum," dated October 2008, also referred to as the Baseline Assessment, was completed as the first step and was prepared by Duffield Associates, Inc. (Duffield Associates). The Baseline Assessment consolidated information generated through a variety of available sources, complemented with additional evaluations to characterize the watershed's current water quality status. A build out projection was also completed for the Baseline Assessment to determine potential future issues and impairments.

The second step was an inventory of potential pollution control opportunities targeted at the identified impairments. The Broadkill River tributary action team (TAT) developed a pollution control strategy with recommendations to help reduce pollutant loads to the TMDLs. Strategies to reduce pollutants included suggestions to better manage agriculture runoff, stormwater from developed lands and wastewater. Based on the Baseline Assessment and the recommendations from the TAT, the DNREC project team [(DNREC, Duffield Associates, and Center for Watershed Protection (CWP)] completed evaluations of various pollution control measures. Duffield Associates produced a memorandum detailing the natural or ecological pollution control approaches titled "Broadkill River Watershed Management Water Quality Technologies Opportunities," dated August 2008. The CWP staff produced a memorandum detailing upland pollution control approaches titled "Broadkill Upland Restoration Opportunities," dated August 5, 2008. These memoranda provided the data for the second report titled "Broadkill River Watershed Pollution Control Opportunities: Technical Memorandum," dated October 2008 by Duffield Associates which includes a synthesis of pollution control strategies evaluated by Duffield Associates and the CWP.

This report is the final step, the Implementation Plan for the Watershed based on the pollution control opportunities identified. The Implementation Plan contains strategies and potential prioritization to achieve the pollution control goals using the opportunities identified. This plan is intended for distribution to and use by stakeholders in the Watershed that will be preparing plans, reviewing proposed developments, and implementing pollution control projects.



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Legend

- Municipal Boundary
- Broadkill Watershed Boundary
- Broadkill Subwatershed Boundary
- Water Body
- Route
- Railroad

BASEMAP:
Delaware Datamil Opening View

DRAWN BY:
ADK

CHECKED BY:
JME

FILE:
3362WC_Broadkill_Implementation_Fig1.mxd

BROADKILL RIVER WATERSHED
General Location Map
SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO.
3362.WC

SHEET:
FIGURE 1

B. REPORT ORGANIZATION

This report contains a section (Section III) that provides and overview of the current and recommended regulatory and program practices of the various jurisdictions in the Watershed. The next sections (Sections IV, V, and VI) contain different strategies to implement the recommended pollution control opportunities. Costs, schedule, and a general monitoring plan are discussed in the final two sections (Section VII and VIII).

C. BASELINE ASSESSMENT

The Broadkill River Watershed is located in Sussex County, Delaware, within the Coastal Plain physiographic province. The Watershed borders the Delaware Bay and the Atlantic Ocean along its eastern most boundary (see Figure 1). The Watershed is predominantly agricultural (44%) with almost 14% urban/residential (Table 1, Figure 2).

Duffield Associates prepared a sub-watershed delineation map for the Watershed (Figure 3). The delineation was based on existing geospatial data (no field review was performed as part of the delineation). There are four (4) sub-watersheds within the Broadkill River Watershed (USGS, Hydrologic Unit Code Map). These sub-watersheds are Prime Hook Creek, Red Mill Creek, Round Pole Bridge, and Wagamons Pond. Sub-watershed boundaries used in this report are consistent with the boundaries used for reporting in the Baseline Assessment.

A Baseline Assessment was completed to characterize the Watershed and project future conditions. Several components were used to characterize the current and possible future status of the Watershed. A build out projection was completed to determine where potential land use change may further impair the watershed (Figure 4). A brief summary of components in the Baseline Assessment is listed below.

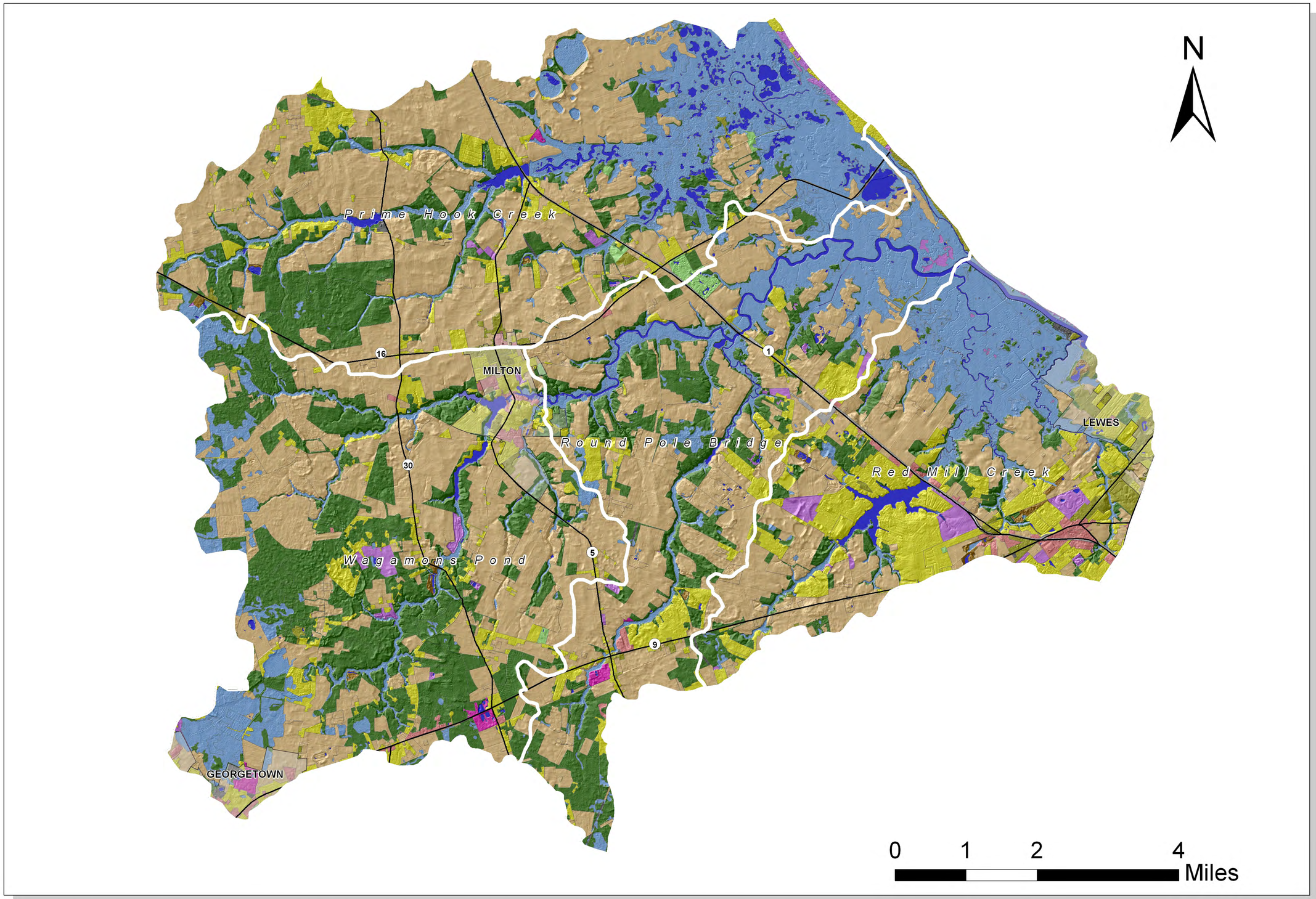
Databases-
Results of the analysis of land use/geospatial data were considered for both the current condition and proposed built out condition within the watershed. A series of maps were compiled including: Hydrography, Topography, Depth to Water, Groundwater Recharge Potential, Land Use 2002 and 2007, Protected Lands, and TMDL Impaired Streams.

Published studies-
Fact sheets from DNREC on land use trends and nitrogen and phosphorous sources along with analysis for the proposed TMDLs were reviewed to determine land use trends and pollution issues within the Watershed.

Table 1. Broadkill River Watershed Land Use Changes 1997 – 2007

Watershed Statistics		1997	2007	Change
Land Use (Square Miles)	Agriculture	44.9 (43.47%)	43.83 (42.09%)	-1.07 (-1.37%)
	Barren/Open	0.9 (0.87%)	1.37 (1.32%)	0.47 (0.44%)
	Combined Urban	1.2 (1.16%)	1.52 (1.46%)	0.32 (0.3%)
	Commercial	0.7 (0.68%)	0.92 (0.88%)	0.22 (0.21%)
	Extraction	0.4 (0.39%)	0.29 (0.28%)	-0.11 (-0.11%)
	Forested Land	24.4 (23.62%)	21.87 (21%)	-2.53 (-2.62%)
	Industrial	0.1 (0.1%)	0.26 (0.25%)	0.16 (0.15%)
	Recreation	0.1 (0.1%)	0.33 (0.32%)	0.23 (0.22%)
	Residential	7.9 (7.65%)	11.28 (10.83%)	3.38 (3.18%)
	Transportation	0.4 (0.39%)	0.38 (0.36%)	-0.02 (-0.02%)
	Utilities	0.1 (0.1%)	0.16 (0.15%)	0.06 (0.06%)
	Wetlands/Water	2.4 (2.32%)	2.95 (2.83%)	0.55 (0.51%)

*Statistics derived from GIS analysis completed for the Baseline Assessment.



1. THIS MAP IS PART OF A REPORT TITLED "BROADKILL RIVER WATERSHED IMPLEMENTATION PLAN" PREPARED BY DUFFIELD ASSOCIATES, INC. AND AS SUCH SHOULD ONLY BE VIEWED IN THE CONTEXT OF THAT REPORT.
2. THE 2007 LAND USE LAND COVER OVERLAY WAS OBTAINED FROM THE DELAWARE OFFICE OF MANAGEMENT AND BUDGET.

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Legend

- Sub-watershed Boundary
- Municipal Boundaries

2007 Land Use Land Cover

- Agriculture
- Barren/Open
- Combined Urban
- Commercial
- Extraction
- Forested Land
- Industrial
- Recreation
- Residential
- Transportation
- Utilities
- Water
- Wetlands
- Major Roads

SOURCE:
2007 LULC DRAPED OVER USGS/DGS 2-METER BARE-EARTH DEM

DRAWN BY:
MPN

CHECKED BY:
JME

FILE:
3362WC_Broadkill_Implementation_Fig2.mxd

BROADKILL RIVER WATERSHED

2007 LAND USE/ LAND COVER MAP

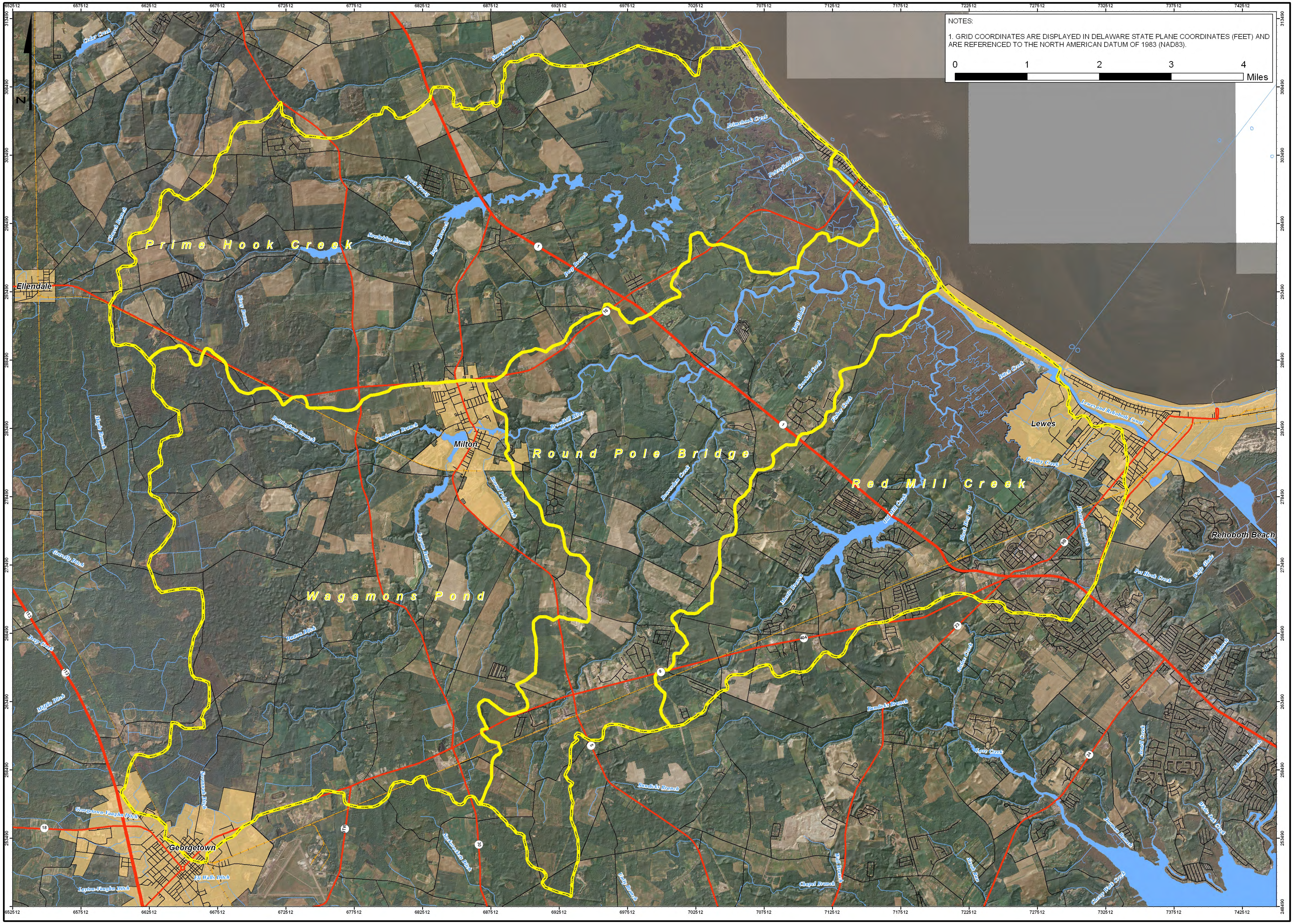
SUSSEX COUNTY~ DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO:
3362.WC

SHEET:
FIGURE 2



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Legend

- Municipal Boundary
- Broadkill Watershed Boundary
- Broadkill Subwatershed Boundary
- Water Body
- Stream or River
- Route
- Road
- Railroad

BASEMAP:
2006 USDA NAIP AERIAL DRAPED OVER USGS/DGS 2-METER BARE-EARTH DEM

DRAWN BY:
ADK

CHECKED BY:
JME

FILE:
3362WC_Broadkill_Implementation_Fig3.mxd

BROADKILL RIVER WATERSHED

Sub-Watershed Delineation Map

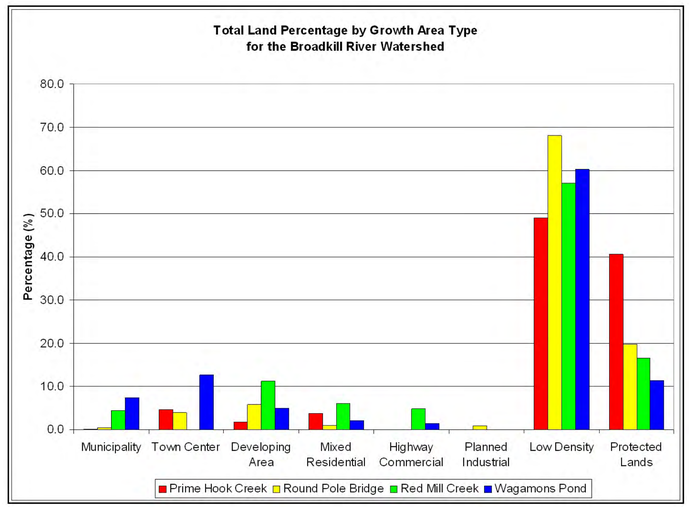
SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO.
3362.WC

SHEET:
FIGURE 3



BROADKILL RIVER WATERSHED BUILD-OUT STATISTICS

Prime Hook Creek Sub-watershed Statistics			
	Total Acres	Estimated Existing Impervious (Acres)	Projected Impervious (Acres)
Municipality	36.2	16.3	13.8
Town Center	930.9	34.0	353.7
Developing Area	342.3	13.4	130.1
Mixed Residential	760.0	34.3	288.8
Highway Commercial	10.8	1.4	9.2
Planned Industrial	0.0	0.0	0.0
Low Density	9904.9	224.6	1981.0
Protected Lands	8198.9	24.3	x
Total Acres	20184.0	348.3	2762.8

*Estimated Dwelling Units Calculated via the Low Growth Scenario = 19,924
*Estimated Dwelling Units Calculated via the High Growth Scenario = 27,658

Round Pole Bridge Sub-watershed Statistics			
	Total Acres	Estimated Existing Impervious (Acres)	Projected Impervious (Acres)
Municipality	61.3	4	23.3
Town Center	564.5	14.6	214.5
Developing Area	818.0	62.2	204.5
Mixed Residential	144.7	21.3	55.0
Highway Commercial	0.0	0	0.0
Planned Industrial	131.7	23	94.8
Low Density	9618.1	238.8	1923.6
Protected Lands	2800.8	21	x
Total Acres	14139.1	384.9	2515.7

*Estimated Dwelling Units Calculated via the Low Growth Scenario = 14,718
*Estimated Dwelling Units Calculated via the High Growth Scenario = 31,018

Red Mill Creek Sub-watershed Statistics			
	Total Acres	Estimated Existing Impervious (Acres)	Projected Impervious (Acres)
Municipality	515.7	121.5	196.0
Town Center	0.0	0.0	0.0
Developing Area	1335.7	35.5	333.9
Mixed Residential	728.0	179.6	276.6
Highway Commercial	562.8	164.5	478.4
Planned Industrial	0.0	0.0	0.0
Low Density	6789.4	516.8	1357.9
Protected Lands	1970.9	15.1	x
Total Acres	11902.5	1033.0	2642.8

*Estimated Dwelling Units Calculated via the Low Growth Scenario = 14,410
*Estimated Dwelling Units Calculated via the High Growth Scenario = 27,658

Wagamons Pond Sub-watershed Statistics			
	Total Acres	Estimated Existing Impervious (Acres)	Projected Impervious (Acres)
Municipality	1345	259.5	511.1
Town Center	2299.2	29.1	873.7
Developing Area	903.6	10.8	225.9
Mixed Residential	370.9	23.7	140.9
Highway Commercial	273.5	15.7	232.5
Planned Industrial	0.0	0.0	0.0
Low Density	10973.2	256.1	2194.6
Protected Lands	2078.6	6.8	x
Total Acres	18244.0	601.6	4178.8

*Estimated Dwelling Units Calculated via the Low Growth Scenario = 26,753
*Estimated Dwelling Units Calculated via the High Growth Scenario = 57,602

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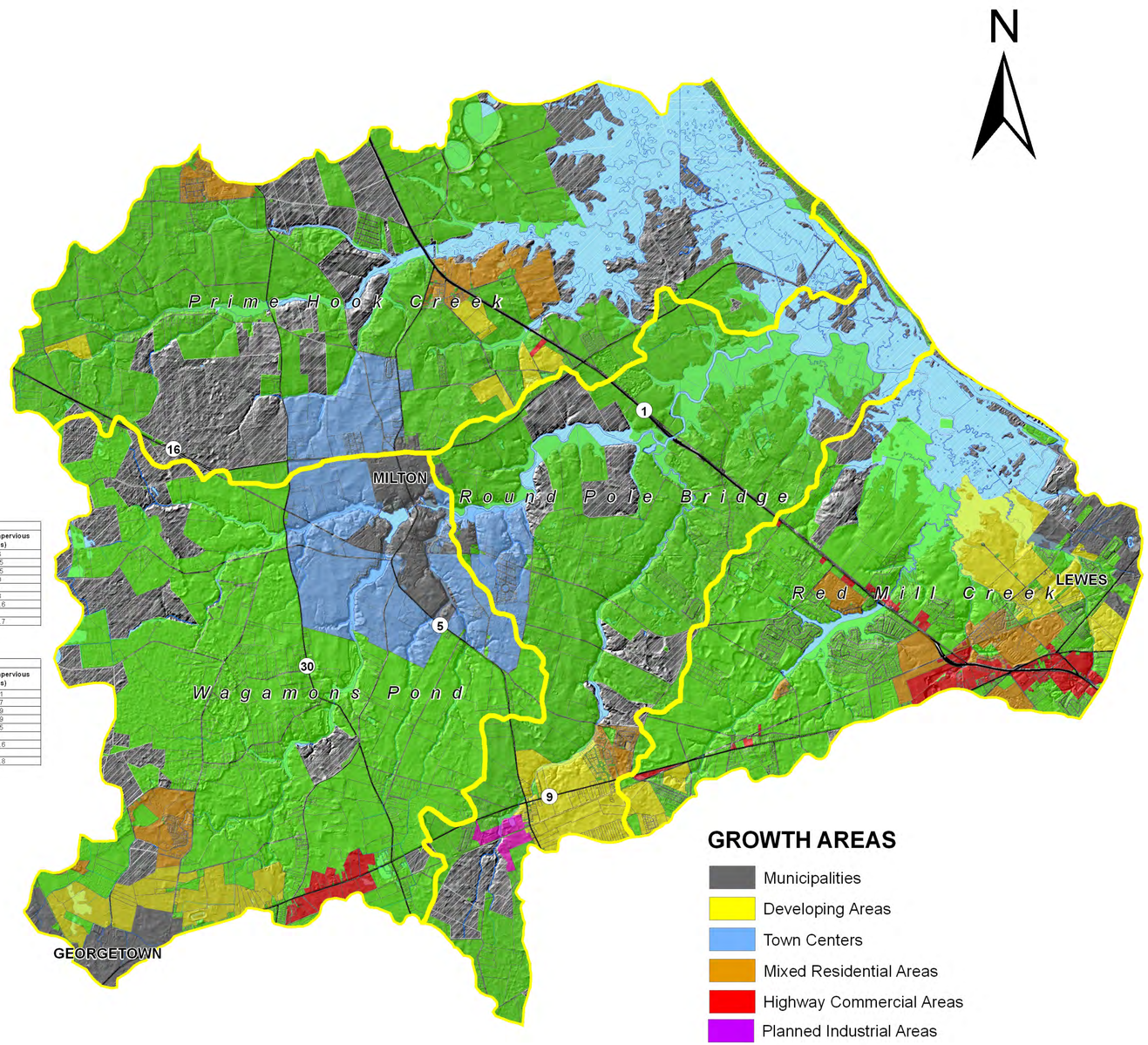
2. THIS MAP WAS GENERATED BY DIGITALLY CONVERTING A FIGURE IN THE 2007 SUSSEX COUNTY COMPREHENSIVE PLAN TITLED "FUTURE LAND USE PLAN MAP". THE FIGURE CAN BE FOUND IN CHAPTER THREE OF THE PLAN ON PAGE 3-22 & ONLINE AT HTTP://WWW.SUSSEXCOUNTYDE.GOV/COMPPLAN/

2. PUBLIC AND MANAGED LAND AREAS TAKEN FROM MULTIPLE AVAILABLE PUBLIC DATA SETS OF VARIOUS DATES.

3. PROPOSED BUILD-OUT IS FOR PLANNING PURPOSES TO ASSIST IN IDENTIFYING POTENTIAL POLLUTION CONTROL AND/OR PRESERVATION OPPORTUNITES.



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Legend
- Sub-watershed Boundary
- Water Features
- Rivers and Streams
- Major Roads

SOURCE: HILLSHADE OF USGS/DGS 2-METER BARE-EARTH DEM

DRAWN BY: MPN

CHECKED BY: JME

FILE: 3362WC_BROADKILL_Implementation_Fig4.mxd

BROADKILL RIVER WATERSHED
PROJECTED BUILD-OUT
SUSSEX COUNTY ~ DELAWARE

DATE: AUGUST 2008

SCALE: AS SHOWN

PROJECT NO: 3362.WC

SHEET: FIGURE 4

Field review-
Volunteer stream field assessments were conducted on October 13, 2007. Assessment forms completed by volunteers were compiled to assign ranges for general visual stream reach impairment.

Program/Community regulation-
Local regulations and ordinances were reviewed to identify regulations and programs that should be used to support watershed restoration and protection strategies, and if necessary, to highlight gaps and weaknesses in the local ordinances and regulations.

Published studies and reports reviewed included issues of land use change and nutrient loading from point and non-point sources. Both factors are important to the ground and surface water health of any watershed. In particular, urbanization in Sussex County may increase nutrient loads through development of land (impervious cover) and individual septic system use. In addition, the report "Broadkill Watershed Proposed TMDLs" (DNREC, August 2006) was reviewed for point and non-point source pollution targets.

Section 303(d) of the Federal Clean Water Act (CWA) requires States to develop a list [303(d) List] of water bodies for which existing pollution control activities are not sufficient to attain applicable water quality standards and to develop Total Maximum Daily Loads (TMDLs) for pollutants of concern. A TMDL sets a limit on the amount of a pollutant that can be discharged into a water body such that water quality standards are met.

The State established TMDLs for the Broadkill River Watershed in December 2006. DNRECs target reduction for the existing pollutants in the Watershed, as a result of various load reduction analyses, is 40% non point source reduction of nitrogen and phosphorous (nutrients) and carbon (BOD), and 75% non-point source reduction of *enterococcus* (bacteria or pathogen). The non-point source load reductions will be coupled with point source reductions. The point sources identified are in the Wagamons Pond sub-watershed, SAW Georgetown Plant, Purdue Georgetown, Allen Family Foods, and City of Milton Waste Water Treatment Plant.

The studies reviewed state that the current condition of the water resources in the Watershed is of degraded quality. Water quality samples have shown that the impairments (parameters) listed in Table 2 affect approximately 48.7 miles of streams and 273.8 acres of ponds (Figure 5). This is almost one quarter of the 206 stream miles of the Watershed. These impairments are caused by point and non-point sources (DNREC, 2006). The segments included in Table 2 (1998, 2002, 2004 and 2006 Draft 303(d) Lists) were listed as impaired by pollutants. Impairments include dissolved oxygen (DO), nutrients, and bacteria.

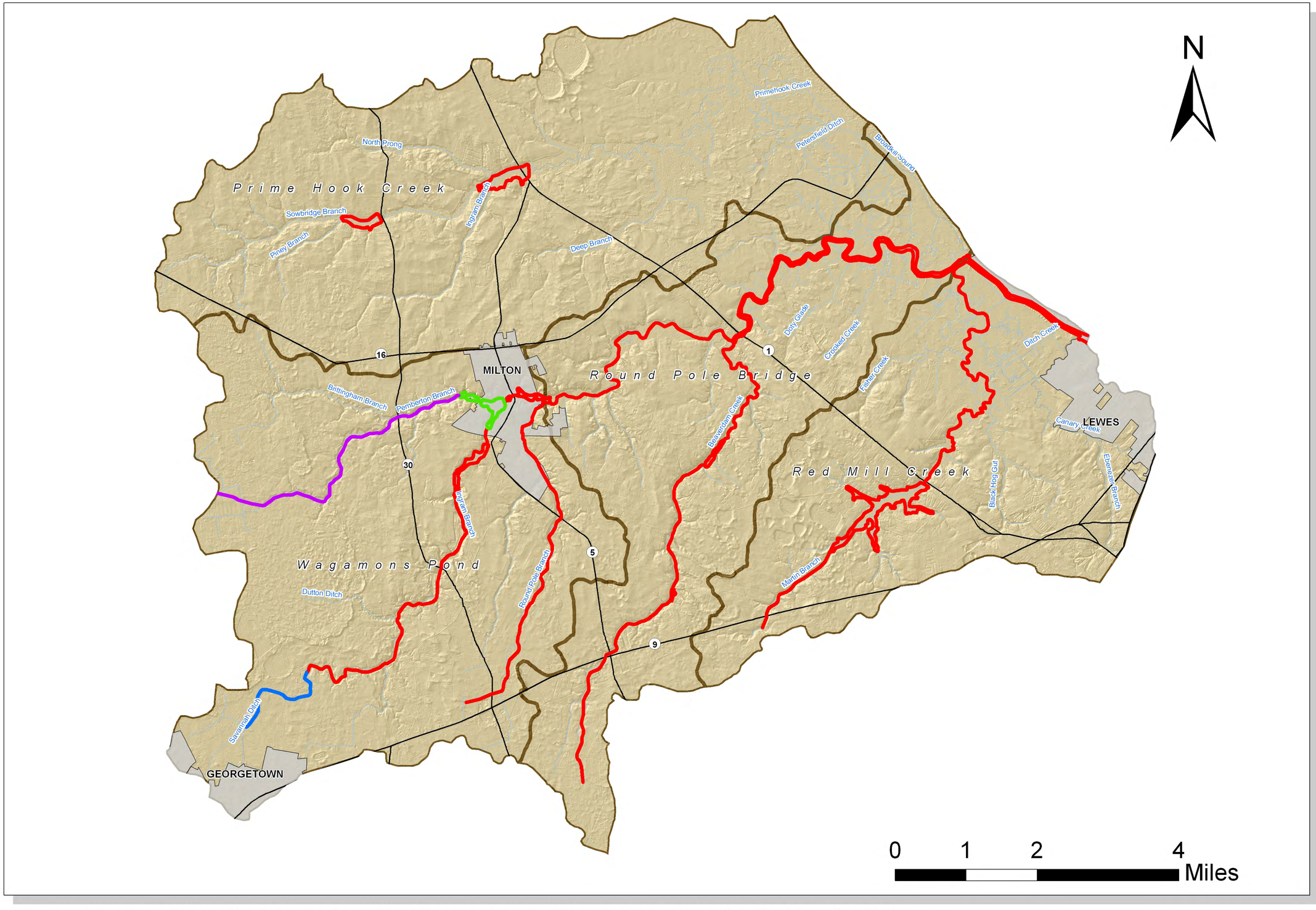
Land use changes affect the amount of pollution entering watersheds. Land use changes in the Watershed have been trending toward more development (conversion) of agricultural and forested lands. While grasslands contribute the highest annual nutrient load for nitrogen, development contributes the second highest with septic systems third highest. Annual phosphorous loads are highest from septic systems while grassland is second and development fourth (agriculture supplies the third highest annual phosphorous load) (Volk, Jennifer).

Table 2. Miles of Impaired Waterbodies within Broadkill River Watershed under the EPA 303(d) Guidelines

Sub-watershed	Segment	Length/ Size (miles)	Impairments	Probable Source
Red Mill Creek	Lower Red Mill Branch	5.3	Bacteria, DO Nutrients	NPS
	Martin Branch	1.5	Bacteria, DO Nutrients	NPS
	Heronwood Branch	1.0	Bacteria, DO	NPS
	Red Mill Pond	150.0 acres	Bacteria, DO Nutrients	NPS
Prime Hook Creek	Waples and Reynolds Ponds	88.8 acres	Bacteria, DO Nutrients	NPS
Round Pole Branch	Broadkill River	8.1	Bacteria, DO* Nutrients	NPS**
	Beaverdam Creek	8.3	Bacteria, DO Nutrients	PS***, NPS
	Upper Broadkill	5.0	Bacteria, DO Nutrients	PS, NPS
Wagamons Pond	Round Pole Branch	5.2	Bacteria, DO Nutrients	NPS
	Ingrams Branch	7.6	Bacteria, DO Nutrients	PS, NPS
	Ingrams Branch	1.7	DO	PS, NPS
	Pemberton Branch	5.0	Bacteria, Nutrients	NPS
	Wagamons Pond	35.0 acres	Nutrients	PS, NPS

Adapted from DNREC report "Broadkill River Watershed Proposed TMDLs," August 2006.

*NPS-non-point source
**PS-point source
***DO-low dissolved oxygen



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2. THIS FIGURE IS ADAPTED FROM SEGMENTS LISTED IN THE "BROADKILL RIVER WATERSHED PROPOSED TMDLs" DATED 2006.

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Legend

- Sub-watershed Boundary
- Municipal Boundaries

TMDL SEGMENTS

- Dissolved Oxygen (DO)
- Nutrients
- Bacteria, DO, Nutrients
- Bacteria, Nutrients
- NON-TMDL STREAM SEGMENTS
- Major Roads

SOURCE: HILLSHADE OF USGS/DGS 2-METER BARE EARTH DEM

DRAWN BY: MPN

CHECKED BY: JME

FILE: 3362WC_Broadkill_Implementation_Fig5.mxd

BROADKILL RIVER WATERSHED

EPA 303(d) TMDL IMPAIRED STREAMS

SUSSEX COUNTY~ DELAWARE

DATE: AUGUST 2008

SCALE: AS SHOWN

PROJECT NO: 3362.WC

SHEET: FIGURE 5

The nutrient loads from development are from urban stormwater runoff. The runoff takes excess fertilizer into the waterbodies.

In areas of Sussex County, ground and surface waters are generally directly connected. This connection allows nutrients from septic systems to reach surface waters through groundwater discharges. Cumulative impacts of onsite wastewater treatment and disposal systems (OWTDS), which are mostly individual systems in the Broadkill River Watershed is a major concern (Gerner, Jay).

Reducing nitrogen and phosphorous concentrations from septic systems by connecting to municipal systems, or using performance based systems, was identified by DNREC as a desirable path to reduce nutrient loads in ground and surface waters. In addition, DNREC identified using BMPs in urban areas, such as wet and dry ponds, infiltration and constructed wetlands, to reduce nutrient loads from development (Greer, Randy).

To characterize the current condition of the Watershed four (4) elements were assessed including current reports, geospatial data, current regulations, and field review of the actual stream bodies. Based on the elements reviewed, identified conditions causing the impairments in the Watershed include:

1. Undersized culverts downstream from development;
2. Lack of Riparian Buffer area;
3. Point source discharge pollutant problems;
4. Older developments without stormwater quality best management practices;
5. Uncontrolled stormwater runoff - severe channel erosion;
6. Lack of infiltration basins;
7. Isolated wetland loss due to lack of regulations; and,
8. Agricultural nutrient loading.

The impairments that have been described in the studies, reports, and field work reviewed for the Watershed could be reduced through watershed management water quality (WMWQ) techniques in the non-developed portions of the watershed, agricultural best management practices (subject of other DNREC initiatives) and upland restoration projects within and around urban areas. Approaches to pollutant reduction include:

- Tree Planting, additional native landscaping;
- Stormwater pond maintenance or creation or bioretention;
- Impervious cover removal;
- On-site stormwater management (e.g., rain barrels, rain gardens, green rooftops);
- Creation/Restoration of Upland Buffers;

- Wetland/Floodplain Creation and/or Restoration;
- Stormwater Infiltration;
- Stream Channel Improvements;
- Preservation of Streams, Wetlands, Floodplains, and Buffers; and
- Flood Control.

The Baseline Assessment indicated various sources and types of water quality impairment. Table 3 shows a summary of the build out projections for the sub-watersheds shown in Figure 4. With land uses projected to continue to change (develop) especially in particular sub-watersheds, the Watershed could benefit from pollution control strategies including urban retrofit and the WMWQ technologies (including preservation). Agricultural best management practices, a separate initiative by DNREC, would also benefit the Watershed. Local planning and regulatory agencies could benefit from assistance from DNREC and other stakeholders in developing local planning documents and programs (both regulatory and project implementation) directed toward pollution control.

D. POLLUTION CONTROL OPPORTUNITIES

Potential pollution control opportunities to improve or prevent water quality impairment within the Watershed were identified and evaluated for each of the major sub-watersheds and urban areas within the Watershed. Thirty (30) WMWQ and 109 upland sites were identified, screened, scored, and prioritized. An additional five (5) potential corridors for preservation/land management opportunities were also identified (Figure 6). Details of the methods used and findings are included in the "Pollution Control Opportunities Technical Memorandum," dated October 2008. It should be noted that property owners or business owners were not contacted as part of this plan.

The Baseline Assessment identified several practices that could reduce pollution in the Watershed. Sites were selected in the Watershed to evaluate the various practices. Upland target areas included opportunities such as retrofitting existing sites with revised best management practices (e.g., bioswales, bioretention) and select neighborhood and hotspot sites that could increase water quality protection by using different site or land management practices. The upland sites were ranked from high to low priority (Table 4). The WMWQ sites were evaluated for six (6) technologies, which focused on wetland/floodplain restoration and creation, buffers, infiltration, and preservation. The WMWQ sites were scored and then ranked by Watershed-wide, sub-watershed, technology, and site. Table 5 shows Watershed wide rankings for total WMWQ scores and individual WMWQ technology scores for each site evaluated.

Table 3. Summary of Broadkill River Watershed Potential Future Land Use Statistics and Existing Protected Lands

	SUB-WATERSHED			
	Red Mill Creek	**Prime Hook Creek**	**Round Pole Bridge**	**Wagamons Pond**
Current Impervious	1,033 acres (8%)	348 acres (1%)	384 acres (2%)	602 acres (3%)
Designated Open Space (Protected Lands)	1,971 acres (15%)	8,199 acres (40%)	2,801 acres (19%)	2,079 acres (11%)
Future Impervious Cover	2,643 acres (21%)	2,763 acres (13%)	2,516 acres (17%)	4,179 acres (22%)

*Statistics derived from the build out projection completed for the Baseline Assessment.

Table 4. Recommended Upland Sites by Target Area, Rank, and Sub-Watershed

Rank	Project ID	Name
High	R29a	Cape Henlopen High School
	N21	Briggs Development
	N1	Shipbuilders Village 1
	N2	Shipbuilders Village 2
	N113	Harvest Run
	N19	Laurel Street
	N15	Su Sax Acres (aka Diamond Overlook)
	N20	Race Street
	N109	Sandhill Acres
	N24	Harborview
	N28	Devries Circle
Medium	R18d	Delmarva Christiana High School
	R30a	Richard A. Shields Elementary School
	R21a	University of De Pollution Ecology Lab & Coast Guard
	R22c	Hooper Marine Operations Building
	R07a	H.O. Brittingham Elementary School
	R17b	Georgetown Square
	N29	Manila Road
	N26	Shipcarpenters Square
	N27	Orr and Mulberry
	N74	Nassau Grove
	N601	Cape Shores
	N95	Cripple Creek
	N25	Pilot Town Village
	N41	Creekside Manor/Pagan Creek Village
	N103	Hunter Mill Estates
	N40	Villages of Five Points
	N85	Paynters Mill 2
	H700	Sherman Heating Oil

Rank	Project ID	Name
	H601	Angler's Marina
	H701	ACE Hardware Shipping
Low	R27a	Angler's Marina
	R02a	Downtown Public Parking
	R30b	Richard A. Shields Elementary School
	R702a	Town Hall
	R701c	Sussex County Library
	R17c	Georgetown Square
	R17a	Georgetown Square
	R701b	Sussex County Library
	R701d	Sussex County Library
	R701a	Sussex County Library
	R10a	Milton Firehouse / Police Auxiliary Parking
	R34a	ACE Hardware / Strip Mall / Recycling Center
	R700a	Iguana Grill
	N20	Race Street
	N109	Sandhill Acres
	N24	Harborview
	N28	Devries Circle
	N53	McNichol Place
Low	N14	Cannery Village
	N54	Villages of Five Points 1
	N45	Sylvan Acres
	N125	Sweet Briar
	N30	Daiber Residence
	N84	Paynters Mill 1
	N115	New Market Village
	N16	Collins and Russell
	N33	Savannah Place/Swaandael
	N34	Hulling Cove
	N72	Edgewater Estates
	N31	Highland Acres

Rank	Project ID	Name
Low	N23	Sandhill Mobile Home Park
	N120	Steamboat Landing
	N123	Tall Pines MHP
	N21	Villages of Five Points 2
	N55	Rolling Meadows/Eagle Point
	N122	Trails at Beaver Creek
	N124	River Rock Run
	N22	Carriage Place
	H401	Reed Trucking

*Property owners have not been contacted as part of the preparation for this report.

Sub-Watershed Key
Red Mill Creek
Prime Hook Creek
Round Pole Bridge
Wagamons Pond

TABLE 5 - WATERSHED WIDE TOTAL WMWQ SCORES RANKED HIGHEST TO LOWEST
BROADKILL RIVER WATERSHED

	SITE IDENTIFICATION NUMBERS																													
Screening Categories for WMWQ Technologies	**11**	**6**	**16**	**14**	**8**	**5**	**12**	**9**	**21**	**6A**	**19**	**20**	**10**	**13**	**1**	**28**	**22**	**26**	**3**	**24**	**15**	**17**	**18**	**25**	**2**	**23**	**29**	**27**	**7**	**4**
CREATION/RESTORATION OF UPLAND BUFFERS	48	49	40	47	51	44	40	40	34	39	44	45	38	42	34	34	39	40	33	37	24	39	44	29	33	31	31	30	19	17
WETLAND/FLOODPLAIN CREATION AND/OR RESTORATION	54	48	52	50	44	54	47	49	49	45	42	47	38	47	35	49	40	41	37	34	54	37	31	37	32	34	30	36	27	41
INFILTRATION	38	46	38	43	43	41	42	37	45	47	38	35	38	31	46	41	42	40	35	39	19	35	32	41	44	36	34	36	38	34
STREAM CHANNEL IMPROVEMENTS	31	31	35	30	30	40	35	34	34	33	39	30	32	35	32	27	33	30	30	26	25	31	35	32	32	31	32	20	21	21
PRESERVATION OF STREAMS, WETLANDS & BUFFERS	34	27	35	32	30	7	27	30	24	21	25	21	30	26	31	25	25	23	32	30	28	24	24	25	12	24	26	26	37	8
FLOOD CONTROL	17	12	17	10	13	8	13	14	12	10	5	14	13	8	10	12	5	10	11	6	21	5	5	7	14	5	6	10	6	9
TOTAL SCORE	222	213	217	212	211	194	204	204	198	195	193	192	189	189	188	188	184	184	178	172	171	171	171	171	167	161	159	158	148	130

Red numbers are highest scores for each technology.
Numbers in blue are recently developed areas.

Sub-Watershed Key
Red Mill Creek
Prime Hook Creek
Round Pole Bridge
Wagamons Pond

*** Property owners had not been contacted as part of the preparation of this report.**

NOTES:

1. THIS PLOT IS PART OF A REPORT TITLED "BROADKILL RIVER WATERSHED IMPLEMENTATION PLAN" PREPARED BY DUFFIELD ASSOCIATES, INC., AND AS SUCH SHOULD ONLY BE VIEWED IN THE CONTEXT OF THAT REPORT.

2. PUBLIC AND MANAGED LAND AREAS TAKEN FROM MULTIPLE AVAILABLE PUBLIC DATA SETS OF VARIOUS DATES.

3. CORRIDORS SHOWN ARE FOR PLANNING PURPOSES TO IDENTIFY POTENTIAL PRESERVATION OPPORTUNITES WITHIN THESE CORRIDORS. THE INTENT IS NOT TO NECESSARILY PRESERVE THE ENTIRE CORRIDOR BUT RATHER IDENTIFY BEST OPPORTUNITIES FOR PARCELS THAT ARE CONTIGUOUS WITH AND PROTECT TARGETED RESOURCES.

4. GRID COORDINATES ARE DISPLAYED IN DELAWARE STATE PLANE COORDINATES (FEET) AND ARE REFERENCED TO THE NORTH AMERICAN DATUM OF 1983 (NAD83).

0 1 2 3 4 Miles

Prime Hook Creek

Round Pole Bridge

Red Mill Creek

Wagamons Pond

1

2

3

4

5

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Legend

Protected Lands

- Federal
- Municipal
- Private Conservation
- State Park (PR)
- State Forest
- State Forest (DDA)
- Fish and Wildlife Area
- Timber Conservation Easement
- Agricultural Preservation
- Municipal Boundary
- Broadkill Watershed Boundary
- Broadkill Subwatershed Boundary
- Water Body
- Stream or River
- Route
- Road
- Railroad
- Potential Corridors for Preservation Opportunities

BASEMAP:
2006 USDA NAIP AERIAL DRAPED OVER USGS/DGS 2-METER BARE-EARTH DEM

DRAWN BY:
ADK

CHECKED BY:
JME/DJ

FILE:
3362WC_Broadkill_Implementation_Fig6.mxd

BROADKILL RIVER WATERSHED

Potential Corridors For Preservation Opportunities
(shown with Existing Holdings)

SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE: 1:36,000
1 inch equals 3,000 feet

PROJECT NO.
3362.WC

SHEET:
FIGURE 6

II. WATERSHED PLAN GOALS AND RECOMMENDATIONS

A. BROADKILL RIVER WATERSHED PLAN GOALS

The purpose of the Watershed Plan is to identify pollutant sources and outline methods to reduce pollutant loads to the established TMDLs. Once the TMDLs are met, the stream segments can be removed from the EPA 303(d) Impaired Streams list. The Watershed Plan provides the State of Delaware with a prioritized list of pollution control opportunities within the Watershed. The opportunities presented are based on an extensive screening process specific to the Watershed.

In order to create a functional and defensible list of pollution control opportunities, the following objectives were identified for the Watershed Plan:

- Identifying appropriate technologies that are accepted approaches used to improve water quality;
- Develop scoring criteria to be used to evaluate selected sites relative to the identified technologies;
- Develop scoring values that are properly weighted to measure the value and feasibility of the sites;
- Obtain sufficient desktop information to allow each site to be evaluated;
- Perform a site reconnaissance for each site to gain additional site-specific insight and verify desktop assumptions; and
- Present the findings in a useable format allowing the end user to quickly identify appropriate pollution control sites when funding is available.

Existing data was used as the primary source for characterizing the sub-watersheds (i.e., land use data). Additional data collection focused on identifying areas of impairments (i.e., field reconnaissance) and potential pollution control. Potential types of restoration, enhancement, retrofit, and preservation opportunities have been identified in the following major categories for the Watershed:

- Stream/Riparian Buffers/Floodplains;
- Wetlands;
- Agricultural Best Management Practices;
- Urban Stormwater Retrofits;
- Urban Sub-watershed Site Reconnaissance; and
- Conservation Easements or Acquisitions.

A goal of the Watershed Plan is to identify and prioritize potential restoration, preservation, or improvement projects within the respective Watershed for

implementation by DNREC and others. A goal of the Implementation Plan is to provide a framework for approaching pollution control on a watershed basis as well as sub-watershed basis, a technology basis, and jurisdictional basis. In addition, projects that may be eligible for 319(b) funds will be identified for DNREC's use in submitting grant applications.

B. IMPLEMENTATION RECOMMENDATIONS

Improvements to the Watershed will be dependent on participation from a myriad of stakeholders/users, funding from a variety of sources with different mandates, and level of improvements anticipated versus the feasibility and cost of implementation. To accommodate these varied considerations, recommendations for implementation are presented in the following general categories:

- Watershed wide
- Sub-watershed
- Technology
- Jurisdiction

In presenting the strategy in this format, decision makers can identify priorities for the identified opportunities on several bases and levels, and present the strategy to various users/funding agents tailored to those specific objectives.

In general for the Watershed, based on the types and locations of impairments, the communicated pollutant reduction goals, and types and locations of opportunities identified, strategies for pollution control are presented according to these general categories.

III. CURRENT AND RECOMMENDED REGULATORY AND PROGRAM PRACTICES

As part of the Broadkill River Watershed Baseline Assessment, the CWP produced a memorandum titled "Local Regulatory and Program Audit of Jurisdictions in the Broadkill Watershed," dated June 20, 2008 (CWP audit memorandum). The audit was performed for three (3) jurisdictions in the Watershed: Sussex County; the Town of Milton and the Town of Georgetown. The audit was intended to (1) identify existing local regulations and programs that should be used to support watershed restoration and protection strategies, and (2) to highlight gaps and weaknesses in the local ordinances and regulations with respect to pollution control prevention. The City of Lewes was not included in this assessment simply due to budgetary limitations; however, many of the regulations for the evaluated municipalities of the audit will likely be similar.

The findings and recommendations provided in the CWP audit memorandum are intended to serve as guidance for the Watershed planning team, interested stakeholders, and local jurisdictions throughout the Watershed planning process. This evaluation did not cover the

full suite of potential program options and alternatives available to the jurisdictions, rather it recommends which existing tools should be further utilized and suggests possible remedies for existing gaps in the programs and regulations.

The comprehensive plans and zoning ordinances reviewed were up to date for the entities of Sussex County, Town of Milton, and Town of Georgetown. In general, with respect to ways to control and prevent pollution, the reviewed plans and regulations could offer more protection for wetlands, contiguous and large forest stands, 100-year floodplain and farms. In addition, codes could be updated to promote cluster development, require open space, require buffers on streams (intermittent and ephemeral), protect isolated freshwater wetlands, and promote native vegetation. Table 6 lists the summary of audit findings.

Table 6. Summary of Audit Findings for Sussex County and the Towns of Milton and Georgetown

Category	Overall Findings	Recommendations
Land Use Planning	• Comprehensive plans are in place and are regularly updated. • Some natural resource protections exist.	• Incorporate the watershed plan and recommendations from the draft plans. • Ensure that wetlands, contiguous forest stands, 100-year floodplain, and farms are fully protected from development.
Land Conservation	• Minimal to no contiguous forest protection is provided throughout the three communities. • DNREC has an Open Space Program to help conserve.	• Large forest tracts should be included in the tree and natural area preservation ordinances. • Open space should always be required in subdivisions with specific management and maintenance requirements.
Aquatic Buffers	• Aquatic buffer protection varies and does not always include wetlands. • Native vegetation in the buffer is currently encouraged. • The term "buffer" is sometimes used interchangeably with "setback".	• Adopt standard buffer regulations that include intermittent and ephemeral streams and all wetlands, especially around sensitive, isolated freshwater wetlands. • Require native vegetation and demarcation, signs and physical barriers on development site to prevent encroachment. • Define aquatic buffer to ensure it is not seen as simply a setback.
Site Design	• Where cluster developments are allowed, they require additional steps/permits.	• Cluster development should be a by-right form of development. • Update codes to reflect better site design practices.
Sediment Control and Stormwater Management	• Delaware state sediment and stormwater regulations are being updated. • On-lot flagging of limits of disturbance (LOD) is not required.	• Adopt or refer to these updated regulations, when approved. • Ensure limited disturbance and protection of on-site natural resources by requiring demarcation and flagging of the LOD.
Non-Stormwater Discharges	• Discharges into a watercourse of industrial wastes, sewage, or other harmful substances are generally prohibited.	• Define and limit allowable discharges. • Assume legal authority and detail the enforcement measures and penalties in ordinances that address non-stormwater discharges.
Watershed Stewardship	• Among these communities, little to no street sweeping is conducted. • Milton worked with DNREC and the University of Delaware on a storm drain stencil project in September 2007.	• Increase street sweeping efforts, particularly during the spring and fall. • Sussex and Georgetown should follow Milton's lead and conduct a storm drain stenciling campaign.

A. WATERSHED PROTECTION PRACTICES

The CWP audit memorandum lists recommendations for the Watershed planning process. In general, Watershed planning or Watershed boundaries should be taken into consideration in the comprehensive planning of the individual jurisdictions. Additionally, there is necessity of consistent protection, definition and requirements for aquatic buffers. Build out projections for Wagamons Pond and Red Mill Creek show that they are the sub-watersheds that may experience the highest amount of future development. As such, the planning for these sub-watersheds should focus on the recommended protections (critical areas, buffers, floodplain, open space, wetlands) and encourage conservation practices (green infrastructure, green building, and onsite stormwater management) and prioritize retrofits for business and neighborhoods identified in the Pollution Control Strategies.

Continuation of DNREC's Watershed Planning efforts is recommended. DNREC in its role can assist in viewing the improvement on a watershed basis and help guide jurisdictions on priorities and coordination between initiatives.

B. MUNICIPAL PRACTICES AND PROGRAMS

The following summarizes the municipal practices and programs for the major jurisdictions within the Watershed.

1. CITY OF LEWES

The City of Lewes was not individually audited for the supporting regulations and ordinances. It has been assumed that the recommendations listed for the Towns of Milton and Georgetown and Sussex County will apply to the City of Lewes as well.

2. TOWN OF MILTON

The Town of Milton was audited by the CWP and detailed recommendations can be found in the CWP audit memorandum. However, notable recommendations are:

- recognize that Wagamons Pond sub-watershed is expected to have the highest future growth in the Watershed according to build out projections and this could substantially impact the water quality if proper planning and regulation is not in place;
- adopt local floodplain regulations restricting activity (including clearing) in the 100-year floodplain; and
- adopt local conservation practices to protect natural resources such as wetlands and forested lands.

3. TOWN OF GEORGETOWN

The Town of Georgetown was audited by the CWP and detailed recommendations can be found in the CWP audit memorandum. However, notable recommendations are:

- recognize that Wagamons Pond sub-watershed is expected to have the
- highest future growth in the Watershed according to build out projections; and this could substantially impact the water quality if proper planning and regulation is not in place;
- adopt local floodplain regulations restricting activity (including clearing) in the 100-year floodplain; and
- refine open space regulations to include passive natural areas.

4. SUSSEX COUNTY

Sussex County was audited by the CWP and detailed recommendations can be found in the CWP audit memorandum. However, notable recommendations are:

- modify the allowances for cluster design to permit greater density in locations within the designated growth area for more zoning categories;
- make cluster, or open space design by-right rather than a conditional use with an extra review process. The review process for these developments should be streamlined to encourage developers to design this type of conservation development;
- prohibit stormwater discharge into wetlands;
- encourage on-site stormwater treatment;
- require pollution prevention plans for hotspot areas (found in the Pollution Control Opportunities); and
- continue to encourage alternative septic systems that remove a greater percentage of pollutants.

C. CONSERVATION/PRESERVATION PRACTICES

Preservation and management is among one of the oldest, simplest, and often most used pollution control technologies. Within the Broadkill River Watershed, a considerable amount of preservation and related land management efforts have already occurred. The Pollution Control Opportunities report evaluated specific parcels for additional preservation associated with proposed technology implementation. In addition, the Pollution Control Opportunities report identified proposed preservation corridors, which are blocks of parcels along streams that appear to have great value and benefit for preservation when compared to other

areas within the Watershed. The corridors were identified with a focus on expanding/extending existing land masses of currently preserved and/or managed lands, and preserving large areas that have a significant need for preservation that has little preservation currently in place. The intent of delineating a corridor was to identify locations to focus potential preservation opportunities, as well as other pollution control opportunities. Appropriate sites within the corridors need to be identified and further evaluated for preservation potential.

Five (5) potential preservation corridors were identified (Figure 6). Each sub-watershed was represented. Four (4) of the five (5) preservation corridors were located around/near existing densities of existing preserved or otherwise managed lands. One preservation corridor was located in the Wagamons Pond sub-watershed and was associated with an area having little existing preservation, but a high level of preservation need (Corridor No. 1).

D. UPLAND RESTORATION PRACTICES

Wagamons Pond and Red Mill Creek sub-watersheds have a projected high potential future urban growth (Table 3). In addition, they have the most existing urbanized areas in the four sub-watersheds, primarily associated with Town of Milton, Town of Georgetown and City of Lewes. As such, strategies for these sub-watersheds should focus on existing sites that do not have pollution control measures installed (i.e. neighborhoods that do not have management ponds) in addition to ensuring proposed neighborhoods and urban development areas meet criteria for reducing pollution. The potential upland restoration opportunities have been ranked by High/Medium/Low potential/benefit and it is recommended to refer to this prioritization for these technologies and within these sub-watersheds (Table 4).

E. WATERSHED MANAGEMENT WATER QUALITY PRACTICES

WMWQ technology opportunities were identified in all of the sub-watersheds. The sub-watersheds of Prime Hook Creek and Round Pole Bridge do not contain urban centers. Therefore, pollution control opportunities for these sub-watersheds which appear most beneficial appear to be the WMWQ technology sites. Implementation of the WMWQ opportunities (several high priority sites) in conjunction with upland restoration opportunities could cumulatively provide greater benefits for the Wagamons Pond and Red Mill Creek sub-watersheds. Priority ranking for these WMWQ opportunities is also provided and recommended to be referred to in the strategy for these sub-watersheds (Table 5).

F. POLLUTION PREVENTION AND SOURCE CONTROL EDUCATION

Education is an important component in the Watershed Plan. Current activities such as the Nutrient Management Act have been beneficial in educating the Agricultural community to the watershed benefits of nutrient management. In the urbanized areas, efforts directed to existing land users on the benefits of retrofits and site management/maintenance activities would be beneficial for the Watershed. Additional education concerning the preservation and conservation easement aspects of the benefits for this Watershed could help landowners with the decision of preserving land and working with the agencies that provide funding avenues. It would appear that the initial efforts of the TAT, DNREC and other stakeholders regarding pollution prevention and source control could be built upon as part of the Implementation Strategy. Strategies identified in this plan could help to refine and refocus those outreach activities and approaches.

IV. SUBWATERSHED MANAGEMENT STRATEGIES

This section details management strategies and implementation priorities for each sub-watershed within the Watershed. Restoration opportunities include different technologies that were evaluated in the Pollution Control Opportunities. Sub-watershed management maps are included, which show general characterization and locations of restoration opportunities and priority projects. For detailed discussion of methods of selection, evaluation and prioritization refer to the Pollution Control Opportunities Technical Memorandum.

The following subsections (subsections are based on sub-watershed unit) are divided into five parts:

Overall Characterization - Summary of current and future land use characteristics. Refer to the Baseline Assessment for more information.

Existing Sub-watershed Conditions - 303(d) listed waterbodies and results of field assessments to characterize the stream reaches.

Potential Targeted Opportunities – A summary of broad types of approaches or technologies that could benefit the sub-watershed based on the impairments and types of land uses identified in the Baseline Assessment.

Pollution Control Opportunities – A summary of individual restoration opportunities identified and a description of implementation priorities. Projects are ranked as high, medium, or low or scored based on stream conditions, ability to link with other projects, and overall feasibility (although it should be noted that actual implementation may not strictly adhere to this ranking).

Strategy Summary – An overview of the implementation strategy for the sub-watershed.

A. BROADKILL RIVER MAINSTEM

The Broadkill River mainstem comprises portions of several of the delineated sub-watersheds for the Watershed. The Broadkill River mainstem is not delineated as an independent sub-watershed. Significant portions of the Broadkill River mainstem are tidally influenced. Within the lower part of the Broadkill River mainstem, the lands around the mainstem are protected (under conservation or acquired by conservation entities) except for the portion passing through the City of Milton in the upper portions of the river and the portion passing through the City of Lewes at the lower portion of the Watershed.

Impairments for the Broadkill River mainstem, based on published data, include nutrients, dissolved oxygen, pathogens (bacteria), and habitat. One or more of these impairments was reported for each sub-watershed.

For purposes of the Implementation Plan, the Broadkill River mainstem will benefit from any of the opportunities implemented in the four sub-watersheds.

B. RED MILL CREEK

Sub-watershed Characterization

Red Mill Creek sub-watershed comprises the southeastern corner of the Watershed with the easternmost portion in the City of Lewes. Red Mill Creek sub-watershed contains the downstream end of the Broadkill River mainstem. Red Mill Creek is the smallest of the sub-watersheds within the Watershed but also has the highest (8%) existing impervious acreage of all four (4) sub-watersheds. Between 2002 and 2007, the sub-watershed lost significant agricultural acreage (4%) and limited forest lands (0.2%) and had an increase in residential development (2.3%). The sub-watershed does benefit from large areas of protected open space at the lower end of the sub-watershed [almost two (2) times the existing impervious coverage] and the approximately 25% coverage of wetlands and waters; however, projections indicate the impervious coverage could double at a minimum in the future, based on the projection model. A significant portion of the Watershed (almost ½) is still comprised of agriculture and forested lands. Table 7 highlights the potential future impervious cover change that could adversely affect water quality of the sub-watershed.

Table 7. Red Mill Creek Sub-Watershed Potential Future Land Use Statistics and Existing Protected Lands

Red Mill Creek	
Current Impervious	1,033 acres (8%)
Designated Open Space (Protected Lands)	1,971 acres (15%)
Future Impervious Cover	2,643 acres (21%)

The primary impacts appear to be associated with urbanizing areas around the City of Lewes and residential development. Significant water features in Red Mill Creek sub-watershed include Broadkill River, Red Mill Pond, Old Mill Creek, Ditch Creek, Ebenezer Branch, Martin Branch, and Fisher Creek.

Summary of Existing Conditions

Table 2 contains the reaches included on the 303(d) impaired list. Lower Red Mill and Martin Branches, and Red Mill Pond are listed for bacteria, dissolved oxygen and nutrients; Heronwood Branch is listed for bacteria and dissolved oxygen. The impairments are from non point sources.

While the stream field assessments found Martin Branch to be in optimal condition, visually for stream habitat condition and buffer condition, the reach is impaired due to quality contaminants which would not be identified in the field evaluation. Old Mill Branch (not listed 303(d)) was found to be in sub-optimal condition. Other

reaches listed were not visually inspected during the field assessments. (For detail of field assessments see Baseline Assessment.)

Potential Targeted Opportunities

Based on the impairments and land uses identified, the Red Mill Creek sub-watershed could benefit from the following types of pollution control technologies/approaches:

- Additional preservation at the lower end of the basin;
- Retrofits in the urbanized sections of the City of Lewes;
- Retrofits in older neighborhoods around the City of Lewes and around Old Mill Creek;
- Agricultural best management practices and other WMWQ in the upper portion of the sub-watershed; and
- Water quality prevention (agricultural best management practices and other watershed management technologies) in the upper portion of the sub-watershed.

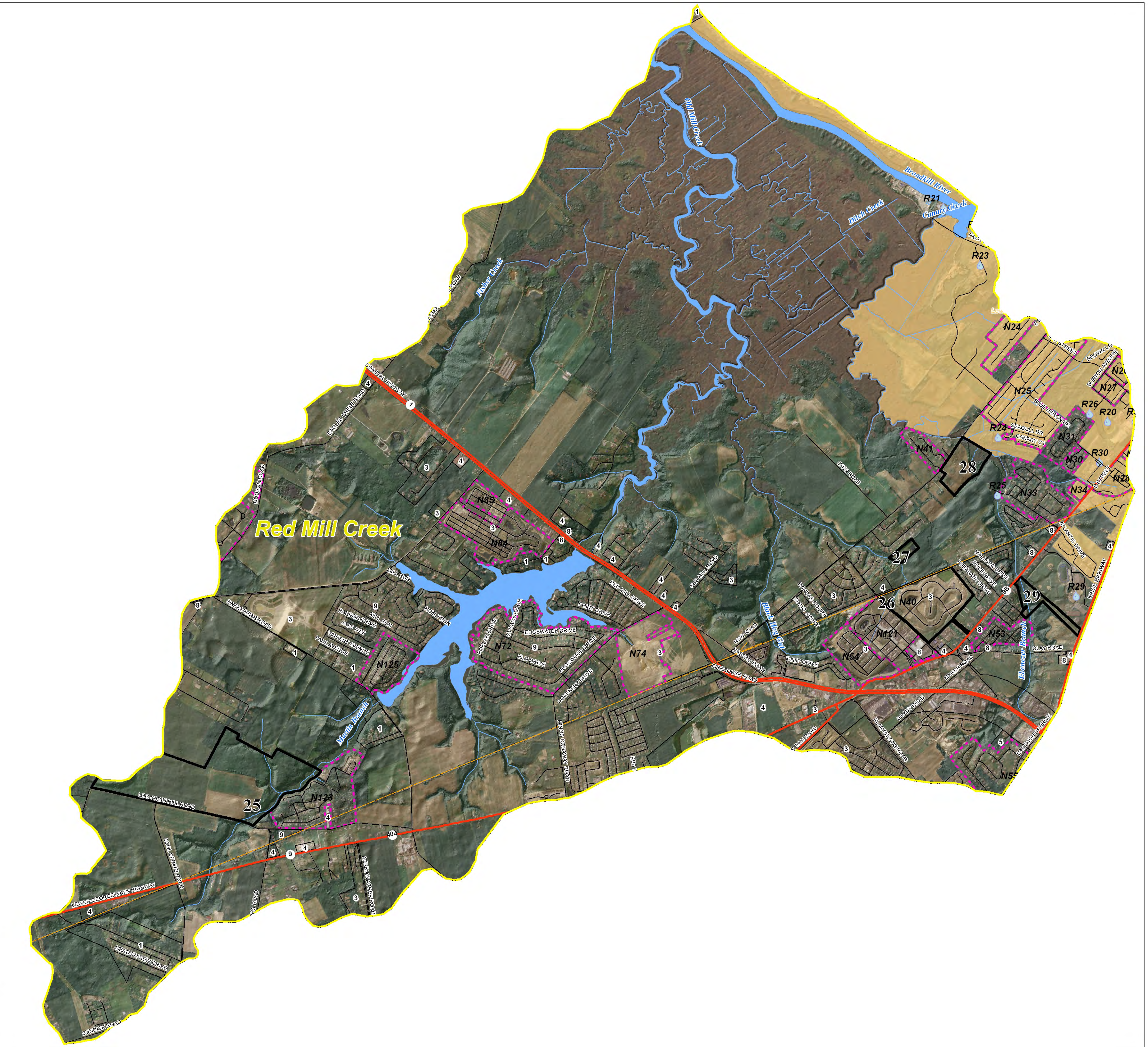
Summary of Pollution Control Opportunities

Within the Red Mill Creek sub-watershed, sixteen (16) upland opportunities (primarily neighborhoods) and five (5) potential WMWQ sites were identified (Figure 7, Tables 8 and 9). The types of opportunities identified include: buffers, wetlands/floodplain restoration, neighborhoods, and limited retrofits. No optimal sites with overall scores were found. Some sites had opportunity for use of more than one technology. One (1) potential corridor for preservation was noted within the Watershed (Figure 8).

Strategy Summary

Based on the sources of impairment, land uses identified, projected land uses, and pollution control opportunities identified, the following strategy is recommended for the Red Mill Creek sub-watershed:

- Focus efforts on the upland retrofits in the municipal centers and implement projects based on the prioritization presented as willing land owners are identified;
- Work with the identified neighborhoods to implement management activities in the high to medium priority sites identified;
- Focus outreach/education efforts to the urban community and neighborhoods through identified successful approaches;
- Evaluate the potential for implementing the limited high priority WMWQ opportunities in the non urban portions of the watershed; and
- Evaluate potential sites within the identified corridor for preservation to prevent additional sources of impairments.



NOTES:
1. THIS PLOT IS PART OF A REPORT TITLED "BROADKILL RIVER WATERSHED IMPLEMENTATION PLAN" PREPARED BY DUFFIELD ASSOCIATES, INC., AND AS SUCH SHOULD ONLY BE VIEWED IN THE CONTEXT OF THAT REPORT.

2. RESTORATION/RETROFIT SITES IDENTIFIED BASED ON DESKTOP REVIEW AND FIELD RECONNAISSANCE (TECHNICAL MERIT). NOT ALL SITES COORDINATED WITH OWNERS TO DATE.

0 0.5 1 1.5 Miles

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Legend

- Municipal Boundary
- Broadkill Watershed Boundary
- Broadkill Subwatershed Boundary
- Water Body
- Stream or River
- Route
- Road
- Railroad
- Retrofit Site
- Hotspot
- Neighborhood Site
- Potential Restoration Parcel

SOURCE:
2006 USDA NAIP AERIAL DRAPED OVER USGS/DGS 2-METER BARE-EARTH DEM

DRAWN BY:
ADK

CHECKED BY:
JME

FILE:
3362WC_Broadkill_Implementation_Fig7.mxd

RED MILL CREEK SUBWATERSHED

POLLUTION CONTROL OPPORTUNITIES

SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO.
3362.WC

SHEET:
FIGURE 7

Table 8. Recommended Upland Sites within the Red Mill Creek Sub-Watershed by Target Area and Rank

Property owners have not been contacted as part of the preparation for this report.

Retrofit

Rank	Project ID	Sub-Watershed	Municipality	Name	Description
High	R29a	Red Mill Creek	None	Cape Henlopen High School	Create shallow wetland with micropool at existing culvert entrance

Neighborhood

Rank	Site ID	Sub-Watershed	Municipality	Name	Onsite Retrofit Potential	Better Management of Common Space
Medium	N74	Red Mill Creek	None	Nassau Grove	X	
	N41	Red Mill Creek	None	Creekside Manor/Pagan Creek Village	X	
	N40	Red Mill Creek	None	Villages of Five Points	X	
	N85	Red Mill Creek	None	Paynters Mill 2	X	
Low	N53	Red Mill Creek	None	McNichol Place		
	N54	Red Mill Creek	None	Villages of Five Points 1	X	
	N125	Red Mill Creek	None	Sweet Briar	X	
	N30	Red Mill Creek	None	Daiber Residence	X	
	N84	Red Mill Creek	None	Paynters Mill 1	X	
	N33	Red Mill Creek	None	Savannah Place/Swaandael	X	
	N72	Red Mill Creek	None	Edgewater Estates	X	
	N31	Red Mill Creek	None	Highland Acres	X	
	N123	Red Mill Creek	None	Tall Pines MHP		
	N55	Red Mill Creek	None	Rolling Meadows/Eagle Point	X	

Hotspots

Rank	ID	Sub-Watershed	Municipality	Name	Hotspot Status	Vehicle Operation	Outdoor Materials	Waste Management	Storm water Infrastructure
Medium	H601	Outside of Red Mill Creek		Angler's Marina	Potential	X	X		

TABLE 9 - TOTAL WMWQ TECHNOLOGY SCORES FOR RED MILL CREEK SUB-WATERSHED
RANKED HIGHEST TO LOWEST
BROADKILL RIVER WATERSHED

Screening Categories for WMWQ Technologies	RED MILL CREEK SUB-WATERSHED SITE IDENTIFICATION NUMBERS				
	26	28	25	29	27
Existing Buffer Width	4	1	1	0	2
Existing Buffer Length	6	6	3	10	9
Proposed Buffer Width	9	9	2	6	3
Areal Buffer Protection	8	7	10	8	3
Surrounding Topography Upgradient of Stream	3	1	3	4	3
Proposed Buffer Type	10	10	10	3	10
CREATION/RESTORATION OF UPLAND BUFFERS	**40**	**34**	**29**	**31**	**30**
Soil Types Within Creation and/or Restoration Areas	3	7	1	1	3
Approximate Average Depth of Excavation	7	9	4	4	4
Soil Relocation	9	10	10	10	5
Hydrology	5	9	2	5	7
Location Within Watershed	7	4	10	4	7
Wetland Type/Size	10	10	10	6	10
WETLAND/FLOODPLAIN CREATION AND/OR RESTORATION	**41**	**49**	**37**	**30**	**36**
Soil Types Within Creation Area	3	3	4	4	3
Appoximate Average Depth of Excavation	6	10	4	7	7
Soil Relocation	9	10	10	10	5
Permeability	7	6	7	6	6
Location Within Watershed	7	4	8	4	7
Size/Land Use	8	8	8	3	8
INFILTRATION	**40**	**41**	**41**	**34**	**36**
Access	9	6	7	9	0
Ownership	3	5	2	6	2
Likely Approach	7	7	7	8	7
Stream Length	2	6	6	6	2
Location Within Watershed	5	2	6	2	2
Level of Impairment	4	1	4	1	7
STREAM CHANNEL IMPROVEMENTS	**30**	**27**	**32**	**32**	**20**
Existing Preservation	7	7	7	7	7
Potential Disturbance Risk	8	8	8	8	8
Potential Preservation	2	4	4	5	5
Location Within Watershed	6	6	6	6	6
PRESERVATION OF STREAMS, WETLANDS & BUFFERS	**23**	**25**	**25**	**26**	**26**
Flood Storage Need	1	2	0	2	1
Storage Potential	1	3	1	1	1
Approximate Average Depth of Excavation	5	5	1	1	5
Location Within Watershed	3	2	5	2	3
FLOOD CONTROL	**10**	**12**	**7**	**6**	**10**
TOTAL SCORE	**184**	**188**	**171**	**159**	**158**

*** Property owners had not been contacted as part of the preparation of this report.**

N

5

Red Mill Creek

Red Mill Pond

Broadkill River

Dutch Creek

Gravelly Creek

Hollow Creek

Murphy Branch

Beaverdam Branch

NOTES:

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Legend

Protected Lands

- Federal
- Municipal
- Private Conservation
- State Park (PR)
- State Forest
- State Forest (DDA)
- Fish and Wildlife Area
- Timber Conservation Easement
- Agricultural Preservation
- Municipal Boundary
- Broadkill Watershed Boundary
- Broadkill Subwatershed Boundary
- Water Body
- Stream or River
- Route
- Road
- Railroad

Potential Corridors for Preservation Opportunities

BASEMAP:
2006 USDA NAIP AERIAL DRAPED OVER USGS/DGS 2-METER BARE-EARTH DEM

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RED MILL CREEK SUBWATERSHED

Potential Corridors For Preservation Opportunties (Shown With Existing Holdings)

SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO.
3362.WC

SHEET:
FIGURE 8

C. PRIME HOOK CREEK

Sub-watershed Characterization

Prime Hook Creek sub-watershed is located at the northern end of the Broadkill River Watershed. There are no major municipal/urban areas within the Watershed. The Watershed is dominated by agriculture and forested lands (approximately 65%), wetlands and waters (approximately 22%), and protected lands (40%). Primary development is residential (6.3%). Prime Hook Creek is the largest (based on acreage) of the sub-watersheds within the Broadkill River Watershed, but also has the least existing impervious acreage of all four (4) sub-watersheds. Between 2002 and 2007, the sub-watershed lost some agricultural acreage (0.6%) and limited forest lands (1%) and had an increase in residential development (1.5%). The sub-watershed does benefit from large areas of protected open space throughout the sub-watershed (almost 30 times the existing impervious coverage); however, projections indicate the impervious coverage could increase nine (9) fold at a minimum in the future, based on the projection model. Table 10 highlights the potential future impervious cover change that could adversely affect the sub-watershed.

Table 10. Prime Hook Creek Sub-Watershed Potential Future Land Use Statistics and Existing Protected Lands

Prime Hook Creek	
Current Impervious	348 acres (1%)
Designated Open Space (Protected Lands)	8,199 acres (40%)
Future Impervious Cover	2,763 acres (13%)

Significant water features of the Prime Hook Creek sub-watershed include Prime Hook Creek, Deep Branch, Ingram Branch, North Prong, Sowbridge Branch, and Piney Branch. Field assessments included the North Prong, Prime Hook Creek, Sowbridge and Ingram Branches. The primary impacts appear to be associated with agriculture.

Summary of Existing Conditions

Waples and Reynolds ponds are the only 303(d) listed water bodies in the Prime Hook Creek sub-watershed (Table 2). The impairments include bacteria, dissolved oxygen and nutrients from non point sources. Field assessments found the streams to be in optimal and sub-optimal condition. Deep Branch scored the lowest for overall condition (stream/buffer/floodplain) in the sub-watershed during the visual assessments (For detail of field assessments see Baseline Assessment.)

Potential Targeted Opportunities

Based on the impairments and land uses identified, the Prime Hook Creek sub-watershed could benefit from the following types of pollution control technologies/approaches:

- Additional preservation throughout the basin;
- Agricultural best management practices; and
- WMWQ in the upper portion of the sub-watershed.

Summary of Pollution Control Opportunities

Within the Prime Hook Creek sub-watershed, three (3) upland opportunities (primarily neighborhoods) and eight (8) potential WMWQ technology sites were identified (Figure 9, Tables 11 and 12). The types of opportunities identified include: buffers, wetland/floodplain restoration, infiltration (highest for all of all sub-watersheds), channel improvements, preservation (high potential), flood control, and neighborhoods. Many of the sites had potential for more than one technology. One (1) significant potential corridor for preservation was noted within the sub-watershed (Figure 10).

Strategy Summary

Based on the sources of impairment, land uses identified, projected land uses, and pollution control opportunities identified, the following strategy is recommended for the Prime Hook Creek sub-watershed:

- Focus efforts on the WMWQ opportunities and implement projects based on the prioritization presented as willing land owners are identified;
- Focus outreach/education efforts on the benefits of agricultural best management practices and need for preservation in the sub-watershed; and
- Evaluate potential sites within the identified corridors for preservation to prevent additional sources of impairments.

NOTES:
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Legend

- Municipal Boundary
- Broadkill Watershed Boundary
- Broadkill Subwatershed Boundary
- Water Body
- Stream or River
- Route
- Road
- Railroad
- Retrofit Site
- Hotspot
- Neighborhood Site
- Potential Restoration Parcel

SOURCE:
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PRIME HOOK CREEK SUBWATERSHED

POLLUTION CONTROL OPPORTUNITIES

SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO.
3362.WC

SHEET:
FIGURE 9

Table 11. Recommended Upland Sites within the Prime Hook Sub-Watershed by Target Area and Rank

Neighborhood						
Rank	**Site ID**	**Sub-Watershed**	**Municipality**	**Name**	**Onsite Retrofit Potential**	**Better Management of Common Space**
Low	N45	Prime Hook Creek	None	Sylvan Acres	X	
	N115	Prime Hook Creek	None	New Market Village		
	N16	Prime Hook Creek	None	Collins and Russell	X	

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TABLE 12 - TOTAL WMWQ TECHNOLOGY SCORES FOR PRIME HOOK CREEK SUB-WATERSHED
RANKED HIGHEST TO LOWEST
BROADKILL RIVER WATERSHED

Screening Categories for WMWQ Technologies	PRIME HOOK CREEK SUB-WATERSHED SITE IDENTIFICATION NUMBERS							
Site	6	6A	5	1	3	2	7	4
Existing Buffer Width	4	2	7	1	0	0	0	0
Existing Buffer Length	10	4	10	3	4	3	3	3
Proposed Buffer Width	9	9	9	6	5	6	0	0
Areal Buffer Protection	10	10	10	10	10	10	10	10
Surrounding Topography Upgradient of Stream	6	4	4	4	4	4	4	4
Proposed Buffer Type	10	10	4	10	10	10	2	0
CREATION/RESTORATION OF UPLAND BUFFERS	**49**	**39**	**44**	**34**	**33**	**33**	**19**	**17**
Soil Types Within Creation and/or Restoration Areas	3	3	7	1	1	1	1	7
Approximate Average Depth of Excavation	10	7	9	4	6	4	1	6
Soil Relocation	10	10	9	10	10	10	10	10
Hydrology	5	5	9	0	0	0	2	5
Location Within Watershed	10	10	10	10	10	7	7	7
Wetland Type/Size	10	10	10	10	10	10	6	6
WETLAND/FLOODPLAIN CREATION AND/OR RESTORATION	**48**	**45**	**54**	**35**	**37**	**32**	**27**	**41**
Soil Types Within Creation Area	3	4	3	4	4	4	3	2
Appoximate Average Depth of Excavation	10	7	7	6	4	6	4	10
Soil Relocation	10	10	9	10	5	9	10	5
Permeability	7	10	6	10	10	10	6	6
Location Within Watershed	8	8	8	8	8	7	7	7
Size/Land Use	8	8	8	8	4	8	8	4
INFILTRATION	**46**	**47**	**41**	**46**	**35**	**44**	**38**	**34**
Access	6	6	9	7	6	7	0	0
Ownership	2	5	2	2	2	2	2	2
Likely Approach	7	7	7	7	7	7	6	7
Stream Length	6	6	6	6	6	8	4	6
Location Within Watershed	6	6	6	6	6	5	5	5
Level of Impairment	4	3	10	4	3	3	4	1
STREAM CHANNEL IMPROVEMENTS	**31**	**33**	**40**	**32**	**30**	**32**	**21**	**21**
Existing Preservation	10	10	0	10	10	0	10	0
Potential Disturbance Risk	10	7	5	10	7	5	10	0
Potential Preservation	5	4	0	4	7	0	8	0
Location Within Watershed	2	0	2	7	8	7	9	8
PRESERVATION OF STREAMS, WETLANDS & BUFFERS	**27**	**21**	**7**	**31**	**32**	**12**	**37**	**8**
Flood Storage Need	2	2	0	2	4	2	1	2
Storage Potential	3	1	1	2	1	4	1	1
Approximate Average Depth of Excavation	2	2	2	1	1	5	1	3
Location Within Watershed	5	5	5	5	5	3	3	3
FLOOD CONTROL	**12**	**10**	**8**	**10**	**11**	**14**	**6**	**9**
TOTAL SCORE	**213**	**195**	**194**	**188**	**178**	**167**	**148**	**130**

*** Property owners had not been contacted as part of the preparation of this report.**

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Legend

Protected Lands

- Federal
- Municipal
- Private Conservation
- State Park (PR)
- State Forest
- State Forest (DDA)
- Fish and Wildlife Area
- Timber Conservation Easement
- Agricultural Preservation
- Municipal Boundary
- Broadkill Watershed Boundary
- Broadkill Subwatershed Boundary
- Water Body
- Stream or River
- Route
- Road
- Railroad
- Potential Corridors for Preservation Opportunities

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PRIME HOOK CREEK SUBWATERSHED

Potential Corridors For Preservation Opportunities (Shown With Existing Holdings)

SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO.
3362.WC

SHEET:
FIGURE 10

D. ROUND POLE BRIDGE

Sub-watershed Characterization

Round Pole Bridge sub-watershed is located in the central region of the Broadkill River Watershed south of the Prime Hook sub-watershed. Round Pole Bridge sub-watershed contains the Broadkill River mainstem. Small portions of the Town of Milton lie within a portion of the western boundary of the sub-watershed; otherwise there are no major municipalities. Round Pole Bridge is smaller than the largest sub-watershed, Prime Hook, and has approximately 2% existing impervious cover. Between 2002 and 2007, the sub-watershed lost significant agricultural acreage (1.9%) and limited forest lands (0.8%) and had a significant increase in residential development (2.2%). The sub-watershed does benefit from approximately 40% forested and wetland areas of which approximately 19% is protected open space interspersed throughout the sub-watershed. A significant portion of the Watershed (almost ¾) is still comprised of agriculture, forested lands, and wetlands. However, based on the projection model, impervious coverage could possibly increase from 2 to 17% in the future. Table 12 highlights the potential future impervious cover change that could adversely affect the sub-watershed.

Table 13. Round Pole Bridge Sub-Watershed Potential Future Land Use Statistics and Existing Protected Lands

Round Pole Bridge	
Current Impervious	384 acres (2%)
Designated Open Space (Protected Lands)	2,801 acres (19%)
Future Impervious Cover	2,516 acres (17%)

Significant water features in the Round Pole Bridge sub-watershed include Broadkill River mainstem, Beaverdam Creek, and Doty Glade. Field assessments included the Broadkill River mainstem and Beaverdam Creek. The primary water quality impacts appear to be associated with agriculture.

Summary of Existing Conditions

The Lower/Upper Broadkill and Beaverdam Creek are 303(d) impaired reaches (Table 2). The impairments include bacteria, dissolved oxygen and nutrients from point and non point sources.

During the field assessments the Broadkill River in this sub-watershed scored marginal (the only reach in the entire watershed to score marginal). The other reaches surveyed, Beaverdam Creek and Ebenezer Branch scored sub-optimal and optimal (respectively). However, the sub optimal score of the Beaverdam was one

of the lowest overall scores in the entire Watershed. (For detail of field assessments see Baseline Assessment.)

Potential Targeted Opportunities

Based on the impairments and land uses identified, the Round Pole Bridge sub-watershed could benefit from the following types of pollution control technologies/approaches:

- Additional preservation throughout the basin;
- Agricultural best management practices; and
- WMWQ in the upper portion of the sub-watershed.

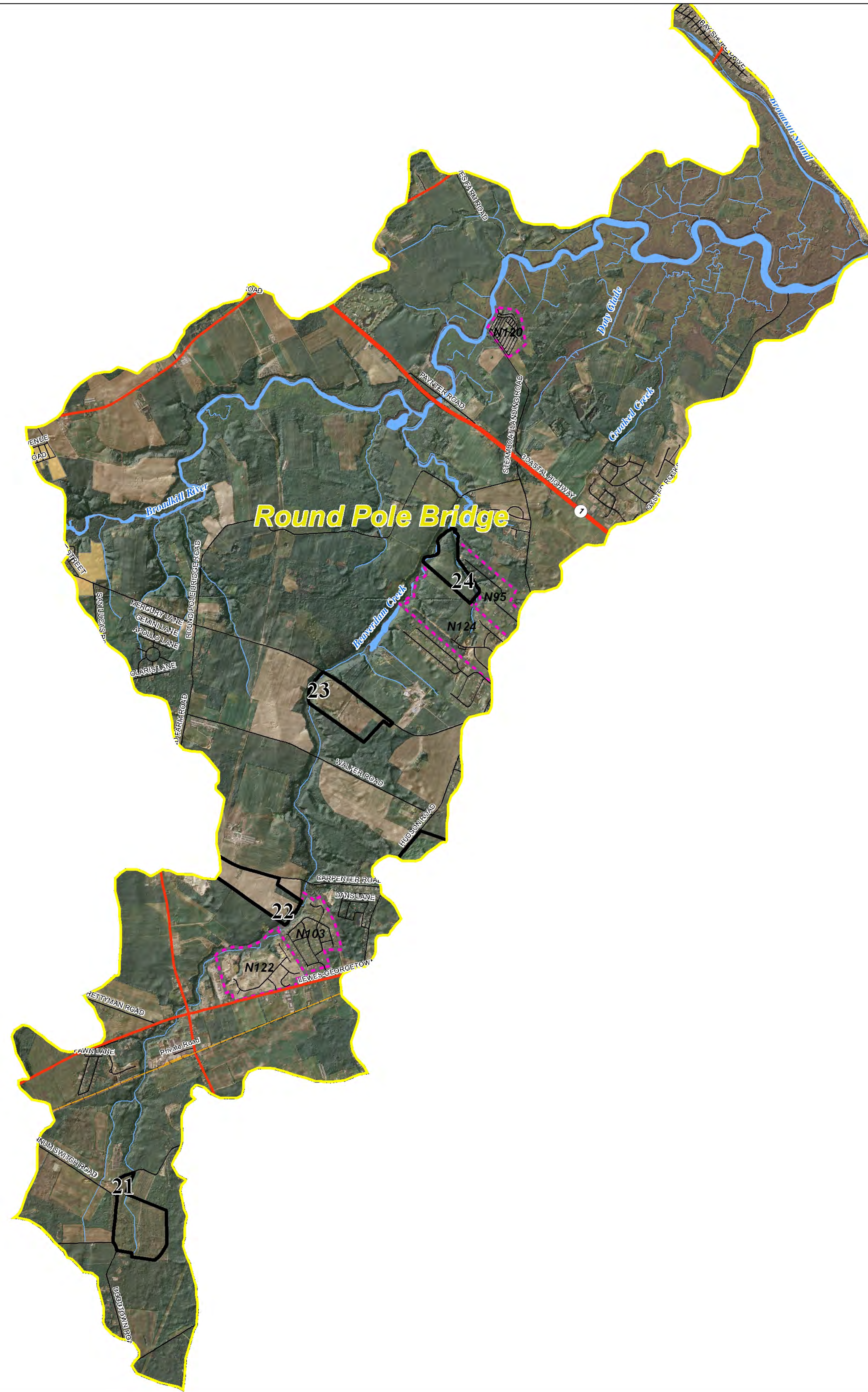
Summary of Pollution Control Opportunities

Within the Round Pole Bridge sub-watershed, five (5) upland opportunities (all neighborhoods) and seven (7) potential WMWQ technology opportunities were identified (Figure 11, Tables 14 and 15). The types of opportunities identified include: buffers, wetlands/floodplain restoration, infiltration, channel improvements, flood control, and neighborhood. Three (3) of these sites scored among the highest for overall scores. One (1) potential corridor for preservation was noted within the Watershed (Figure 12).

Strategy Summary

Based on the sources of impairment, land uses identified, projected land uses, and pollution control opportunities identified, the following strategy is recommended for the Round Pole Bridge sub-watershed:

- Focus efforts on the WMWQ opportunities and implement projects based on the prioritization presented as willing land owners are identified;
- Focus outreach/education efforts on the benefits of agricultural best management practices and need for preservation in the sub-watershed; and
- Evaluate potential sites within the identified corridors for preservation to prevent additional sources of impairments.



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Legend

- Municipal Boundary
- Broadkill Watershed Boundary
- Broadkill Subwatershed Boundary
- Water Body
- Stream or River
- Route
- Road
- Railroad
- Retrofit Site
- Hotspot
- Neighborhood Site
- Potential Restoration Parcel

SOURCE:
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ROUND POLE BRIDGE SUBWATERSHED

POLLUTION CONTROL OPPORTUNITIES

SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE:
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3362.WC

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FIGURE 11

Table 14. Recommended Upland Sites within the Round Pole Bridge Sub-Watershed by Target Area and Rank

Neighborhood						
Rank	**Site ID**	**Sub-Watershed**	**Municipality**	**Name**	**Onsite Retrofit Potential**	**Better Management of Common Space**
Medium	N95	Round Pole Bridge	None	Cripple Creek	X	
	N103	Round Pole Bridge	None	Hunter Mill Estates	X	
Low	N120	Round Pole Bridge	None	Steamboat Landing	X	
	N122	Round Pole Bridge	None	Trails at Beaver Creek	X	
	N124	Round Pole Bridge	None	River Rock Run	X	

* Property owners have not been contacted as part of the preparation for this report.

TABLE 15 - TOTAL WMWQ TECHNOLOGY SCORES FOR ROUND POLE BRIDGE SUB-WATERSHED
RANKED HIGHEST TO LOWEST
BROADKILL RIVER WATERSHED

Screening Categories for WMWQ Technologies	ROUND POLDE BRIDGE SUB-WATERSHED SITE IDENTIFICATION NUMBERS						
Site	21	19	20	22	24	18	23
Existing Buffer Width	2	7	7	1	1	10	0
Existing Buffer Length	3	10	9	6	4	10	3
Proposed Buffer Width	10	10	9	9	9	10	5
Areal Buffer Protection	8	10	10	10	10	8	10
Surrounding Topography Upgradient of Stream	3	3	3	3	3	3	3
Proposed Buffer Type	8	4	7	10	10	3	10
CREATION/RESTORATION OF UPLAND BUFFERS	**34**	**44**	**45**	**39**	**37**	**44**	**31**
Soil Types Within Creation and/or Restoration Areas	3	7	7	3	1	3	1
Approximate Average Depth of Excavation	7	4	7	7	4	7	1
Soil Relocation	10	9	10	10	10	10	10
Hydrology	9	5	9	7	2	2	5
Location Within Watershed	10	7	4	7	7	7	7
Wetland Type/Size	10	10	10	6	10	2	10
WETLAND/FLOODPLAIN CREATION AND/OR RESTORATION	**49**	**42**	**47**	**40**	**34**	**31**	**34**
Soil Types Within Creation Area	3	3	3	3	3	3	3
Appoximate Average Depth of Excavation	10	4	4	7	4	4	1
Soil Relocation	10	10	10	10	10	10	10
Permeability	6	6	7	7	7	7	7
Location Within Watershed	8	7	4	7	7	7	7
Size/Land Use	8	8	7	8	8	1	8
INFILTRATION	**45**	**38**	**35**	**42**	**39**	**32**	**36**
Access	7	9	7	6	0	9	7
Ownership	6	2	5	5	2	2	2
Likely Approach	7	7	7	7	7	5	7
Stream Length	4	6	6	6	8	4	6
Location Within Watershed	6	5	2	5	5	5	5
Level of Impairment	4	10	3	4	4	10	4
STREAM CHANNEL IMPROVEMENTS	**34**	**39**	**30**	**33**	**26**	**35**	**31**
Existing Preservation	7	7	7	7	7	7	7
Potential Disturbance Risk	5	8	5	8	10	8	5
Potential Preservation	5	4	5	2	5	5	5
Location Within Watershed	7	6	4	8	8	4	7
PRESERVATION OF STREAMS, WETLANDS & BUFFERS	**24**	**25**	**21**	**25**	**30**	**24**	**24**
Flood Storage Need	0	0	2	0	1	0	0
Storage Potential	2	1	4	1	1	1	1
Approximate Average Depth of Excavation	5	1	5	1	1	1	1
Location Within Watershed	5	3	3	3	3	3	3
FLOOD CONTROL	**12**	**5**	**14**	**5**	**6**	**5**	**5**
TOTAL SCORE	**198**	**193**	**192**	**184**	**172**	**171**	**161**

*** Property owners had not been contacted as part of the preparation of this report.**

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NOTES:

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Legend

Protected Lands

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FILE:
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ROUND POLE BRIDGE SUBWATERSHED

Potential Corridors For Preservation Opportunities (Shown With Existing Holdings)

SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO.
3362.WC

SHEET:
FIGURE 12

E. WAGAMONS POND

Sub-watershed Characterization

Wagamons Pond sub-watershed is located at the southwestern corner of the Watershed. Wagamons Pond is a mid size sub-watershed within the Watershed and has low current impervious cover (3%), but has the highest possible future impervious acreage of all four (4) sub-watersheds (22%) based on the projection model. Between 2002 and 2007, the sub-watershed lost significant agricultural acreage (2.2%) and had a significant increase in residential development (2.4%). The sub-watershed gained limited forest lands (0.1%). The sub-watershed has the smallest percentage of protected open space (11%) in the Watershed. Approximately 44% of the existing coverage is wetlands and forest, with a significant portion of the sub-watershed (almost ½) still comprised of agriculture. Table 16 highlights the potential future impervious cover change that could adversely affect the sub-watershed.

Table 16. Wagamons Pond Sub-Watershed Potential Future Land Use Statistics and Existing Protected Lands

Wagamons Pond	
Current Impervious	602 acres (3%)
Designated Open Space (Protected Lands)	2,079 acres (11%)
Future Impervious Cover	4,179 acres (22%)

The primary water quality impacts appear to be associated with urbanizing areas around the City of Milton, the City of Georgetown, and residential development. Point sources of pollutant discharge include Allen Family Foods, SAW Georgetown Plant, Purdue Georgetown Plant, and City of Milton WWTP. Significant water features of Wagamons Pond sub-watershed include Wagamons Pond, Brittingham Branch, Pemberton Branch, Round Pole Branch, Ingram Branch of the Broadkill River, Dutton Ditch, and Savannah Ditch. Field assessments included the Brittingham, Pemberton, Ingram and Round Pole Branches, a small section of the Broadkill River mainstem above Wagamons Pond and Dutton Ditch.

Summary of Existing Conditions

Table 2 lists 303(d) impaired waterbodies in the Wagamons Pond sub-watershed. Round Pole Branch and Ingrams Branch are impaired due to bacteria, dissolved oxygen and nutrients. Round Pole contains a point source and non point source. Ingrams impairment is due to non point sources in the 7.6 miles from the headwaters to Wagamons Pond and 1.7 miles of a western tributary to the headwaters is due to point and non point sources. Pemberton Branch impairments include bacterial and nutrients from non point sources. Wagamons Pond contains elevated nutrients due to point and non point sources.

During the field assessment, Brittingnam, Pemberton, Ingram Branches, and the Broadkill River all scored optimally overall. Round Pole and Dutton Ditch scored as suboptimal overall. The Broadkill River mainstem and Ingram Branch had two of the highest scores in the sub-watershed during the field assessments. (For detail of field assessments see Baseline Assessment.)

Potential Targeted Opportunities

Based on the impairments and land uses identified, the Wagamons Pond sub-watershed could benefit from the following types of pollution control technologies/approaches:

- Additional preservation targeted around Savannah Ditch;
- Retrofits in the urbanized sections of Cities of Milton and Georgetown;
- Retrofits in older neighborhoods around the Cities of Milton and Georgetown;
- Reduction of point sources of pollutant discharges from Allen Family Foods, SAW Georgetown Plant, Purdue Georgetown Plant, and City of Milton WWTP; and
- WMWQ throughout the sub-watershed.

Summary of Pollution Control Opportunities

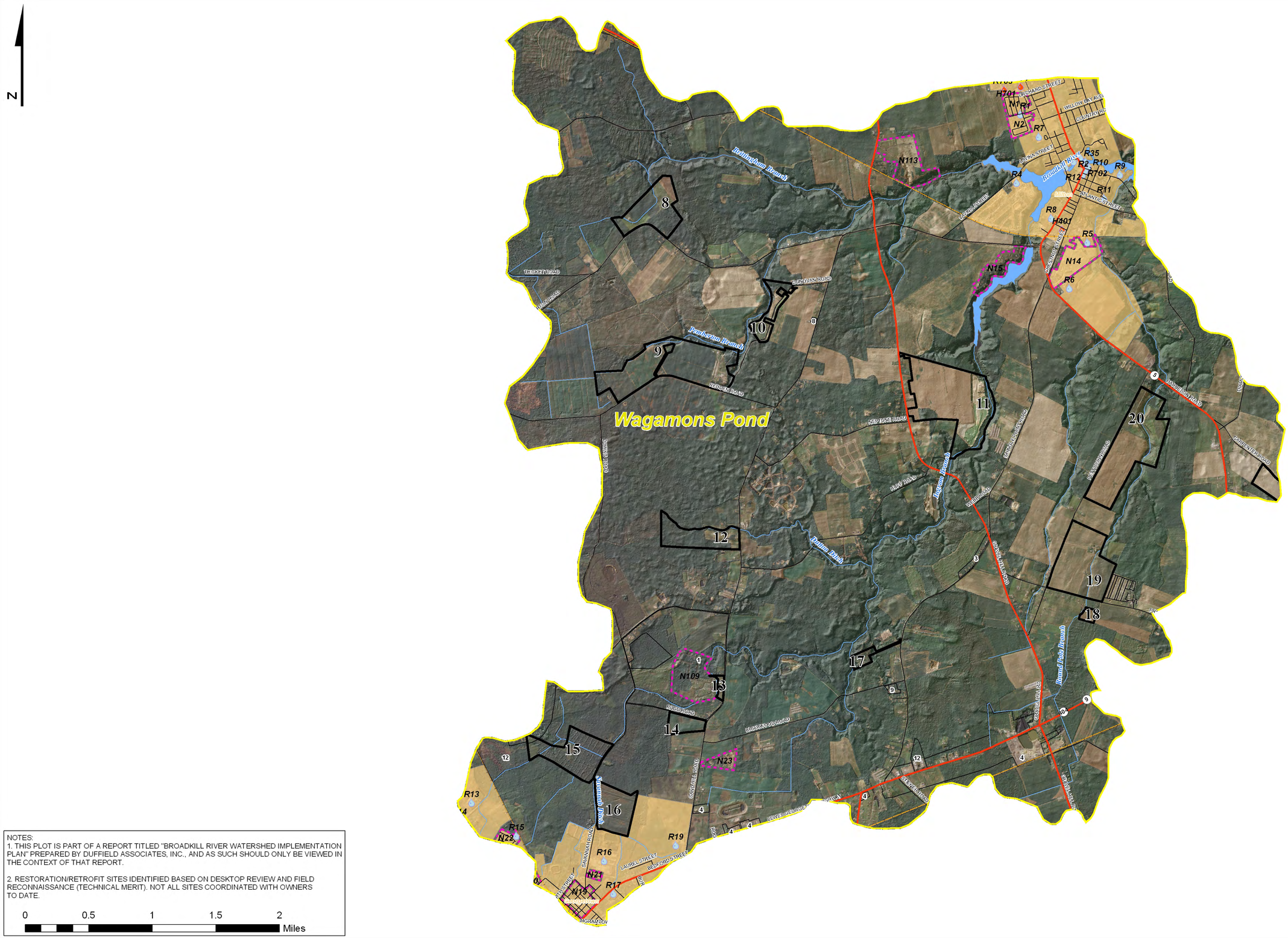
Within the Wagamons Pond sub-watershed five (5) upland opportunities and ten (10) potential WMWQ technology opportunities were identified (Figure 13, Tables 17 and 18). The types of opportunities identified include: buffers, wetlands/floodplain restoration, channel improvements, preservation, flood control, and neighborhoods. Six (6) of the sites scored among the highest in overall scores. This sub-watershed offers the greatest opportunities with the Broadkill River Watershed. Two (2) potential corridors for preservation [one (1) for Ingram Branch/Savannah Ditch and one (1) for Pemberton Branch] were noted within the Watershed (Figure 14).

Strategy Summary

Based on the sources of impairment, land uses identified, projected land uses, and pollution control opportunities identified, the following strategy is recommended for the Wagamons Pond sub-watershed:

- Significant pollution reduction could be gained in the Wagamons Pond sub-watershed through a “holistic” approach capitalizing on the urban retrofits in the urban areas, WMWQ opportunities in the non-urbanized areas to prevent future impairments and the expansion of preservation corridors to prevent future sources of impairment. This sub-watershed could serve as the demonstration sub-watershed for the myriad of technical approaches identified and could demonstrate the significant improvements that “watershed” based improvements can have on water quality;

- Focus efforts on the upland retrofits in the municipal centers and implement projects based on the prioritization presented as willing land owners are identified;
- Work with the identified neighborhoods to implement management activities in the high to medium priority sites identified;
- Focus outreach/education efforts to the urban community and neighborhoods through identified successful approaches;
- Evaluate the potential for implementing the WMWQ opportunities in the non urban portions of the watershed; and
- Evaluate potential sites within the identified corridor for preservation to prevent additional sources of impairments.



NOTES:
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2. RESTORATION/RETROFIT SITES IDENTIFIED BASED ON DESKTOP REVIEW AND FIELD RECONNAISSANCE (TECHNICAL MERIT). NOT ALL SITES COORDINATED WITH OWNERS TO DATE.

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Legend

- Municipal Boundary
- Broadkill Watershed Boundary
- Broadkill Subwatershed Boundary
- Water Body
- Stream or River
- Route
- Road
- Railroad
- Retrofit Site
- Hotspot
- Neighborhood Site
- Potential Restoration Parcel

SOURCE:
2006 USDA NAIP AERIAL DRAPED OVER USGS/DGS 2-METER BARE-EARTH DEM

DRAWN BY:
ADK

CHECKED BY:
JME

FILE:
3362WC_Broadkill_Implementation_Fig13.mxd

WAGAMONS POND SUBWATERSHED

POLLUTION CONTROL OPPORTUNITIES

SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO.
3362.WC

SHEET:
FIGURE 13

Table 17. Recommended Upland Sites within the Wagamons Pond Sub-Watershed by Target Area and Rank

Neighborhood						
Rank	**Site ID**	**Sub-Watershed**	**Municipality**	**Name**	**Onsite Retrofit Potential**	**Better Management of Common Space**
High	N113	Wagamons Pond	None	Harvest Run	X	
	N15	Wagamons Pond	None	Su Sax Acres (aka Diamond Overlook)	X	X
	N109	Wagamons Pond	None	Sandhill Acres		X
Low	N23	Wagamons Pond	None	Sandhill Mobile Home Park		X
	N22	Wagamons Pond	Portion in Georgetown	Carriage Place	X	

* Property owners have not been contacted as part of the preparation for this report.

TABLE 18 - TOTAL WMWQ TECHNOLOGY SCORES FOR WAGAMONDS POND SUB-WATERSHED
RANKED HIGHEST TO LOWEST
BROADKILL RIVER WATERSHED

Screening Categories for WMWQ Technologies	WAGAMONS POND SUB-WATERSHED SITE IDENTIFICATION NUMBERS									
Site	11	16	14	8	9	12	10	13	15	17
Existing Buffer Width	4	4	7	10	4	2	1	7	0	2
Existing Buffer Length	7	10	7	10	3	6	7	7	3	7
Proposed Buffer Width	10	5	10	10	10	9	6	9	0	9
Areal Buffer Protection	10	10	10	10	10	10	10	8	10	8
Surrounding Topography Upgradient of Stream	7	1	3	3	3	3	4	1	1	3
Proposed Buffer Type	10	10	10	8	10	10	10	10	10	10
CREATION/RESTORATION OF UPLAND BUFFERS	**48**	**40**	**47**	**51**	**40**	**40**	**38**	**42**	**24**	**39**
Soil Types Within Creation and/or Restoration Areas	7	8	7	3	7	3	1	10	10	3
Approximate Average Depth of Excavation	10	7	6	6	7	7	6	9	10	6
Soil Relocation	10	10	10	10	10	10	10	5	5	10
Hydrology	10	7	7	5	5	7	5	9	9	5
Location Within Watershed	7	10	10	10	10	10	10	8	10	7
Wetland Type/Size	10	10	10	10	10	10	6	6	10	6
WETLAND/FLOODPLAIN CREATION AND/OR RESTORATION	**54**	**52**	**50**	**44**	**49**	**47**	**38**	**47**	**54**	**37**
Soil Types Within Creation Area	4	1	2	4	1	3	3	1	1	3
Appoximate Average Depth of Excavation	6	4	7	4	7	7	6	4	1	4
Soil Relocation	10	10	10	10	10	10	10	5	5	10
Permeability	7	6	6	10	3	6	7	7	0	7
Location Within Watershed	8	10	10	7	8	8	8	10	8	7
Size/Land Use	3	7	8	8	8	8	4	4	4	4
INFILTRATION	**38**	**38**	**43**	**43**	**37**	**42**	**38**	**31**	**19**	**35**
Access	7	7	7	7	6	7	7	9	0	6
Ownership	2	2	2	2	5	5	2	3	5	5
Likely Approach	7	7	7	5	7	7	7	7	5	7
Stream Length	6	4	4	6	6	6	6	4	8	4
Location Within Watershed	5	8	6	6	6	6	6	8	6	5
Level of Impairment	4	7	4	4	4	4	4	4	1	4
STREAM CHANNEL IMPROVEMENTS	**31**	**35**	**30**	**30**	**34**	**35**	**32**	**35**	**25**	**31**
Existing Preservation	10	10	10	10	10	7	10	10	10	10
Potential Disturbance Risk	10	10	8	7	7	7	7	10	7	7
Potential Preservation	8	8	8	5	5	5	5	2	5	5
Location Within Watershed	6	7	6	8	8	8	8	4	6	2
PRESERVATION OF STREAMS, WETLANDS & BUFFERS	**34**	**35**	**32**	**30**	**30**	**27**	**30**	**26**	**28**	**24**
Flood Storage Need	2	6	1	4	4	0	4	2	7	0
Storage Potential	7	4	2	2	2	3	2	1	4	1
Approximate Average Depth of Excavation	5	3	2	2	3	5	2	1	5	1
Location Within Watershed	3	4	5	5	5	5	5	4	5	3
FLOOD CONTROL	**17**	**17**	**10**	**13**	**14**	**13**	**13**	**8**	**21**	**5**
TOTAL SCORE	**222**	**217**	**212**	**211**	**204**	**204**	**189**	**189**	**171**	**171**

*** Property owners have not been contacted as part of the preparation for this report.**

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2. PUBLIC AND MANAGED LAND AREAS TAKEN FROM MULTIPLE AVAILABLE PUBLIC DATA SETS OF VARIOUS DATES.

3. CORRIDORS SHOWN ARE FOR PLANNING PURPOSES TO IDENTIFY POTENTIAL PRESERVATION OPPORTUNITES WITHIN THESE CORRIDORS. THE INTENT IS NOT TO NECESSARILY PRESERVE THE ENTIRE CORRIDOR BUT RATHER IDENTIFY BEST OPPORTUNITIES FOR PARCELS THAT ARE CONTIGUOUS WITH AND PROTECT TARGETED RESOURCES.

0 0.5 1 1.5 2 Miles

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Legend

Protected Lands

- Federal
- Municipal
- Private Conservation
- State Park (PR)
- State Forest
- State Forest (DDA)
- Fish and Wildlife Area
- Timber Conservation Easement
- Agricultural Preservation
- Municipal Boundary
- Broadkill Watershed Boundary
- Broadkill Subwatershed Boundary
- Water Body
- Stream or River
- Route
- Road
- Railroad
- Potential Corridors for Preservation Opportunities

BASEMAP:
2006 USDA NAIP AERIAL DRAPED OVER USGS/DGS 2-METER BARE-EARTH DEM

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ADK

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JME/DJ

FILE:
3362\WC_Broadkill_Implementation_Fig14.mxd

WAGAMONS POND SUBWATERSHED

Potential Corridors For Preservation Opportunities (Shown With Existing Holdings)

SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO.
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SHEET:
FIGURE 14

V. MUNICIPAL STRATEGIES

The following section provides recommended strategies for each of the municipalities within the Watershed:

- Sussex County
- City of Lewes
- Town of Georgetown
- Town of Milton

For ease in coordinating with each municipality, information for each is included as a separate section that can easily be pulled out for discussion and distribution.

In general, each municipality can play a role in reducing and preventing pollution in the Watershed. Each municipality can specifically work with DNREC and other related stakeholders to review and amend comprehensive plans and local ordinances/regulations to support pollution prevention and reduce existing impairments. Each jurisdiction can also assist in educating residents and business owners in the Watershed using demonstrated successful approaches and networks within the jurisdiction. And finally, the jurisdictions can serve as local sponsors or cooperating technical partners in pollution control opportunity project implementation as part of the overall implementation strategy.

A. SUSSEX COUNTY

The sites that are listed in Tables 8, 11, 14, and 17 and shown on Figures 7, 9, 11, and 13 are outside of the jurisdictions of Towns of Milton and Georgetown and the City of Lewes, and, therefore fall under the jurisdiction of Sussex County. These sites are found within each of the four sub-watersheds.

Sussex County can serve in the following ways to improve water quality in the Watershed:

- Work with stakeholders to implement the opportunities identified within the jurisdictional boundaries;
- Work to coordinate regional approaches with the stakeholders to implement strategies for:
  - Site acquisitions;
  - Project implementation;
  - Comprehensive planning considering the recommendations made; and
  - Coordination with the municipalities within the Watershed for optimizing resources and "holistic" solutions.
- Participate in outreach and education programs.

B. CITY OF LEWES

Within the City of Lewes, thirteen (13) upland opportunities were identified (Figure 7, Table 19). Five (5) retrofit and eight (8) neighborhood target areas were assessed.

City of Lewes can serve in the following ways to improve water quality in the Watershed:

- Work with stakeholders to implement the opportunities identified within the jurisdictional boundaries;
- Support components of regional approaches to be undertaken within the jurisdiction with the stakeholders to implement strategies for:
  - Site acquisitions;
  - Project implementation;
  - Comprehensive planning considering the recommendations made; and
  - Coordination with Sussex County within the Watershed for optimizing resources and "holistic" solutions.
- Participate in outreach and education programs.

Table 19. Recommended Upland Sites by Target Area and Rank in the City of Lewes

Retrofit					
Rank	**Project ID**	**Sub-Watershed**	**Municipality**	**Name**	**Description**
Med	R30a	Red Mill Creek	Lewes	Richard A. Shields Elementary School	Create bioretention at existing depression
	R21a	Red Mill Creek	Lewes	University of De Pollution Ecology Lab & Coast Guard	Create bioretention at existing turf area near dock to capture runoff before entering river
	R22c	Red Mill Creek	Lewes	Hooper Marine Operations Building	Install bioretention at primary parking area.
Low	R27a	Red Mill Creek	Lewes	Angler's Marina	Create bioretention adjacent to boardwalk.
	R30b	Red Mill Creek	Lewes	Richard A. Shields Elementary School	Install oil/grit separator to convey gas station runoff to bioretention area

Neighborhood						
Rank	**Site ID**	**Sub-Watershed**	**Municipality**	**Name**	**Onsite Retrofit Potential**	**Better Management of Common Space**
High	N24	Red Mill Creek	Lewes	Harborview	X	
	N28	Red Mill Creek	Lewes	Devries Circle	X	
Medium	N29	Red Mill Creek	Lewes	Manila Road	X	
	N26	Red Mill Creek	Lewes	Shipcarpenters Square	X	
	N27	Red Mill Creek	Lewes	Orr and Mulberry	X	
	N601	Outside of Red Mill Creek	Lewes	Cape Shores	X	
	N25	Red Mill Creek	Lewes	Pilot Town Village	X	
	N34	Red Mill Creek	Lewes	Hulling Cove		

Property owners have not been contacted as part of the preparation for this report.

C. TOWN OF MILTON

Within the Town of Milton, sixteen (16) upland opportunities were identified (Figure 13, Table 20). The target areas identified in Milton include: retrofits (10), neighborhoods (3), and hotspots (3).

Town of Milton can serve in the following ways to improve water quality in the Watershed:

- Work with stakeholders to implement the opportunities identified within the jurisdictional boundaries;
- Support components of regional approaches to be undertaken within the jurisdiction with the stakeholders to implement strategies for:
  - Site acquisitions;
  - Project implementation;
  - Comprehensive planning considering the recommendations made; and
  - Coordination with Sussex County within the Watershed for optimizing resources and "holistic" solutions.
- Participate in outreach and education programs.

Table 20. Recommended Upland Sites by Target Area and Rank in the Town of Milton

Retrofit					
Rank	**Project ID**	**Sub-Watershed**	**Municipality**	**Name**	**Description**
Medium	R07a	Wagamons Pond	Milton	H.O. Brittingham Elementary School	Add trees and native vegetation to existing dry pond
Low	R02a	Wagamons Pond	Milton	Downtown Public Parking	Install narrow bioretention where island exists on periphery of parking lot
	R702a	Wagamons Pond	Milton	Town Hall	Install sand filter to treat parking lot runoff
	R701c	Wagamons Pond	Milton	Sussex County Library	Create rain garden in housing area
	R701b	Wagamons Pond	Milton	Sussex County Library	Create rain garden in rear of building to treat part of the parking lot
	R701d	Wagamons Pond	Milton	Sussex County Library	Create bioretention cell in parking island
	R701a	Wagamons Pond	Milton	Sussex County Library	Install rain barrels for demonstration purposes
	R10a	Wagamons Pond	Milton	Milton Firehouse / Police Auxiliary Parking	Create bioretention to treat parking lot runoff
	R34a	Wagamons Pond	Milton	ACE Hardware / Strip Mall / Recycling Center	Convert existing parking lot islands and landscaping areas into bioretention cells
	R700a	Wagamons Pond	Milton	Iguana Grill	Create bioretention at existing berm

Neighborhood						
Rank	**Site ID**	**Sub-Watershed**	**Municipality**	**Name**	**Onsite Retrofit Potential**	**Better Management of Common Space**
Medium	N1	Wagamons Pond	Milton	Shipbuilders Village 1	X	
	N2	Wagamons Pond	Milton	Shipbuilders Village 2		
Low	N14	Wagamons Pond	Milton	Cannery Village	X	

Hotspots									
Rank	**ID**	**Sub-Watershed**	**Municipality**	**Name**	**Hotspot Status**	**Vehicle Operations**	**Outdoor Materials**	**Waste Management**	**Stormwater Infrastructure**
Medium	H700	Wagamons Pond	Milton	Sherman Heating Oil	Confirmed	X	X		X
	H701	Wagamons Pond	Milton	ACE Hardware Shipping	Potential		X	X	
Low	H401	Wagamons Pond	Milton	Reed Trucking	Confirmed	X	X		X

* Property owners have not been contacted as part of the preparation of this report.

D. TOWN OF GEORGETOWN

Within the Town of Georgetown, nine (9) upland opportunities were identified (Figure 13, Table 21). The target areas identified in Georgetown include: retrofits (4) and neighborhoods (5).

Town of Georgetown can serve in the following ways to improve water quality in the Watershed:

- Work with stakeholders to implement the opportunities identified within the jurisdictional boundaries;
- Support components of regional approaches to be undertaken within the jurisdiction with the stakeholders to implement strategies for:
  - Site acquisitions;
  - Project implementation;
  - Comprehensive planning considering the recommendations made; and
  - Coordination with Sussex County within the Watershed for optimizing resources and "holistic" solutions.
- Participate in outreach and education programs.

Table 21. Recommended Upland Sites by Target Area and Rank in the Town of Georgetown

Retrofit					
Rank	**Project ID**	**Sub-Watershed**	**Municipality**	**Name**	**Description**
Medium	R18d	Wagamons Pond	Georgetown	Delmarva Christiana High School	Disconnect downspouts in front of school and create rain garden
	R17b	Wagamons Pond	Georgetown	Georgetown Square	Add landscaped islands throughout parking lot to act as filter strips
Low	R17c	Wagamons Pond	Georgetown	Georgetown Square	Disconnect downspouts in rear to pervious areas
	R17a	Wagamons Pond	Georgetown	Georgetown Square	Remove impervious cover that is in poor condition

Neighborhood						
Rank	**Site ID**	**Sub-Watershed**	**Municipality**	**Name**	**Onsite Retrofit Potential**	**Better Management of Common Space**
High	N21	Wagamons Pond	Georgetown	Briggs Development	X	
	N19	Wagamons Pond	Georgetown	Laurel Street	X	
	N20	Wagamons Pond	Georgetown	Race Street	X	
	N21	Wagamons Pond	Georgetown	Villages of Five Points 2		
	N22	Wagamons Pond	Portion in Georgetown	Carriage Place	X	

Property owners have not been contacted as part of the preparation for this report.

VI. IMPLEMENTATION STRATEGIES

A. OVERVIEW

The implementation strategies are broken into three approaches: ranking, technology, and sub-watershed.

- ranking strategy utilizes the scores of each site to prioritize project implementation,
- technology strategy utilizes prioritization based on individual technologies reviewed, and
- sub-watershed strategy focuses on an individual sub-watershed with the highest potential to reap implementation benefits.

B. RANKING BASIS

One strategy to implementing the identified opportunities is to develop a ranking of each of the opportunities identified and work from highest ranked to lowest ranked. Opportunities can be ranked in several ways. There are two major types of opportunities identified for the Watershed (Upland and WMWQ). The upland sites have been ranked by a High/Medium/Low ranking while the WMWQ sites have been ranked based on a scoring matrix. These sites have been ranked by their overall score and sub-scores for each technology. The upland rankings are included in Table 4 and the WMWQ scores in Table 5.

This strategy to implementation prioritization has the benefit of providing lists for different entities that may implement projects. As an example, municipalities may be more interested in upland opportunities and DNREC, Sussex County and regional groups may be more interested in the WMWQ sites. This strategy does not provide the potential entity to implement the projects an understanding of how the site fits into more “holistic” or targeted approaches nor considers location within the Watershed.

C. TECHNOLOGY BASIS

Another strategy to implementing identified opportunities is to develop a ranking and prioritization for the sites identified for each technology. As an example, all wetland restoration/creation sites would be compared to each other and scored and ranked. With this strategy an entity interested in implementing that technology could select the highest ranked site for that technology. There may be sources of funding that target specific technologies and this ranking will help support/justify the selection of particular sites for funding.

This strategy has the benefit of identifying most likely successful sites for a particular technology. However, this strategy does not provide the potential entity with an understanding of how the site fits into more "holistic" or targeted approaches nor considers location within the Watershed.

D. SUB-WATERSHED BASIS

A preferred strategy for implementation would be to focus on strategies within sub-watersheds. Targeted multi-faceted improvements can have significant impact on water quality improvement. This strategy has the benefit of providing "holistic" approach to implementation and satisfies requirements for various funding sources.

The identified pollution control opportunities have been sorted and ranked within each sub-watershed and are included in Tables 7, 8, 11, 12, 14, 15, 17, and 18. Rankings of WMWQ opportunities are provided as well as rankings of upland restoration opportunities. A ranking between the two types was not performed.

As part of the sub-watershed basis strategy, a second level of prioritization is ranking/prioritizing the sub-watersheds for implementation. Based on the existing impairments, projected land use, and identified opportunities, the Wagamons Pond sub-watershed was identified as the best sub-watershed to initiate sub-watershed focused activities. The greatest gains in pollution control meeting the goals of the stakeholders appear to be possible for this sub-watershed.

E. RECOMMENDATIONS

Several strategies for implementation have been presented. Each has merits depending on specific goals and sources of funding.

Watershed implementation strategies can be based on a variety of approaches depending on sources of impairments, land uses, funding availability, schedules, regulatory mandates and local objectives/values. Given the varied users and uses of the Implementation Plan, several strategies that would appear to meet the objectives for the Broadkill River Watershed are recommended. In general, strategies are suggested based on watershed wide criteria, sub-watersheds, and technologies.

It is recommended that the sub-watershed approach be the preferred implementation strategy. Further, it is recommend that the Wagamons Pond sub-watershed be the highest priority sub-watershed. Descriptions of the five recommended highest WMWQ and five recommended highest upland restoration opportunities are also attached as Attachment A. Attachment B includes a map of the Wagamons Pond sub-watershed with each of the opportunities identified. Highest priority opportunities are highlighted

The Baseline Assessment indicated that Wagamons Pond is projected to have the greatest potential urban growth in the future. This is due to the development anticipated in the upper portion of the sub-watershed associated with the City of Georgetown and in the lower portion of the sub-watershed associated with the City of Milton. This growth in urban land use will likely be accompanied by additional impervious cover and possible increase in pollutants entering the Watershed. The highest number (and greatest diversity in geographic location and type) of potential pollution control opportunities were identified for this sub-watershed. Significant preservation corridors for the two (2) main streams in the sub-watershed were also identified. Because of the future stressors this Watershed may experience, prioritization for implementing the identified opportunities for Wagamons Pond is recommended for consideration in the Implementation Strategy. The majority of upland and all of the WMWQ sites can be found on Attachment B. (Due to GIS scale, additional upland sites can be found in Figures 7, 9, 11, and 13.)

Prime Hook Creek and Round Pole Bridge sub-watersheds do not contain urban centers. Additionally, these sub-watersheds have limited although potentially beneficial WMWQ improvement projects. The highest initial priority for these two (2) sub-watersheds appears to be the preservation opportunities identified within these sub-watersheds.

Red Mill Creek sub-watershed is also projected for significant growth. Several WMWQ opportunities in and around the City of Lewes were identified (low end of the Watershed). There are no high ranking WMWQ sites in the headwaters where significant gains can be accomplished. Continued efforts for preservation and high priority (high return) upland retrofits are recommended for this sub-watershed, in and around, the City of Lewes.

Although the sub-watershed strategy is the recommended priority approach, it is also recommended to implement other high priority opportunities in other sub-watersheds as funding becomes available and willing land owners are identified. It is also recommended that specific high priority sites for preservation in each of the sub-watersheds be identified and subsequently evaluated for potential preservation/conservation opportunities.

VII. COSTS AND SCHEDULES

In developing a strategy and prioritization for implementing the plan within the Watershed, a projection of costs and schedule can be beneficial. For the Watershed, opportunities were identified in several categories (upland restoration, WMWQ, preservation/conservation, education/outreach, and comprehensive planning/regulations). In addition, the plan has been prepared to permit stakeholders to implement the strategy based on watershed wide, sub-watershed, technology, etc. bases. Given this approach to the plan, costs and schedules are difficult to prepare.

However, estimated planning level costs have been provided for the priority upland restoration sites and typical upland restoration technologies. These are detailed in the Pollution Control Opportunities Technical Memorandum. Costs for the WMWQ opportunities could not be generated since the amount of land available at a site, the diversity of approaches available on site and the amount of area needed in that location had not been determined. Similarly, costs for preservation efforts could not be projected since specific sites were not identified (only corridors), mechanisms for preservation (acquisition versus restriction/easement, etc.) have not been identified, and the range in land values within the Watershed.

VIII. BROADKILL RIVER MONITORING PLAN

Monitoring plans help determine the effectiveness of watershed projects which aim to improve TMDLs and water quality overall. As a result, it is important to institute tracking and monitoring systems to measure improvements in sub-watershed indicators over time. These systems include the internal tracking of the delivery of restoration projects in a sub-watershed, as well as monitoring of stream indicators at sentinel monitoring stations. Performance monitoring of individual restoration projects can be tracked to improve the design of future restoration practices. Information gathered from a tracking system is then used to revise or improve the restoration plan over a multi-year cycle.

The Watershed may experience significant change in land use if built out projections identified in the Baseline Assessment become reality. Monitoring plans for water quality improvement should take in to account the possibility of build out and the associated impacts. As a result, the following monitoring approaches are recommended:

A. PROJECT MONITORING (PERFORMANCE MONITORING)

Small scale (reach or smaller) project monitoring can be conducted to illustrate benefits of individual restoration efforts. Communities may want to invest in both in-stream and non-stream monitoring of individual restoration projects to assist in measuring project success. Such monitoring can be relatively simple (observing the success of a reforestation project or measuring public awareness through surveys) or extremely complex and expensive (measuring the pollutant reduction of a storm water retrofit or the biological response to a comprehensive stream restoration project). Restoration practices are often experimental or implemented as demonstration projects, which sometimes makes it difficult to show improvement in overall water quality or watershed indicators.

On an annual basis, information derived from the baseline and project monitoring should be complied into a report. This is something the TAT could possibly accomplish. The annual report should summarize current biological and physical conditions (if available) in the watershed; the number, type, and extent of projects taken; and the success to date of the plan in improving watershed conditions. The

project reporting should then be compared to the yearly water quality data to determine if the projects are having an impact on water quality. Reporting on an annual basis will allow for possible corrections and adjustments to be made to the Implementation plan or proposed recommendations based on the monitoring data.

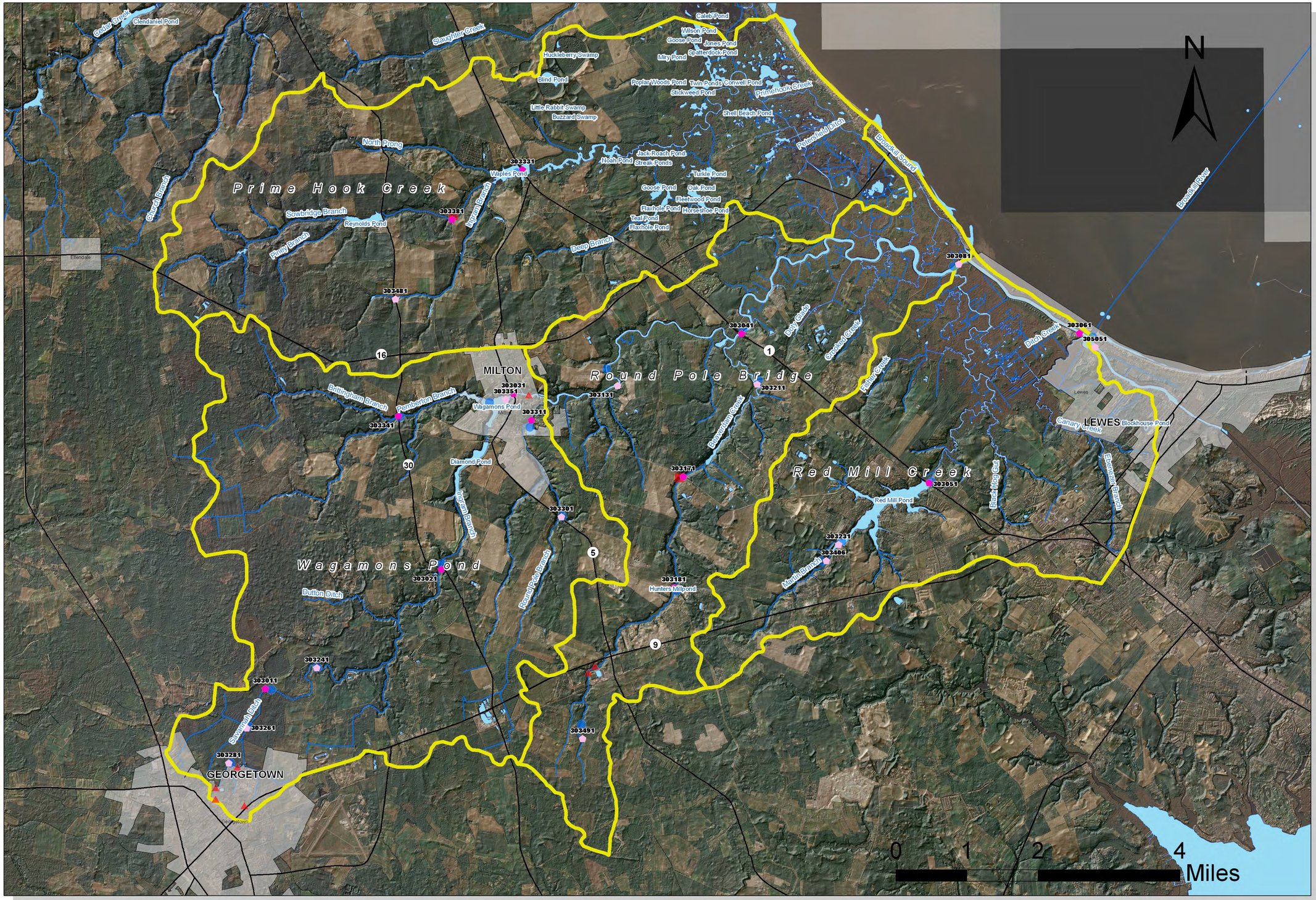
Consider integrating this effort with DNREC's Delaware Environmental Navigator (DEN) system which allows users to explore the many types of information collected by DNREC such as permitted facilities, enforcement actions and environmental monitoring.

B. SENTINEL STATIONS

Sentinel monitoring stations are fixed, long-term monitoring stations which are established to measure trends in key indicators over many years. DNREC's Water Quality Monitoring stations (GAMN) contain the history of data necessary to detect trends in water quality that would be beneficial to determine project success in removing targeted pollutants. Figure 15 provides a map of existing monitoring stations with the Watershed. These are the stations which TMDL data was calibrated. It is understood that data is currently being taken from the sites indicated, and that at a future time, depending on funding, the remaining sites may be monitored again. Other stations shown that could be utilized for future monitoring are STORET, USGS, and NPDES stations. A list of existing GAMN stations can be found in Table 22.

If future funding allows, it is recommended to establish automated sampling at the GAMN station locations. This would allow for data continuity and ease of collection. In addition, if additional point sources are discovered or added, downstream sampling sites should be added.

Because the GAMN data has been used to develop the TMDL models, continued monitoring and reporting is important to determine if implemented projects are affecting the water quality.



1. THIS MAP IS PART OF A REPORT TITLED "BROADKILL RIVER WATERSHED IMPLEMENTATION PLAN" PREPARED BY DUFFIELD ASSOCIATES, INC. AND AS SUCH SHOULD ONLY BE VIEWED IN THE CONTEXT OF THAT REPORT.
2. THE HYDROGRAPHY MAP WAS CONSTRUCTED USING THE USGS NATIONAL HYDROGRAPHY DATASET DIGITALLY AVAILABLE AT HTTP://NHD.USGS.GOV.
3. MONITORING LOCATIONS WERE PUBLICLY AVAILABLE VIA THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY.

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Legend

- Sub-watershed Boundary
- Municipal Boundaries
- Water Features
- Rivers and Streams

Monitoring Locations

Type

- NPDES
- Storet
- USGS - Inactive
- Active GAMN Site
- Inactive GAMN Site

- Major Roads

SOURCE:
2006 NAIP AERIAL DRAPPED OVER USGS/DGS 2-METER BARE-EARTH DEM

DRAWN BY:
MPN

CHECKED BY:
JME

FILE:
3362WC_Broadkill_Implementation_Fig15.mxd

BROADKILL RIVER WATERSHED

EXISTING MONITORING LOCATIONS

SUSSEX COUNTY~ DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO:
3362.WC

SHEET:
FIGURE 15

TABLE 22. BROADKILL RIVER WATERSHED GENERAL ASSESSMENT MONITORING NETWORK (GAMN) STATIONS

SITE ID	EASTING	NORTHING	LOCATION	Active*
303011	203562	79740	Ingram Branch, Savanah Ditch at Rd. 246	Y
303021	207548	82444	Ingram Branch at Rd. 248	Y
303031	209181	86420	Rt. 5 Bridge	Y
303041	214344	87783	Rt. 1 Bridge (Mainstem)	Y
303051	218591	84401	Red Mill Pond at Rt. 1	Y
303061	221996	87790	0.10 Miles From Mouth	Y
303081	219261	89353	2.14 Miles From Mouth	
303131	211538	86605	11.5 Miles From Mouth	
303171	213025	84544	Beaverdam Creek at Rd. 88	Y
303181	212808	82030	Beaverdam Creek above Rd. 259, Hunters M	Y
303211	214693	86639	Beaverdam Creek at Road 257 Bridge	
303231	216542	83005	Trib. to Red mill Pond at Rd. 261	
303241	204727	80214	Ingram Branch at Road 319	
303261	203140	78845	Savannah Ditch S of Rd 245 & 246 Int	
303281	202734	78051	Savannah Ditch 0.5 N Of Townsend Ef	
303301	210261	83630	Round Pole Branch at De Rt 5	
303311	209582	85823	Round Pole Branch at Rd. 88	Y
303321	212816	82023	Beaver Dam Creek at Rd. 259	
303331	209383	91497	Waples Pond at Rt. 1	
303341	206571	85916	Pemberton Branch at Rt. 30 above Wagamon	Y
303351	209002	86289	Wagamons Pond Outlet at County Rd. 250	
303381	207782	90367	Sowbridge Branch at Rd. 212, Waples Pond	Y
303406	216262	82637	Martin Branch, Upstream Of Road 261	
303471	209002	86297	Wagamons Pond Spillway	
303481	206508	88564	Ingrams Branch at Rt. 30 above Waples Po	
303491	210743	78602	Beaverdam Creek at Rd. 293	
305051	222348	87478	Lewes And Rehoboth Canal at Canal Mouth	

*Sites actively monitored as of November 2008

C. ILLICIT DISCHARGE MONITORING

Illicit discharge detection and investigation are critical elements of watershed restoration and planning especially when there are obvious indicators of illicit discharges. Illicit discharges are often a significant source of pollution in a watershed that occurs repeatedly in association with specific polluting behaviors. The NPDES stations are areas where illicit discharges can be detected. Additionally, volunteer stream assessments which could be conducted yearly could identify potential illicit discharges.

D. PROJECT TRACKING

Create a routine spreadsheet or GIS system to track project data over time, such as project location, inspection, maintenance and performance. Project tracking data chronicles progress made in sub-watershed implementation, and can isolate management problems to improve the delivery of future restoration projects. Performance standards for each project can be projected, tallied and a running record of reductions in pollutants to demonstrate measurable improvements toward the goals can be accomplished.

E. REASSESSMENT OF WATERSHED STATUS

On a regular basis (every 5-7 years) the Watershed should be reassessed. The reassessment should include a general overview of land use practices and land disturbance, wetlands, and streams to determine the longer term effects of project implementation or Watershed changes. Streams should be monitored where project implementation has occurred for buffer and stream condition (possibly with the rapid bioassessment or the CWP Unified Stream Assessment used in the Baseline Assessment). The reassessment should help refocus the Watershed Plan to keep the implementation and issues current with the existing issues in the future.

IX. REFERENCES

Broadkill Pollution Control Strategy. 2008. Available online. Accessed: July 23, 2008. http://broadkill.ocean.udel.edu/Publications/Broadkill_PCS_Final051208.pdf

Center for Watershed Protection. February 2005. *Manual 10. Urban Subwatershed Restoration Manual Series. Unified Stream Assessment: A User's Manual.* Version 2.0.

DNREC. August 2006. Broadkill River Watershed Proposed TMDLs.

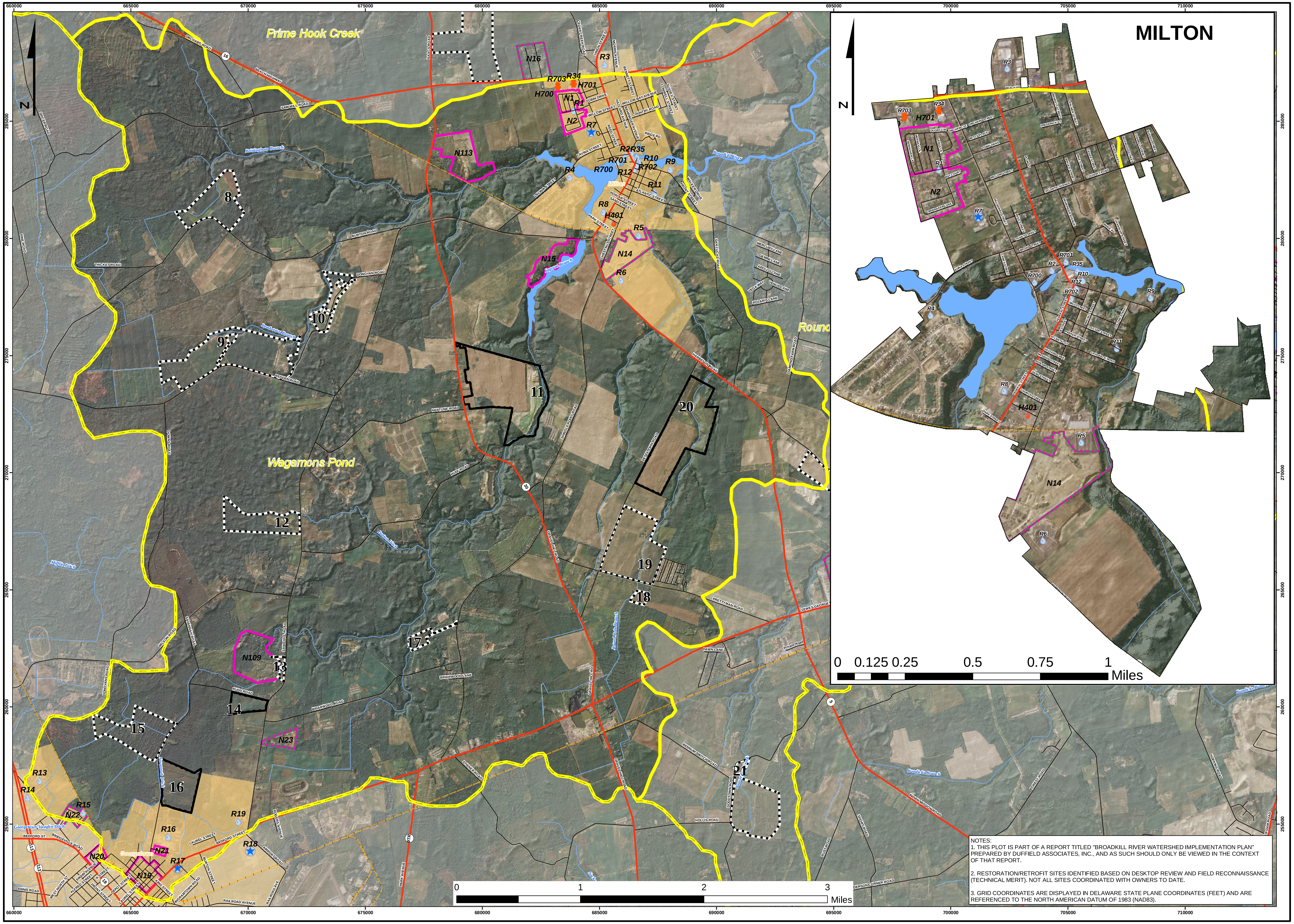
Duffield Associates, Inc. October 2008. *Broadkill River Watershed Baseline Assessment Technical Memorandum.*

Duffield Associates, Inc. October 2008. *Broadkill River Watershed Pollution Control Opportunities Technical Memorandum.*

Gerner, J. and Bowman, J. Land Use Trends Fact Sheet, Watershed Assessment Section, DNREC.

Greer, Randy and Bowman, Jennifer. Broadkill Watershed Urban Stormwater Runoff BMPs. Broadkill Watershed Fact Sheet, Watershed Assessment Section, DNREC.

Volk, Jennifer and Karki, Jyoti. Nitrogen and Phosphorous Loading from Septic System. Broadkill Watershed Fact Sheet, Watershed Assessment Section, DNREC.



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2. RESTORATION/RETROFIT SITES IDENTIFIED BASED ON DESKTOP REVIEW AND FIELD RECONNAISSANCE (TECHNICAL MERIT). NOT ALL SITES COORDINATED WITH OWNERS TO DATE.

3. GRID COORDINATES ARE DISPLAYED IN DELAWARE STATE PLANE COORDINATES (FEET) AND ARE REFERENCED TO THE NORTH AMERICAN DATUM OF 1983 (NAD83).

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Legend

- Municipal Boundary
- Broadkill Watershed Boundary
- Broadkill Subwatershed Boundary
- Water Body
- Stream or River
- Route
- Road
- Railroad
- Retrofit Site
- Recommended Initial Retrofit Site
- Hotspot
- Recommended Initial Hotspot Site
- Neighborhood Site
- Rec. Initial Neighborhood Site
- Potential Restoration Parcel
- Rec. Initial Restoration Parcel

SOURCE:
2006 USDA NAIP AERIAL DRAPED OVER USGS/DGS 2-METER BARE-EARTH DEM

DRAWN BY:
ADK

CHECKED BY:
JME

FILE:
3362WC_Broadkill_Implementation_AttachmentA.mxd

BROADKILL RIVER WATERSHED
319(b) INITIAL PLANNING

Target Subwatershed - Wagamons Pond
Recommended Sites for Initial Retrofit and Restoration Efforts

SUSSEX COUNTY-DELAWARE

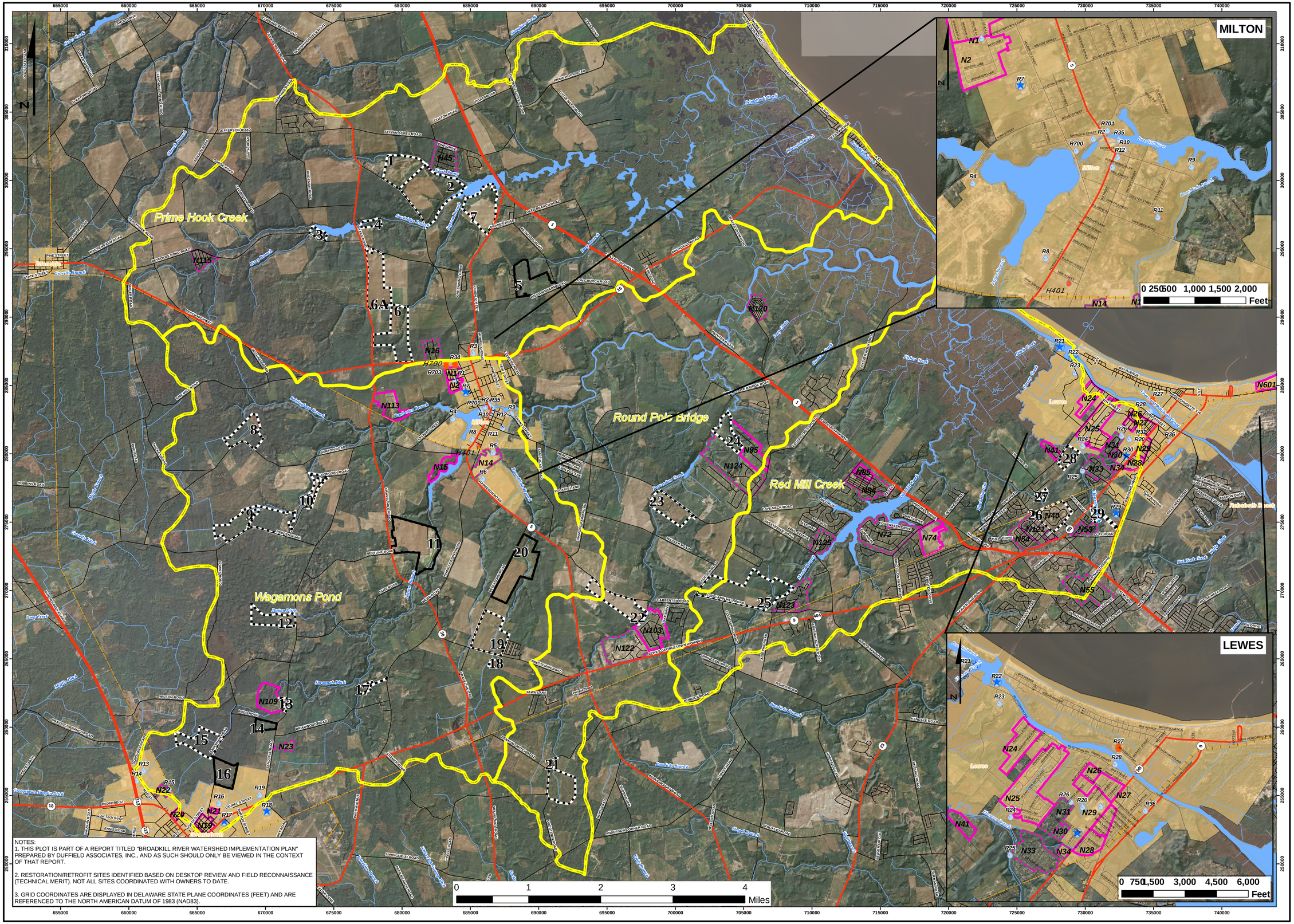
DATE:
SEPTEMBER 2008

SCALE: 1:21,000
1 inch equals 1,750 feet

PROJECT NO.
3362.WC

SHEET:
ATTACHMENT A

PLOT SIZE:
24" x 36"



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- Recommended Initial Retrofit Site
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- Rec. Initial Neighborhood Site
- Potential Restoration Parcel
- Rec. Initial Restoration Parcel

SOURCE:
2006 USDA NAIP AERIAL DRAPED OVER USGS/DGS 2-METER BARE-EARTH DEM

DRAWN BY:
ADK

CHECKED BY:
JME

FILE:
3362WC_Broadkill_Implementation_AttachmentB.mxd

BROADKILL RIVER WATERSHED 319(b) INITIAL PLANNING

Upland Retrofits and Watershed Management Water Quality Opportunities

SUSSEX COUNTY-DELAWARE

DATE:
SEPTEMBER 2008

SCALE: 1:36,000
1 inch equals 3,000 feet

PROJECT NO.
3362.WC

SHEET:
ATTACHMENT B

PLOT SIZE:
24" x 36"

RECOMMENDED SITES FOR 319 FUNDED PROJECTS

Site Designation: 5
Owner: Betts, Clyde & Son Inc.
Parcel #: 2-35-007.00-0161.00
Acreage: 130.39
Waterway: Deep Branch
Summary: This site is located north-northeast of Milton, east of State Route 30 off of Williams Farm Road. This site is located immediately east of a small residential community. It is an active agricultural property bisected by the upper portion of Deep Branch. Deep Branch predominantly receives agricultural run-off. The site is relatively flat and much of it could be converted to wetlands for water quality by the construction of a low berm and capturing storm flows from Deep Branch. Infiltration and buffering opportunities may also be available.

RECOMMENDED SITES FOR 319 FUNDED PROJECTS

Site Designation: 11
Owner: T.A. & P.H.M.A. Hastings
Parcel #: 2-35-025.00-0011.00
Acreage: 197.95
Waterway: Ingram Branch
Summary: This site is located south-southwest of Milton between State Route 30 and Shingle Point Road. This site has been historically used as a large barrow pit. It is located parallel to Ingram Branch and offers numerous project opportunities, including: stormwater storage, wetland creation, preservation, and/or reforestation (buffering). It is located upgradient of Milton and could offer improvements prior to entering highly developed areas. This site also has potential for long-term benefits associated with fisheries/wildlife management and recreation. It's hydrology and physical configuration suggests high water quality return for investment.

RECOMMENDED SITES FOR 319 FUNDED PROJECTS

Site Designation: 14
Owner: Brittingham, Donald & Thelma
Parcel #: 1-35-010.00-0053.00
Acreage: 25.34
Waterway: Savannah Ditch
Summary: This site is located north of Georgetown southeast of the intersection of Sand Hill Road and Rudd Road. The site would capture stormwater from northeastern Georgetown. This area has flooding issues during significant storm events. Recently, the drainage pipe underneath Rudd Road was replaced with a larger pipe and road side ditches were cleaned out. This site could provide water quality improvements through the creation of wetlands, increased buffers, infiltration, and/or flood control. It is located adjacent to State-managed forestland.

RECOMMENDED SITES FOR 319 FUNDED PROJECTS

Site Designation: 16
Owner: Melvin L. Joseph Trustees
Parcel #: 1-35-015.00-0008.00
Acreage: 66.84
Waterway: Savannah Ditch
Summary: This site is located north of City of Georgetown limits, east of Savannah Ditch Road. The site is located on the periphery of a cluster of State Forest Land. This site has exceptional potential for flood control, wetland creation, and land preservation. Its location and topography allows for relatively simple access to surface hydrology. An additional benefit to the site is that it is located immediately downstream of Georgetown and could address nutrient loading entering the watershed from the Georgetown area and help address anticipated stormwater volume pressures for the growing area.

RECOMMENDED SITES FOR 319 FUNDED PROJECTS

Site Designation: 20
Owner: The Farm Is., Inc., P. Bonk
Parcel #: 2-35-025.00-0056.00
Acreage: 179.09
Waterway: Round Pole Branch
Summary: This site is located south of Milton, west of State Route 5 and east of Pettyjohn Road. The site appears to have historically been used as a barrow pit. It is surrounded by agriculture. The drainage entering Round Pole Branch is primarily agriculture. The site offers water quality benefit potential in the form of flood control, wetland creation, buffers, preservation, and possibly infiltration.