Nassau County
Stormwater Management Program

KENTUCK BROOK SUBWATERSHED
Stormwater Runoff Impact Analysis AND CANDIDATE SITE ASSESSMENT REPORT

FINAL – October 1, 2007

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Nassau County
Stormwater Management Program

Kentuck Brook Subwatershed
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1. INTRODUCTION

The Kentuck Brook Stormwater Runoff Impact Analysis (Analysis Report) has been prepared in accordance with the Nassau County Stormwater Management Program *Stormwater Runoff Impact Analysis Procedures Manual* (Procedures Manual). The Procedure Manual provides a methodology to assess and score all of the subwatersheds in the County in accordance with a standardized procedure. The Analysis Report contains a summary of all of the assessment data collected and developed regarding the subwatershed condition and also identifies potential water quality improvements.

The goals and objectives of the Stormwater Runoff Impact Analysis are to:

- Assess the condition of the existing subwatershed;
- Map the drainage infrastructure;
- Identify pollutants of concern; and
- Develop candidate projects and sites for mitigation of pollutant loading and improvement of water quality within the stream to the greatest extent possible.

The Analysis Report is organized into two main sections as follows:

- Subwatershed assessment; and
- Stormwater management practice (SMP) candidate site assessment and recommendations.

The subwatershed assessment section describes the drainage infrastructure mapping, vulnerability analysis and stream assessment which were conducted in accordance with the methodology outlined in the Procedure Manual. The SMP candidate site assessment and recommendations section analyzes the collected data and identifies potential locations to site SMP's and also provides an analysis of potential pollutant load reduction and water quality improvement.

The data developed in this report can be entered into a comparative analysis sheet that will allow the County to track existing conditions and anticipated improvements for each subwatershed in the County.

2. SUBWATERSHED ASSESSMENT

The Center for Watershed Protection (CWP) classifies watersheds into five watershed management units. These include catchment area, subwatershed, watershed, subbasin, and basin. According to the CWP, the subwatershed-scale is preferred for assessment studies and is therefore the scale is used for this analysis. The drainage basins for water in Nassau County are the South Shore Estuary on the south shore and the Long Island Sound on the north shore. Nassau County has defined the watersheds based on the bay or inlet to which tributaries drain. The Oyster Bay Harbor/Mill Neck Creek watershed is located between Locust Valley and Oyster Bay Cove on the north shore. Subwatersheds are the tributaries that drain to the watersheds. For Oyster Bay Harbor and Mill Neck Creek the tributaries include Tiffany Creek, Whites Creek and Mill River which drain directly into the harbor and Francis Ponds/Beaver Brook, Kentuck Brook and Bailey Arboretum Brook which drain into Mill Neck Creek.

The subwatershed assessment includes review of available subwatershed data including Nassau County Geographic Information System (NCGIS) mapping, other available municipal mapping, Nassau County record documents and other available municipal record documents. After available records were reviewed, the land use data was utilized to estimate existing impervious cover, water quality storm volumes and pollutant loads. The stream assessment was conducted to verify mapping, assess field conditions and examine drainage infrastructure systems. The compiled information was then analyzed to identify locations where stormwater runoff is impacting the stream either via inputs (i.e., outfalls, illicit discharges or lack of buffers) or through effects on the stream corridor (erosion, channelization or stream crossings). This data is used to identify potential candidate site locations for recommended stormwater management practices.

2.1. DRAINAGE INFRASTRUCTURE MAPPING

All sources of potentially available drainage data were reviewed and the information collected on a new layer in the GIS system. Prior to completing the stream assessment, areas where drainage infrastructure appeared to be lacking were noted and highlighted for review in the field. Drainage infrastructure data collected during the stream assessment was added to the drainage infrastructure maps.

2.1.1. MAP DEVELOPMENT

The Nassau County Geographic Information System (NCGIS) files for the subwatershed were requested and received from the Nassau County Department of Information Technology. The NCGIS data served as the base map on which newly identified information could be added.

At the offices of the NCDPW Engineering Department, a list of drainage maps for road projects and subdivision developments within the subject subwatershed was compiled from the County drainage books (a series of three sets of documents). A Freedom of Information Law (FOIL) request including the list of drainage maps necessary for the subject infrastructure review was prepared. Table 2-1 shows the list of documents requested via the FOIL. Review of the Nassau County as-built records identified 49 documents that pertained to work conducted in the Kentuck Brook subwatershed. The maps were provided to a printing sub-consultant for scanning into tagged image file (TIFF) formatted documents. The documents were returned to the NCDPW Engineering Department along with a CD copy of the scanned documents. The drainage information from the scanned documents was transferred to a new GIS layer in accordance with Nassau County mapping protocols.

A FOIL request for available record documents for road projects within the subwatershed was made to New York State Department of Transportation. Paper copies of record documents were received. The drainage information that pertained to

the subwatershed was mapped in AutoCAD and transferred to GIS format on the same layer as the scanned data from Nassau County record documents.

The final layer combining the data from all sources is titled "Final GIS Layers" and includes identification of the source of the data in the "Origin" database column. The data identified in the field using GPS is included on the "Final GIS Layers" and is identified as "Cashin Associates GPS".

2.1.2. FIELD DATA COLLECTION

Using the mapping developed in Section 2.1.1, areas with incomplete drainage mapping were identified. A field survey of the drainage infrastructure in those locations was conducted. This task was performed in conjunction with the Stream Assessment described in Section 2.3. During the assessment, the stream corridor was walked to verify the mapped outfalls and to identify other locations where storm runoff appeared to be directly entering the stream. The drainage infrastructure upstream of each outfall was then field verified to identify the extent of the drainage infrastructure contributing to each outfall. The drainage infrastructure of the Kentuck Brook subwatershed is shown on Map 2-1.

2.2. SUBWATERSHED VULNERABILITY ANALYSIS

The Subwatershed Vulnerability Analysis consists of three components as follows:

- subwatershed characterization;
- impervious cover assessment; and
- pollutant load analysis.

The subwatershed characterization includes a description of the subwatershed's size, land uses, boundary, and length of waterbody. The impervious cover assessment calculates the amount of impervious area in the subwatershed based on: 1) NCGIS data for parking lots, roads, building footprints; and 2) area calculations for sidewalks and driveways. The

pollutant load calculation uses NCGIS data for land use in conjunction with standard coefficients for runoff pollutant levels, resulting in an estimate of pollutant loads for the subwatershed.

2.2.1. SUBWATERSHED CHARACTERIZATION

The Kentuck Brook subwatershed is located within the Town of Oyster Bay in the northern portion of Nassau County. Presently, Kentuck Brook is categorized as freshwater. The brook receives stormwater runoff from street gutters and underground piping from areas upgradient to and surrounding the brook. Kentuck Brook discharges into the southwest corner of Beaver Lake, which is located at the northern end of the Francis Pond subwatershed.

The geographic limits of the Kentuck Brook subwatershed were defined through review of topographic maps, plans of existing municipal drainage infrastructure, and field assessment. Map 2-2 shows subwatershed topography along with existing drainage infrastructure.

The Kentuck Brook subwatershed encompasses approximately 1,516 acres that potentially contribute runoff that could eventually reach Kentuck Brook. See Section 3 for a description of self-contained areas that no longer contribute water quality volume runoff to Kentuck Brook. The Kentuck Brook subwatershed is located from south of Ryefield Road south and from Oyster Bay Road at Ayers Road west to Forest Avenue at the Nassau County Country Club. Land use in the subwatershed is 58% residential. Other land uses include parks, recreational, open space and municipal uses such as public service and community service. The remaining land uses include limited areas of roadways, industrial and commercial land uses. Of the 1,783 residences in the subwatershed, 1,106 or 62% are one-quarter acre or smaller and are concentrated toward the northern and southwestern portions of the subwatershed.

2.2.2. IMPERVIOUS COVER ASSESSMENT

Percentage of impervious cover has been determined to be an indicator of subwatershed health. Lower percentages of impervious cover in a subwatershed generally indicate that water quality is less impacted by pollutants than in subwatersheds with higher impervious cover percentages. The Center for Watershed Protection (CWP) has established subwatershed classification based on percentage of impervious cover ranging from sensitive streams (0-10% impervious) to urban drainage stream (>60% impervious). The impervious cover assessment uses methodology included in the NC Procedures Manual. The methodology is based on CWP procedures that use GIS data to estimate impervious cover. The impervious cover within the subwatershed was calculated from the NCGIS data and standardized tables developed by the CWP. The NCGIS data necessary to calculate impervious cover is presented in Table 2-2 GIS Data Chart.

The following sources or methods were used to calculate the impervious cover in the Kentuck Brook subwatershed:

- NCGIS data allowed the actual footprint of all building areas and parking lot areas within each land use to be calculated.
- Area of roads was calculated from the NCGIS data.
- Total average driveway area was estimated by tallying the number of residences in each of five size categories, ranging from less than 1/8 acre to greater than one acre and applying impervious driveway factors from CWP as developed by Cappiella and Brown , 2001.
- Sidewalks were estimated by viewing aerial photography of the site and estimating the percentage of the subwatershed roads with sidewalks. In the case of Kentuck Brook, 40% of the streets are estimated to have 4’ wide sidewalks on both sides.

The impervious cover data was entered into the standard table from the Procedures Manual. The data table and results of calculations are shown on Table 2-3. The impervious area of the Kentuck Brook subwatershed is 229 acres of the 1,516 total subwatershed acres. This represents 15% of the subwatershed. Based on the 15% impervious figure, Kentuck Brook receives a subwatershed classification of impacted stream.

Impacted streams possess subwatershed impervious cover ranging from >10% to 25% and have clear signs of degradation due to urbanization within the subwatershed. The streams exhibit changes to their hydrology with increased runoff and more frequent overbank flooding. Elevated storm flows begin to alter stream geometry and both erosion and channel widening are clearly evident. Streams banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with most sensitive fish and aquatic insects disappearing from the stream. Impacted streams often have good stream repair potential due to moderate degradation, intact stream corridor and available land to install upgradient restoration practices. The main goals for impacted subwatershed management in Kentuck Brook's case are to limit the degradation of the stream habitat and maintain the biological community.

2.2.3. STORM POLLUTANT LOAD CALCULATION

Nassau County has identified a number of pollutants associated with stormwater runoff to be of concern for the County's subwatersheds. Impervious surfaces act as a "trap and conveyance" mechanism for the pollutants, ultimately resulting in deposition of the pollutants into nearby waterbodies. These pollutants negatively affect the surface water quality. The pollutants identified by the County are carried in large quantities in storm runoff from roads and paved surfaces.

Total Suspended Solids – Total Suspended Solids (TSS), which includes silts and sediments, constitute the largest mass of pollutant loadings to surface waters. This pollutant is exported in greatest quantities from construction sites. In addition, TSS is generated from lands with insufficient vegetative cover, stream channel erosion, street sanding operations, and vehicle tires. NYSDEC has identified TSS as a pollutant of concern for New York State waters and requires that 80% of TSS be removed from runoff from new construction. The subwatershed's road systems and small, older lots contribute to TSS in Kentuck Brook.

Phosphorus and Nitrogen – Total Phosphorus (TP) and Total Nitrogen (TN) are two nutrients necessary for plant growth. Nonpoint sources of TP and TN are recognized causes of water quality degradation in many water bodies. These nutrients, washed into waterbodies via stormwater runoff, typically originate in lawn fertilizers and animal wastes from pets, waterfowl, small mammals and livestock. NYSDEC has identified TP as a pollutant of concern for New York State waters and requires that 40% of TP be removed from runoff from new construction. Residences with small yards that drain to the street and properties with lawns that extend to the brook and/or ponds contribute TP and TN to Kentuck Brook.

Fecal Coliform and Other Pathogens – Pathogens include bacteria, viruses and other microorganisms that can cause human illnesses such as hepatitis A. The suspected causes of this impairment originate in the feces of pets, livestock and waterfowl that are carried into waterbodies by stormwater runoff. Pet and waterfowl wastes may contribute to fecal coliform levels in Kentuck Brook.

Hydrocarbons (Oils and Grease, Petroleum Compounds) – Oils and grease contain an array of hydrocarbon compounds, some of which can be toxic to aquatic life even at low concentrations. The major source of hydrocarbons in urban runoff is through the leakage of crankcase oil and other lubricating agents from motor vehicles and from

facilities that service motor vehicles (e.g., repair shops and gasoline stations). Hydrocarbon concentrations are typically highest in runoff from parking lots, roadways, and service stations. Residential and roadway land uses are the main contributors of hydrocarbons within the Kentuck Brook subwatershed. Illegal disposal of waste oil onto streets and into storm sewers can also contribute to this problem.

Floatable Debris – Besides the obvious negative aesthetic effects, trash can impact aquatic life through either ingestion or entanglement. The areas of concentrated residential land use in Kentuck Brook may contribute to the levels of floatable debris and trash that accumulates in the stream.

The pollutant loads were calculated in accordance with the Nassau County Procedures Manual using the "Simple Method" for all pollutants with the exception of Floatable Debris. The Simple Method uses the land uses and CWP pollutant coefficients to calculate the pollutant loads. Land use was separated into the five categories of residential, commercial, industrial, roads and other. Pollutant load coefficients were assigned based on the land use. The "other" category includes parks, municipal properties and any other uses not included in the categories mentioned. Existing land uses within the subwatershed are presented on Map 2-4. The NCGIS land use data necessary to calculate pollutant loads is presented in Table 2-2 GIS Data Chart. For floatable debris, coefficients based on land use were developed for the categories of residential, commercial, industrial, roads and other. The coefficients are applied to each land use area to estimate floatable debris generation with the subwatershed.

The data was entered into the Water Quality Volume and Pollutant Load Calculation Table provided in the Procedures Manual. The resulting pollutant loads are shown on Table 2-4. The pollutant loads for each pollutant were assigned severity points based on the least, 1 point, to the most, 6 points, severe pollutant threat in the watershed. The pollutant loads are multiplied by the assigned severity points and the total is divided

by 100 and entered into the pollutant severity score row on the Comparative Analysis Table. The pollutant loads are also used to assess potential SMP improvements to each individual subwatershed.

2.3. STREAM ASSESSMENT

The stream assessment was conducted in accordance with the NC Procedures Manual. In addition, the CWP *Unified Stream Assessment: A User's Manual* was reviewed prior to the field effort. The assessment was conducted during the winter months when the lack of vegetation improved access to and provided visibility of the outfalls and stream corridor condition. Kentuck Brook was assessed by traveling upstream from the mouth of the river at Beaver Lake. On the data sheets, the banks are described as left (west) and right (east) looking downstream.

The stream assessment for Kentuck Brook was conducted on January 9, 2007. The equipment used by survey personnel to conduct the assessment included data assessment sheets, GPS unit, dry erase board and markers, digital camera, clipboard with a water resistant storage compartment, tape measure and waders. For this subwatershed, aerial photos and property line maps were used to record field data. In the event that property owners had concerns regarding the work, the survey team carried a contact list of the governing authority to provide to the residents. Each stream assessed was assigned an identification number starting with 100. Kentuck Brook was the fifth stream assessed by this methodology and was assigned identification number 104.

During the stream assessment, the stream corridor was photographed at regular intervals and at specific locations. The interval photographs record the stream surroundings and any immediately identified points of interest. When a data assessment sheet was completed, a photograph of the specific location was taken. For each Outfall (OT) sheet, photographs were taken from three different directions. When the location to be photographed was accessible, a dry erase board was labeled with the RCH and OT #'s and sited to appear

within the photograph. All photographs were immediately logged on the Photo Log sheet. The photographic log and photographs are included in Appendix B.

The data sheets were completed in either the field at each location or, when field conditions did not allow the immediate completion, immediately after returning from the field. Data Sheets are included in Appendix A. The data sheets are organized by reach in number order. In each reach section, the reach data sheets (RCH) are first followed by the outfall data sheets (OT), then the other data sheets.

When it was necessary to cross private property to reach the stream corridor, the assessment team would explain the purpose of the assessment and ask the property owner for permission to cross the property.

Reach boundaries were determined during the field assessment. The reach limits are selected based on one or more of the following criteria: change in surrounding land use; change in stream conditions; or a dividing characteristic such as a stream crossing or long culvert. Kentuck Brook was assigned one reach based on the stream's consistent surroundings and conditions.

The following paragraphs are a summary of the data collected on the assessment sheets. Kentuck Brook, located at the northeastern end of the subwatershed, is less than a mile long. Kentuck Brook flows northeast into Beaver Lake. The creek is dominated by a natural stream with some stormwater runoff from the upgradient drainage infrastructure and nearby railroad tracks. The stream also appears to enter a wetland area toward the mouth of the stream along Beaver Lake.

RCH 104-1, which encompasses all of Kentuck Brook, was assessed as having 10 outfalls. Several of the outfalls are 4" – 6" PVC pipe from residential properties. The areas of the outfalls were stable and vegetated and the outfalls are not considered to contribute

excessive pollutant loads. The assessment identifies some of outfalls (OT-1, OT-2, OT-3, OT-4, OT-5 and OT-7) as potential areas of concern.

Outfall OT-1 is a swale located on Kaintuck Lane that carries runoff from the road to the brook. The existing swale is steeply sloped, is covered with decaying leaves and organic matter and erosion is not evident. The brook and the drainage swale are located on private residential property.

OT-2 and OT-3 are located on the south side of the railroad embankment just south of Valley Avenue. The upgradient drainage area for these outfalls could not be verified by the stream assessment methodology and may require additional investigation to verify the drainage area. Based on a review of the existing conditions, it is suspected that the drainage area for these outfalls is the high-density residential neighborhood located north of the railroad tracks including Valley Avenue and Maple Avenue, as no recharge basins and limited drainage structures were identified.

OT-4 and OT-5 are located under Oyster Bay Road where it crosses Kentuck Brook. These outfalls carry runoff from Oyster Bay Road to the brook. Determination of the actual drainage area of these outfalls requires additional research. Based on a review of the surface elevations, it appears that the limits of the road drainage area could extend from Kaintuck Lane west to Town Cocks Lane.

OT-7, located on the north side of Oyster Bay Road across from Brook Row, is identified as an 18-inch concrete pipe that discharges to a swale that connects directly into the brook. The pipe carries road runoff from Oyster Bay Road and also has excessive orange staining. The existing swale has a narrow, slightly eroded bottom with vegetated side slopes.

Other areas of concern identified include an eroding weir/dam and a 4-inch metal pipe extending 12 inches vertically from the stream bed (MI-1). Both sites are located at the northeast end of the pond on the north side of the railroad tracks toward the end of Kaintuck Lane. The weir/dam retains a large pond on its west side and flows into the stream on its east side. It is approximately 6 feet high and is severely eroded on all sides. The 4-inch metal pipe (MI-1) was identified as having a moderate flow and excessive algae growth and is located to the east of the weir/dam. Further investigation is necessary at both sites. The overall stream condition was assessed as being within the optimal range due to its ideal in-stream habitat and vegetative protection. The overall buffer and floodplain condition was assessed as being within the suboptimal to optimal range due to some buffer and floodplain encroachment from man-made structures.

Table 2-5 Subwatershed Comparative Analysis tabulates the information collected during the field assessment, along with the impervious cover results and pollutant severity score to produce a subwatershed total score. While the subwatershed total score can be subjective due to the many additional factors involved in assessing the subwatershed condition and the feasibility of SMP's, the general subwatershed score categories are as follows:

- 0-15 Optimal/Sensitive
- 16-30 Suboptimal/Impacted
- 31-45 Marginal/Non-supporting
- 46+ Poor/Urban

Kentuck Brook was scored a five placing this brook in the optimal/sensitive category. Optimal/sensitive brooks are estimated to have low levels of impervious cover and pollutant loads. The subwatershed score can also be used to assess the conditions of a specific subwatershed in relation to other subwatersheds in the County or other jurisdiction. For example a watershed with a score of 48 would be identified as poor/urban

and would face greater impacts that a watershed with a score of 11. However, even watersheds with low score may have segments that can be improved by specific stormwater management practices.

The optimal/sensitive rank appears to match the existing conditions found in the Kentuck Brook subwatershed. The Kentuck Brook subwatershed is in optimal condition for most of the subwatershed but at the lower limit there are limited areas of buffer and floodplain encroachment and several outfalls that contribute road runoff to the brook. It also appears that there are opportunities to implement SMP's that will further reduce pollutant impacts to Kentuck Brook.

3. SMP CANDIDATE SITE ASSESSMENT AND RECOMMENDATIONS

3.1. WATER QUALITY CLASSIFICATIONS/DESIGNATED USES

Table 3.1 summarizes the NYSDEC general water quality classifications in terms of their best usage. The watersheds that were analyzed for this report include the freshwater sections of the creek tributaries which fall within the Class 'C" waters.

Table 3.1 NYSDEC Water Quality Classifications (6 NYCRR Part 885 and Part 701)**.**

Waterbody	Water Classification	Best Usage
River /Creek - freshwater	C	The best usage of Class C waters is fishing. These waters shall be suitable for fish propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes. (TS) – Designated waters are suitable for trout spawning and the dissolved oxygen specification for trout spawning waters shall apply.
River/Creek - tidal	SC	The best usage of Class SC waters is fishing. These waters shall be suitable for fish propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.
Oyster Bay Harbor/Mill Neck Creek	SA	The best usages of Class SA waters are shell fishing for market purposes, primary and secondary contact recreation and fishing. These waters shall be suitable for fish propagation and survival.

The NYSDEC has designated Oyster Bay Harbor and Mill Neck Creek and their tidal tributaries priority waterbodies with known aquatic life impairment. A priority waterbody is a waterbody determined by NYSDEC staff, with public input, having uses precluded, impaired, stressed or threatened and, in some cases, requiring establishment of a TMDL. The causes of the impairments have been identified as pathogens from urban/storm runoff and municipal sources. The western portion of Mill Neck Creek is a NYSDEC uncertified

shellfishing area. The eastern segment is conditionally certified or seasonally certified. Uncertified shellfishing areas are lands where the NYSDEC has prohibited shellfish harvesting for food uses in accordance with NYSDEC regulation 6NYCRR Part 41. Conditionally certified and seasonally certified areas are opened on a limited basis dependent on factors defined by the NYSDEC. Pathogen TMDL's for shellfishing waters in Mill Neck Creek and Oyster Bay Harbor have been completed. There are set target percent reductions for pathogens levels.

Table 3.1 identifies "best usages". The actual usage of the waters is dependent upon the impairments to the quality of the waters. The numerous parameters that commonly characterize water quality include taste, color, suspended solids, oils, refuse, thermal discharges, phosphorus, nitrogen, pathogens and dissolved solids. A common example of this is Class "B" waters that have a best usage for primary recreational contact (swimming) but are closed due to impacts to the water quality as a result of high bacteria levels. Town and County beaches are often closed after a rainfall that causes high bacteria levels in those waters.

Two major water quality parameters for Class "C" waters are dissolved oxygen (DO) and coliform bacteria concentrations. Adequate DO is essential to the growth and reproduction of finfish and shellfish. DO is also important for the natural decomposition of organic wastes. Current public health standards call for low coliform bacteria concentrations as the presence of such bacteria is regarded to be an indication of potentially pathogenic contamination from human or animal wastes. The actual water quality may not be suitable for the best usage based on these water quality parameters.

3.2. SITE ASSESSMENT/SMP SELECTION

The Kentuck Brook subwatershed is dominated by both low-density and high-density residential land use with limited areas of commercial, community and park land uses. The impervious cover assessment for Kentuck Brook determined that the subwatershed is 15% impervious and that Kentuck Brook is an impacted brook with signs of degradation from urbanization. Kentuck Brook has limited locations with buffer encroachment and has extensive vegetative cover. No potential 'hot spots" or illicit discharges were identified in the vicinity of the brook. Hot spots are land uses that are known to have high levels of various materials including oil, grease, auto or marine parts, dumpsters, gas tanks or other hazardous materials. Illicit discharges are locations where storm runoff or unpermitted discharges outfall directly into the brook corridor or into infrastructure that discharges into or will eventually reach the brook.

The area of the subwatershed that actually contributes surface runoff to Kentuck Brook has been reduced by the installation of upgradient recharge basins and other drainage infrastructure that contain the storm runoff volume from roads, subdivision developments, and commercial and industrial sites. When an area contains storm runoff in on-site drainage infrastructure with no overflow, that area is described as self-contained. It appears that numerous recharge basins and areas of drainage infrastructure have been installed at the upper limits of the Kentuck Brook subwatershed. Based on the design and location of the drainage infrastructure, it appears that these facilities, at a minimum, contain the water quality volume and/or have properly designed overflows. These areas can be considered to be self-contained. On Table 3-3, these areas will be subtracted from the overall pollutant loads calculated for Kentuck Brook.

Several areas where surface runoff along the brook corridor drains toward the brook were also identified. These areas have significant wooded buffers and extremely limited

development and no SMP is recommended for these location. Should the land use in these areas be modified, the need for SMP's should be reassessed.

Roads in the areas of low-density residential land use drain into numerous individual drainage structures with some connecting to recharge basins. High-density residential developments in the southwestern and northwestern sections of the subwatershed appear to have infrastructure in place that directs the storm runoff to recharge basins. The main areas of the subwatershed that contribute runoff to Kentuck Brook include the residential area in the northeastern section of the subwatershed and area roads including Oyster Bay Road and adjacent residential roads. The drainage infrastructure and area topography are shown on Map 2-2. In several locations, the field assessment did not provide complete data on the drainage infrastructure systems. Two areas were identified where additional research is required in order to determine the extent of piping infrastructure that discharges to Kentuck Brook. The first area is the drainage infrastructure along Oyster Bay Road and Buckram Road from Kentuck Brook west to approximately Town Cocks Lane. Several pipe connections could not be investigated due to inaccessible covers and/or the pipe being covered with material or water. The second area is the neighborhood north of the railroad tracks which may be connected to outfalls OT-2 and OT-3 and includes the streets surrounding Valley Road and Maple Avenue.

SMP's that can treat pollutants found in runoff from existing roads and high-density residential areas include ponds, infiltration trenches, sand filters, and bioretention basins. Additionally, ultra-urban retrofits can be considered if suitable locations for other SMP's are not available or feasible.

3.3. SMP IMPLEMENTATION CANDIDATE SITES

The Kentuck Brook watershed has several potential parcels that could be used to site SMP's from several of the outfalls identified.

Outfall OT-1 is located on Kaintuck Lane, which may be a private road, where runoff from the road is carried to the brook via a swale that appears to have originally been concreted-lined. The drainage area is 10 acres and is 8% impervious. The existing swale is steeply sloped, is covered with decaying leaves and organic matter and erosion is not evident. The brook and the drainage swale are located on private residential property. Potential SMP options include installation of an infiltration basin or revegetation of the swale. These options require that a right-of-way exist or access is granted by the property owners. A dry swale has been selected for SMP pollutant reduction analysis.

Outfall OT-2 and OT-3 are located on the south side of the railroad tracks and discharge into swales that carry that storm runoff to the brook. The drainage area is 18 acres and is 22% impervious. The outfall appears to be on the railroad embankment on railroad property but flows over private residential property to the brook. The outfalls are not accessible for equipment. The upgradient drainage area for these outfalls could not be verified by the stream assessment methodology and require additional research or investigation to verify the drainage area. Based on a review of the existing conditions, it is suspected that the drainage area for these outfalls is the high-density residential neighborhood located north of the railroad tracks including Valley Avenue and Maple Avenue, having no apparent recharge area and limited drainage structures. As this location would have both roadway and residential pollutant concerns, potential mitigation measures would ideally treat for sediments, oils and greases, nitrogen and phosphorus, and bacteria. Two apparently vacant parcels located on the northeast side of Midway Avenue could offer potential stormwater mitigation if elevations of the existing drainage system and the parcels are compatible. Ultra-urban retrofits, such the installation of catch basin filters through the system or the installation of a water quality inlet or hydrodynamic structure in the inlet prior to outfall can treat some of the pollutant loads from these outfalls. Water quality inlets on each outfall have been selected for SMP pollutant reduction analysis.

Outfalls OT-4 and OT-5 are located under Oyster Bay Road where it crosses Kentuck Brook. The drainage area is 209 acres and is 24% impervious. These outfalls carry runoff from Oyster Bay Road to the brook. Determination of the actual drainage area of these outfalls requires additional research. Based on a review of the surface elevations, it appears that the limits of the road drainage area extend west from Kaintuck Lane to Town Cocks Lane. The property south of Oyster Bay Road is undeveloped. Potential SMP mitigation measures include the installation of a pond or filtering system if a siting location can be identified. If no location can be identified, the installation of ultra-urban retrofit practices, such as catch basin inserts in upgradient structures or construction of water quality inlet or hydrodynamic structure prior to outfall, should be examined. Water quality inlets on each outfall have been selected for SMP pollutant reduction analysis.

Outfall OT-7 is a pipe discharge to a swale along the north side of Oyster Bay Road that discharges into Kentuck Brook. The drainage area is 14 acres and is 15% impervious. The pipe carries road runoff from Oyster Bay Road. The existing swale has a narrow, slightly eroded bottom with vegetated side slopes. The swale can be redesigned with infiltration measures at the pipe outfall and additional filtering capacity by reshaping and revegetating the swale. A wet swale has been selected for SMP pollutant reduction analysis.

Non-structural SMP's that can aid in reducing the pollutants that enter the Kentuck Brook include:

- Increased street sweeping;
- Public education on fertilizer and chemical use and disposal;
- Public education on the importance of buffers between cultivated lawns and waterbodies; and
- Public education on the importance of vegetative cover to prevent soil erosion.

3.4. POLLUTANT LOAD REDUCTION ANALYSIS AND SUBWATERSHED IMPROVEMENTS

To estimate the pollutant load reductions achieved by implementation of the proposed SMP's, the outfall drainage areas that contribute to each identified SMP were estimated and the outfall drainage area pollutant loads were calculated using Tables 3-2 GIS Data, Table 3-2 Impervious Cover Calculations, and Table 3-3 Water Quality Storm Event Volume and Pollutant Load Estimates for each outfall and for the area identified as self-contained. The individual outfall and self-contained tables for each area are included in the rear of this report. Table 3-5 Subwatershed Pollutant Reduction Analysis was completed by inserting the pollutant load total for each pollutant of concern from Table 2-5 and from Table 3-3 for each outfall and the self-contained area in the appropriate columns and rows on Table 3-5.

Based on a review of the topography and drainage infrastructure, it was determined that 963 acres of the 1,516 acre total subwatershed area of Kentuck Brook are now self-contained. These areas include locations where road runoff and subdivision development drainage are directed to recharge basins having connection to Kentuck Brook. The self contained areas account for a significant drop in the anticipated pollutant loads having the potential to reach Kentuck Brook. Approximately 300 acres appear to have limited developed and surface drainage to Kentuck Brook and the associated wetland located southwest and north of the actual brook.

The Candidate Site Assessment identified a total of six outfalls for potential SMP's at four candidate sites. Proposed SMP's include swales and water quality inlets, and the outfall locations include two swales, two pipes and two road grate outfalls. Where outfalls are located in close proximity and carry flow from similar areas, two SMP's are proposed but identified as a single candidate site. For example, the road drainage from the west side of Oyster Bay Road is carried to outfalls OT 4 and OT 5 located in immediate proximity to each other. A similar condition exists with OT 2 and OT 3.

If the proposed swale and water quality inlets are implemented, and perform as anticipated, it is estimated that the pollutants loads from outfall drainage areas of Kentuck Brook can be reduced by the following quantities and percentages:

Pollutant	Load Removal	Percent Removal
Total Nitrogen (TN)	466 lbs	29%
Total Suspended Solids (TSS)	37,123 lbs	77%
Total Phosphorus (TP)	55 lbs	26%
Fecal Coliform (F Coli)	0 billion colonies	0%
Trash (Floatable Debris)	1,021 lbs	36%
Oil & Grease (Hydrocarbons)	1,497 lbs	45%

Siting of SMP's that will reduce fecal coliform levels and additional nitrogen and phosphorus from runoff is limited by the ability to identify land where these SMP's can be located. Generally, these SMP's require longer detention time and, subsequently, larger land areas. If land to site SMP's such as wetlands, infiltration or filtering practices or bioretention basins can be identified, it is recommended that these SMP's be pursued to further reduce pollutant load levels to Mill Neck Creek.

Nassau County Stormwater Management Program
Stormwater Runoff Impact Analysis
NCDPW Engineering Department
Map File List of Requested Plans
Table 2-1

Kentuck Brook (ID No. 104)					
COUNTY FILE # (BROWN / BLACK BOOK)		**OLD COUNTY FILE #** (BLUE BOOK)		**MUNICIPALITY FILE #** (RED BOOK)	
1707-1		60-2		4392-1	
245-13		103-5		4386-4	
286-3		103-7		7207-1	
465-2		493-1		7288-2	
3059-2		1490-2		7263-1	
3195-4		1452-7		1401-4	
1087-7		523-4		83-8	
131-1		237-7		237-71	
238-5		237-10		1414-6	
4384-7		1813-1		7364-1	
1708-1				4082-6	
2044-1				1174-2	
574-8				1478-4	
1534-2				1964-7	
611-3				104-7	
103-2				7210-2	
320-10				7207-4	
317-3				7211-6	
232-2				1495-3	
				103-6	

Nassau County Stormwater Management Program
Stormwater Runoff Impact Analysis
GIS Data
Table 2-2

Name of Subwatershed: Kentuck Brook (ID No. 104)

Tributary to:	**Mill Neck Creek**
Adjacent Land Use:	**Low Density Residential**

Impervious Information

	Area		Building Area		Parking Lot Area		Length of Roads		Number of Residences
Residential	880	Acres	18	Acres					1,783
Commercial	25	Acres	8	Acres	11	Acres			
Industrial	1	Acres	0.5	Acres	0.5	Acres			
Roadway (Pavement)	85	Acres							
Other (Parks, Municipal, (ROW-Pvmt), Etc.)	525	Acres	70	Acres	8	Acres			
Total Subwatershed	1,516	Acres	96	Acres	19	Acres	144,593	LF	

Residential Lots	Quantity in Subwatershed
43561 +	187
21781 - 43560 SF	111
10891 - 21780 SF	379
5446 - 10890 SF	816
0 - 5445 SF	290
Total Number	1,783

Assumed Percentage of Roadway With Sidewalks (%)	40
Sidewalk Width (FT)	4
Assumed Sides of Roadway With Sidewalk	2

*** Source NCGIS Database Dated July 24, 2006**

Nassau County Stormwater Management Program
Stormwater Runoff Impact Analysis
Impervious Cover Calculations
Table 2-3

Impervious Driveway Factors		
Residential Lot Area (AC)	**Average Driveway Area (SF)**	**NC criteria**
2	3,212	1-2+ AC
1	2,073	1/2-1 AC
1/2	1,152	1/4-1/2 AC
1/4	652	1/8 - 1/4 AC
1/8	432	0-1/8 AC
Source : Cappiella and Brown, 2001		
WVA Table 4: Average Driveway Areas in the Chesapeake Bay Region		

Average Residential Driveway Area Calculation				
Subwatershed:	**Kentuck Brook (ID No. 104)**			
Tributary to:	Mill Neck Creek			
Residential > 1 acre - 3212 SF	Units	187	Acres	2
Residential > 1/2 acre to ≤ 1 acre - 2,073 SF	Units	111	Acres	1
Residential > 1/4 acre to ≤ 1/2 acre - 1,152 SF	Units	379	Acres	4
Residential > 1/8 acre to ≤ 1/4 acre - 652 SF	Units	816	Acres	8
Residential ≤ 1/8 acre - 432 SF	Units	290	Acres	3
Total Acres Driveways Impervious	Units	1,783	Acres	18

Sidewalk Area Calculation	
Subwatershed:	**Kentuck Brook (ID No. 104)**
Tributary to:	Mill Neck Creek
Linear feet of road	144,593
Assumed percentage with Sidewalks	40
Sidewalk Width	4
Sides Sidewalk	2
Total Acres Sidewalk	11
Calculation : LF of road x % with sidewalks x 4 ft w x 2 sides	

Impervious Area Calculation		
SubWatershed:	**Kentuck Brook (ID No. 104)**	
Tributary to:	Mill Neck Creek	
Adjacent Land Use:	Low Density Residential	
Total Subwatershed Area	Acres	1,516
Impervious areas		
Buildings Area	Acres	96
Roads Area	Acres	85
Parking Lot Area	Acres	19
Sidewalks Area - See Table	Acres	11
Driveway Area Total - See Table	Acres	18
TOTAL IMPERVIOUS AREA	Acres	**229**
TOTAL % IMPERVIOUS	%	**15%**
Classification	**6**	

Impervious Area Notes
1. GIS Data Table is source for areas of buildings, roads and parking lots.
2. Sidewalk area calculations are based on percentage of sidewalk area estimated by preparer
3. Impervious Driveways Factors Table - Average Driveway Areas Souce: WVA Table 4, Cappiella and Brown

Initial Subwatershed Classification			
	8	Sensitive Stream	0-10% impervious
	6	Impacted Stream	>10%- to 25% impervious
	4	Non-Supporting Stream	> 25%- 60% impervious
	2	Urban Drainage Stream	> 60% impervious
Source: WVA Figure 4 and Table 2			

Nassau County Stormwater Management Program
Stormwater Runoff Impact Analysis
Water Quality Storm Event (WQSE) Volume and Pollutant Load Estimates
Table 2-4

Subwatershed		**Kentuck Brook (ID No. 104)**							
Tributary To		Mill Neck Creek							
Land Use		**Residential**	**Commercial**	**Industrial**	**Roadway**	**Other**	**TOTAL**		
Contributory Area	Acres	880.0	25.4	1.4	84.6	525.2	**1,516.4**		
Impervious Area	Acres	17.6	19.1	1.0	84.6	78.1	**200.2**		
Impervious Area	%	2.0	75.1	68.8	100.0	14.9	13.2		
Water Quality Storm Event Volume	WQv-acre-feet	6.0	1.8	0.1	8.0	9.7	25.6		
Water Quality Storm Event Volume	WQv-Cubic Feet	260,652.2	80,209.2	4,024.9	349,926.2	420,445.5	1,115,258.0		
Annual Rainfall	inches	42.0	42.0	42.0	42.0	42.0	42.0		
Annual Runoff	inches	2.6	27.4	25.3	35.9	6.9	6.4		
Total Nitrogen (TN)	coefficient mg/l	2.2	2.0	2.5	3.0	2.0		SEVERITY PTS.*	TOTALS
	lbs	1,124.6	314.6	19.7	2,058.8	1,649.1	**5,166.8**	3.0	15,500.5
Total Suspended Solids (TSS)	coefficient mg/l	100.0	75.0	150.0	120.0	54.5			
	lbs	51,118.0	11,797.7	1,184.0	82,351.2	44,938.5	**191,389.4**	4.0	765,557.8
Total Phosphorus (TP)	coefficient mg/l	0.4	0.2	0.4	0.5	0.3			
	lbs	204.5	31.5	3.2	343.1	214.4	**796.6**	2.0	1,593.2
Fecal Coliform (F Coli)	coefficient mpn/100 ml	7,750.0	3,000.0	2,400.0	1,700.0	5,000.0			
	billion colonies	1.8	0.2	0.0	0.5	1.9	**4.4**	6.0	26.6
Floatable Debris	coefficient CF/AC	5.0	8.0	5.0	8.0	5.0			
	CF	4,399.8	203.0	6.9	676.5	2,625.8	**7,911.9**	1.0	7,911.9
Oil and Grease	coefficient mg/l	3.3	5.0	4.0	8.0	3.0			
	lbs	1,686.9	786.5	31.6	5,490.1	2,473.7	**10,468.7**	5.0	52,343.7
							215,738.0		**842,933.8**
								SCORE	**555.9**

SOURCE:
"C" Valve Source; See Table
Impervious Area is based on NCGIS Impervious Area Data from building areas, parking areas, and road areas
* The pollutant loads for each pollutant were assigned severity points based on the least, 1 point, to the most, 6 points, severe pollutant threat in the watershed. The pollutant loads are multiplied by the assigned severity points and the total is divided by 100

Nassau County Stormwater Management Program
Stormwater Runoff Impact Analysis
Subwatershed Comparative Analysis
Table 2-5

	Unit Criteria	Scoring Criteria	Kentuck Brook (ID No. 104)	
			104-1	
Stream Assessment Quantification	**Unit**	**Points**	**Qty**	**Qty x Pts**
Outfall	per outfall	2	13	26
Suspected Illicit Discharge or Hot Spot Locations	per location	8	1	8
WQ Retrofit/Restoration Candidates	per location	1	1	1
Infrastructure Investigations Required	per location	1	1	1
Severe Bank Erosion	per location	1	0	0
Inadequate Buffers	per 5% of reach	5	0	0
Road Crossings	per location	1	2	2
Channelized Segments	per 5% of reach	1	1	1
Public Ownership of the Stream Corridor	per 10% of reach	1	0	0
Livestock Encroachment or High Waterfowl Populations	per location	5	0	0
Threatened Infrastructure	per location	3	1	3
Trash Accumulation In Stream	per location	5	0	0
Stream Condition Subtotal (RCH)	from RCH sheet.	80	72	-9
Buffer/Floodplain Condition Subtotal (RCH)	from RCH sheet.	80	67	-8
Reach Total	**No. of Reaches**	1	**25**	
Subwatershed Total			**25**	
Impervious Cover Classification	Sensitive, Impacted, Non supporting, Urban	8,6,4,2	**6**	
Pollutant Load			**6**	
Total Score			**5**	
RANK				

Nassau County Stormwater Management Program
Candidate Site Assessment
Water Quality Storm Event (WQSE) Volume and Pollutant Load Estimates
Table 3-3

Outfall		**OT 1**					
Tributary To		Kentuck Brook Reach 104-1					
Land Use		**Residential**	**Commercial**	**Industrial**	**Roadway**	**Other**	**TOTAL**
Contributory Area	Acres	10	0	0	0	0	**10**
Impervious Area	Acres	0	0	0	0	0	**1**
Impervious Area	%	2	0	0	100	0	7
Water Quality Storm Event Volume	WQv-acre-feet	0	0	0	0	0	0
Water Quality Storm Event Volume	WQv-Cubic Feet	2971	0	0	1779	0	4750
Annual Rainfall	inches	42	42	42	42	42	42
Annual Runoff	inches	3	2	2	36	2	4
Total Nitrogen (TN)	coefficient mg/l	2	2	3	3	2	
	lbs	13	0	0	10	0	**23**
Total Suspended Solids (TSS)	coefficient mg/l	100	75	150	120	55	
	lbs	583	0	0	419	0	**1001**
Total Phosphorus (TP)	coefficient mg/l	0	0	0	1	0	
	lbs	2	0	0	2	0	**4**
Fecal Coliform (F Coli)	coefficient mpn/100 ml	7750	3000	2400	1700	5000	
	billion colonies	0.02	0.00	0.00	0.00	0.00	**0.02**
Floatable Debris	coefficient CF/AC	5	8	5	8	5	
	CF	48	0	0	3	0	**51**
Oil and Grease	coefficient mg/l	3	5	4	8	3	
	lbs	19	0	0	28	0	**47**

SOURCE:
"C" Valve Source; See Table
Impervious Area is based on NCGIS Impervious Area Data from building areas, parking areas, and road areas

Nassau County Stormwater Management Program
Candidate Site Assessment
Water Quality Storm Event (WQSE) Volume and Pollutant Load Estimates
Table 3-3

Outfall		OT 2 & OT 3					
Tributary To		Kentuck Brook Reach 104-1					
Land Use		**Residential**	**Commercial**	**Industrial**	**Roadway**	**Other**	**TOTAL**
Contributory Area	Acres	18	0	0	0	0	**18**
Impervious Area	Acres	3	0	0	0	0	**3**
Impervious Area	%	16	0	0	0	0	16
Water Quality Storm Event Volume	WQv-acre-feet	0	0	0	0	0	0
Water Quality Storm Event Volume	WQv-Cubic Feet	15224	0	0	0	61	15285
Annual Rainfall	inches	42	42	42	42	42	42
Annual Runoff	inches	7	2	2	2	2	7
Total Nitrogen (TN)	coefficient mg/l	2	2	3	3	2	
	lbs	66	0	0	0	0	**66**
Total Suspended Solids (TSS)	coefficient mg/l	100	75	150	120	55	
	lbs	2986	0	0	0	7	**2992**
Total Phosphorus (TP)	coefficient mg/l	0	0	0	1	0	
	lbs	12	0	0	0	0	**12**
Fecal Coliform (F Coli)	coefficient mpn/100 ml	7750	3000	2400	1700	5000	
	billion colonies	0.11	0.00	0.00	0.00	0.00	**0.11**
Floatable Debris	coefficient CF/AC	5	8	5	8	5	
	CF	89	0	0	0	1	**90**
Oil and Grease	coefficient mg/l	3	5	4	8	3	
	lbs	99	0	0	0	0	**99**

SOURCE:
"C" Valve Source; See Table
Impervious Area is based on NCGIS Impervious Area Data from building areas, parking areas, and road areas

Nassau County Stormwater Management Program
Candidate Site Assessment
Water Quality Storm Event (WQSE) Volume and Pollutant Load Estimates
Table 3-3

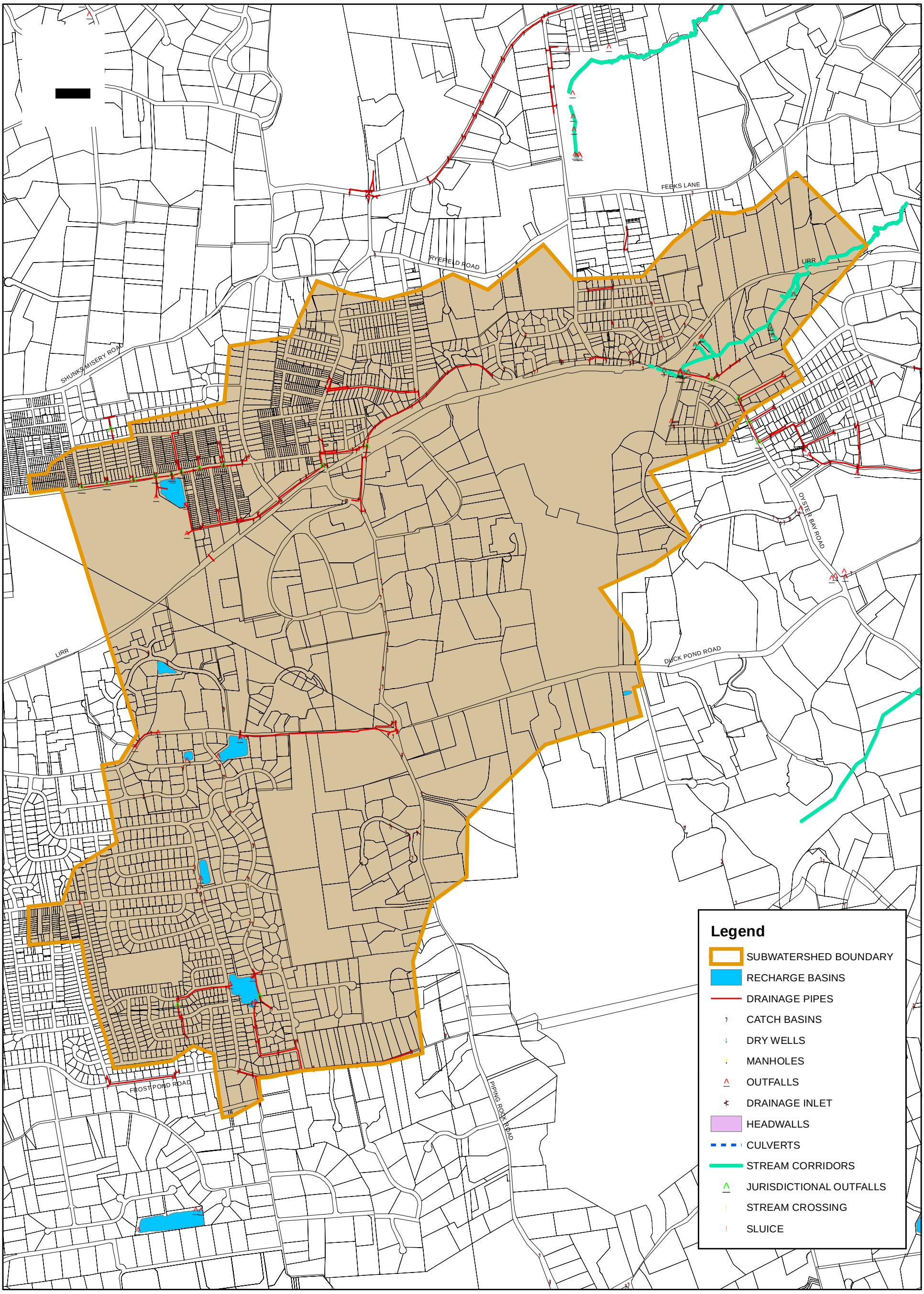
Outfall		**OT 4 & OT 5**					
Tributary To		Kentuck Brook Reach 104-1					
Land Use		**Residential**	**Commercial**	**Industrial**	**Roadway**	**Other**	**TOTAL**
Contributory Area	Acres	145	12	0	19	34	**209**
Impervious Area	Acres	16	8	0	19	3	**45**
Impervious Area	%	11	67	35	100	10	22
Water Quality Storm Event Volume	WQv-acre-feet	2	1	0	2	0	5
Water Quality Storm Event Volume	WQv-Cubic Feet	93131	32692	318	76557	20343	223040
Annual Rainfall	inches	42	42	42	42	42	42
Annual Runoff	inches	6	25	14	36	5	9
Total Nitrogen (TN)	coefficient mg/l	2	2	3	3	2	
	lbs	402	128	2	450	80	**1062**
Total Suspended Solids (TSS)	coefficient mg/l	100	75	150	120	55	
	lbs	18265	4809	94	18017	2174	**43358**
Total Phosphorus (TP)	coefficient mg/l	0	0	0	1	0	
	lbs	73	13	0	75	10	**172**
Fecal Coliform (F Coli)	coefficient mpn/100 ml	7750	3000	2400	1700	5000	
	billion colonies	0.65	0.09	0.00	0.12	0.09	**0.94**
Floatable Debris	coefficient CF/AC	5	8	5	8	5	
	CF	725	92	1	148	170	**1136**
Oil and Grease	coefficient mg/l	3	5	4	8	3	
	lbs	603	321	2	1201	120	**2247**

SOURCE:
"C" Valve Source; See Table
Impervious Area is based on NCGIS Impervious Area Data from building areas, parking areas, and road areas

Nassau County Stormwater Management Program
Candidate Site Assessment
Water Quality Storm Event (WQSE) Volume and Pollutant Load Estimates
Table 3-3

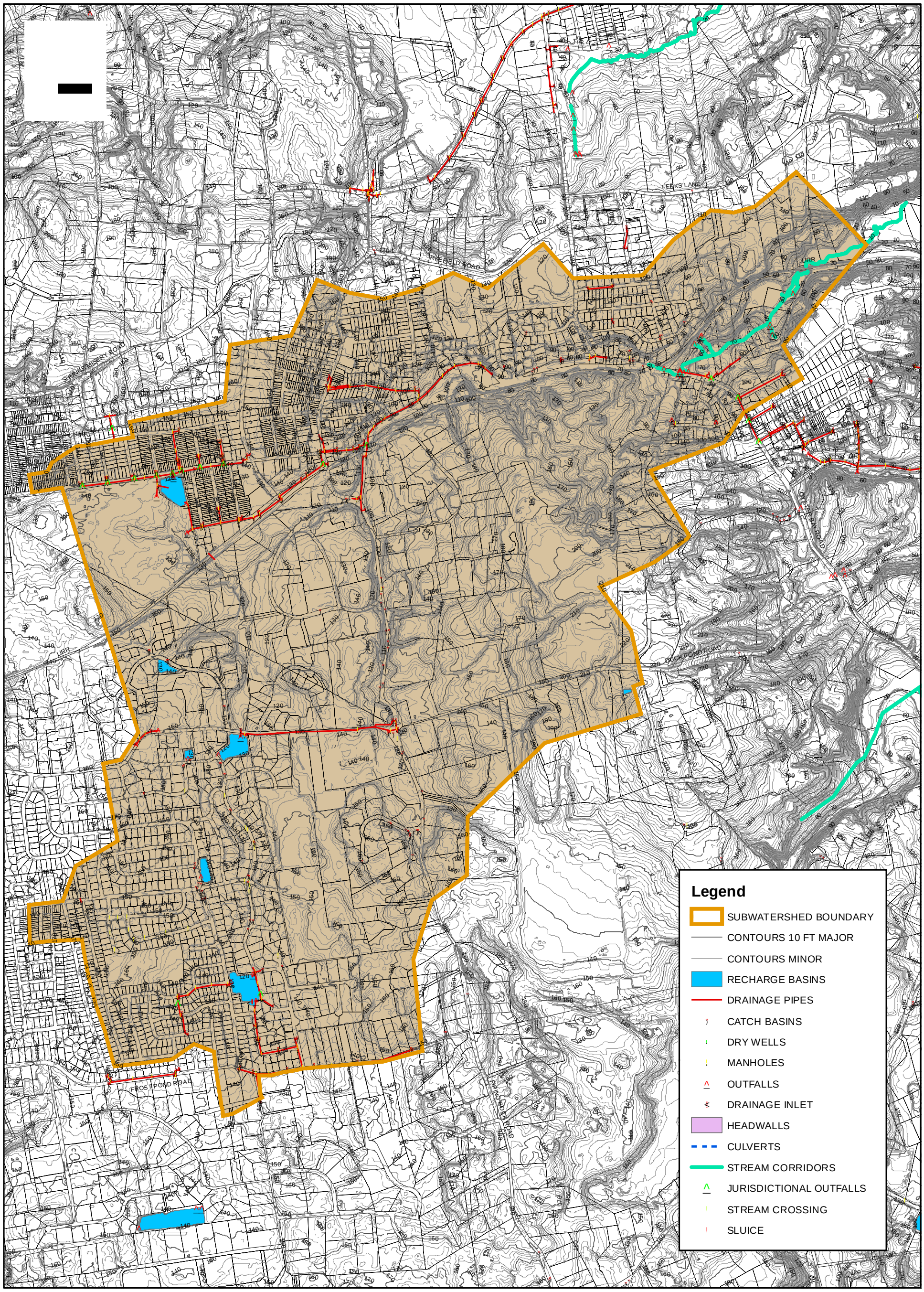
Subwatershed		**OT 7**					
Tributary To		Kentuck Brook 104-1					
Land Use		**Residential**	**Commercial**	**Industrial**	**Roadway**	**Other**	**TOTAL**
Contributory Area	Acres	10	0	0	1	3	**14**
Impervious Area	Acres	1	0	0	1	0	**2**
Impervious Area	%	7	0	0	100	0	12
Water Quality Storm Event Volume	WQv-acre-feet	0	0	0	0	0	0
Water Quality Storm Event Volume	WQv-Cubic Feet	4857	0	0	3724	632	9213
Annual Rainfall	inches	42	42	42	42	42	42
Annual Runoff	inches	4	2	2	36	2	6
Total Nitrogen (TN)	coefficient mg/l	2	2	3	3	2	
	lbs	21	0	0	22	2	**45**
Total Suspended Solids (TSS)	coefficient mg/l	100	75	150	120	55	
	lbs	953	0	0	876	68	**1897**
Total Phosphorus (TP)	coefficient mg/l	0	0	0	1	0	
	lbs	4	0	0	4	0	**8**
Fecal Coliform (F Coli)	coefficient mpn/100 ml	7750	3000	2400	1700	5000	
	billion colonies	0.03	0.00	0.00	0.01	0.00	**0.04**
Floatable Debris	coefficient CF/AC	5	8	5	8	5	
	CF	49	0	0	7	15	**70**
Oil and Grease	coefficient mg/l	3	5	4	8	3	
	lbs	31	0	0	58	4	**94**

SOURCE:
"C" Valve Source; See Table
Impervious Area is based on NCGIS Impervious Area Data from building areas, parking areas, and road areas



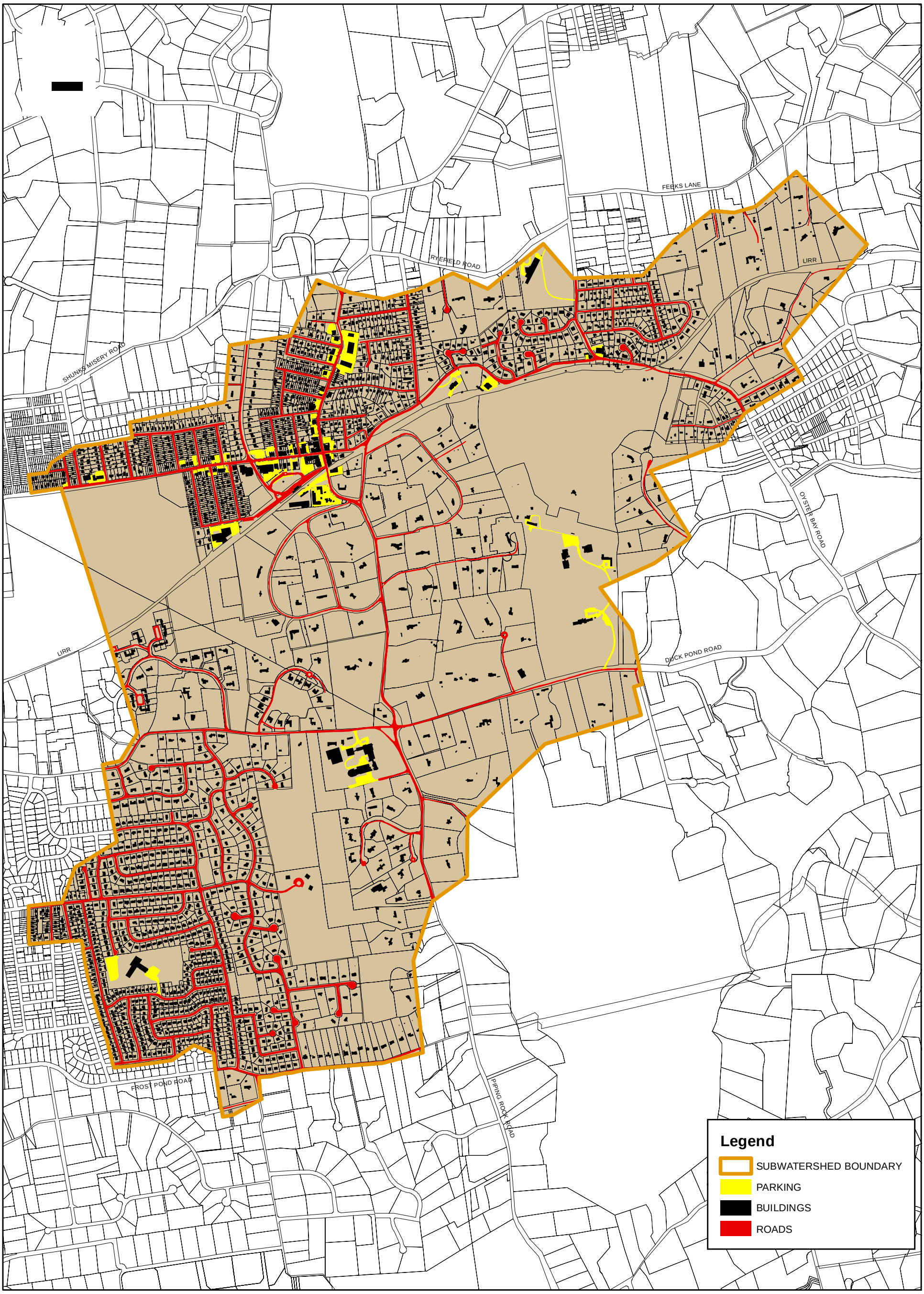
SOURCE: NCGIS AND CASHIN ASSOC. P.C.

MAP 2-1
NASSAU COUNTY STORMWATER MANAGEMENT PROGRAM
STORMWATER RUNOFF IMPACT ANALYSIS
DRAINAGE INFRASTRUCTURE
KENTUCK BROOK SUBWATERSHED



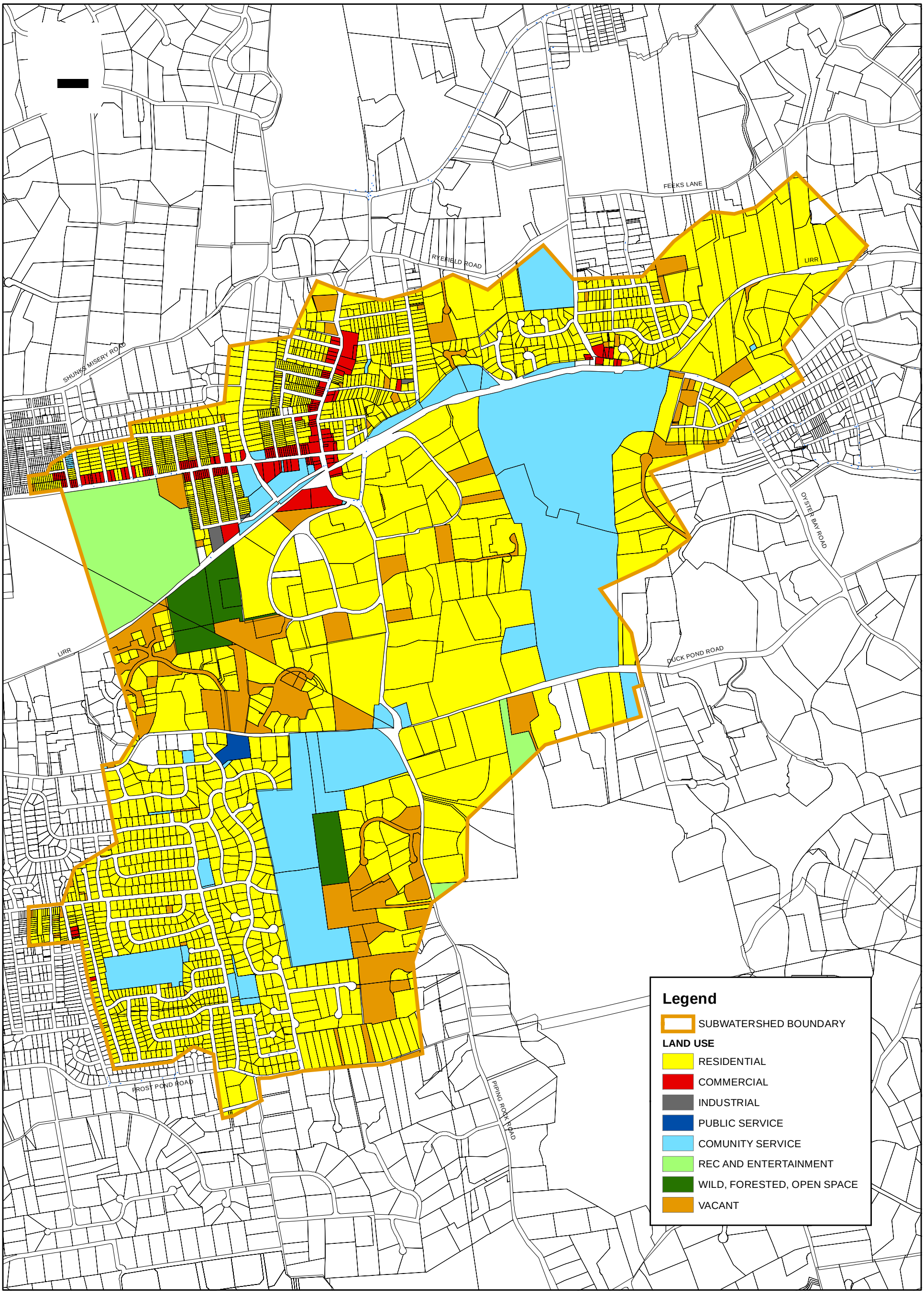
SOURCE: NCGIS AND CASHIN ASSOC. P.C.

MAP 2-2
NASSAU COUNTY STORMWATER MANAGEMENT PROGRAM
STORMWATER RUNOFF IMPACT ANALYSIS
CONTOURS
KENTUCK BROOK SUBWATERSHED



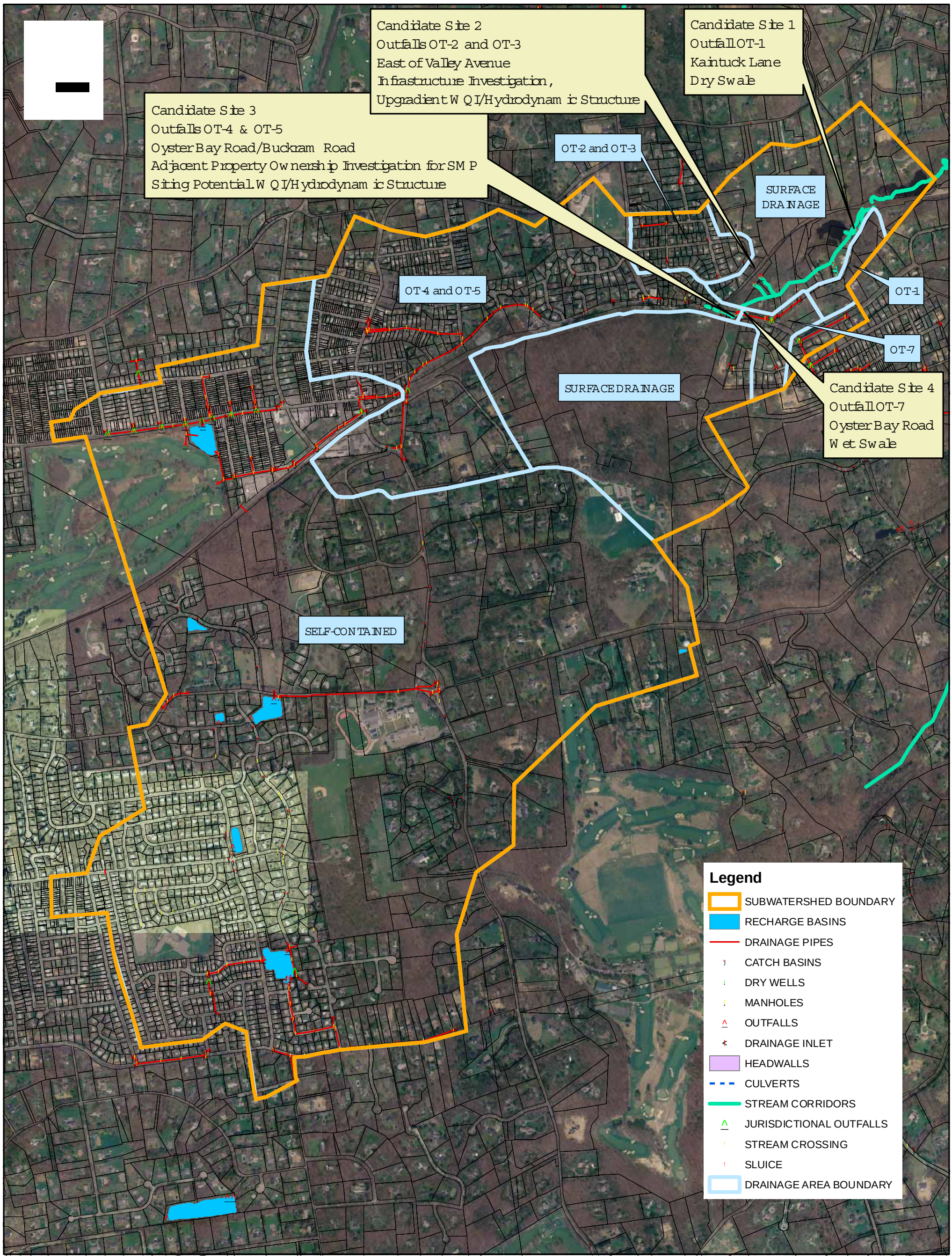
SOURCE: NCGIS AND CASHIN ASSOC. P.C.

MAP 2-3
NASSAU COUNTY STORMWATER
MANAGEMENT PROGRAM
STORMWATER RUNOFF IMPACT ANALYSIS
IMPERVIOUS AREAS
KENTUCK BROOK SUBWATERSHED



SOURCE: NCGIS AND CASHIN ASSOC. P.C.

MAP 2-4
NASSAU COUNTY STORMWATER
MANAGEMENT PROGRAM
STORMWATER RUNOFF IMPACT ANALYSIS
LAND USE
KENTUCK BROOK SUBWATERSHED



SOURCE: NCGIS AND CASHIN ASSOC. P.C.

Cashin Associates, P.C.
ENGINEERING • PLANNING • CONSTRUCTION MANAGEMENT

MAP 3-1
NASSAU COUNTY STORMWATER MANAGEMENT PROGRAM
STORMWATER RUNOFF IMPACT ANALYSIS
SMP CANDIDATE SITE MAP
KENTUCK BROOK SUBWATERSHED

0 500 1,000 2,000 3,000 4,000 Feet

Nassau County
Stormwater Management Program

KENTUCK BROOK SUBWATERSHED
Stormwater Runoff Impact Analysis AND CANDIDATE SITE ASSESSMENT REPORT

Appendix a – FIELD DATA

CASHIN ASSOCIATES, P.C.

Engineering • Planning • Construction Management